

- (d) The dip weight shall have the lengths of graduation and weights given below :

	Light	Heavy
Length of graduations	150 mm	150 mm
from bottom weight	700 ± 50 g	1500 ± 50 g

- (e) The dip weight shall be graduated in a manner similar to the tape.
- (f) The graduations on the dip weight shall begin from its bottom and shall be carried over in such a manner that when the dip weight is attached to the tape the graduations are continuous from the weight to the tape.

7. Permissible error

The error in the length of the tape supported on horizontal surface with a tension of 50 newtons shall not exceed the following limits :

- | | |
|---|--|
| (a) Between any two adjoining mm and cm lines | Not more than ± 0.2 mm |
| (b) Between any two adjoining decimetre and metre lines | Not more than ± 0.4 mm |
| (c) From zero to the points specified below : | |
| (i) One metre mark | ± 0.4 mm |
| (ii) Two metre mark | ± 0.6 mm |
| (iii) Five metre mark | ± 1.0 mm |
| (iv) Any metre mark beyond the first five metres | ± 1.0 mm for the first five metres plus 0.5 mm for each additional five metres or part thereof subject to a maximum error of 2.0 mm. |

8. Marking

(a) Every centimetre, decimetre and metre shall be marked with international form of Indian numerals. The decimetre and metre numerals shall be in bold type. The metre divisions shall, in addition, bear the designation 'मी' or 'm' or both. The end of the tape measure shall be marked with word 'मीटर' or 'metre' or both.

(b) On the ungraduated side and on the case of each tape and also on the dip weight, the name or trade-mark of the manufacturer and the

denominations shall be legibly marked. In addition, direction of winding shall also be legibly marked on the case or reel. Suitable provisions shall be made for Legal Metrology Officer's stamps on the dip weight and the tape.

(c) Every dip weight and dip tape shall be suitably marked to identify them with each other.

Note : The word 'मीटर' and abbreviation 'मी' may be indicated in the regional script.

SEVENTH SCHEDULE - HEADING - A

[See Rule 13]

SPECIFICATION FOR NON-AUTOMATIC WEIGHING INSTRUMENTS

PART I

TERMINOLOGY

1. General definitions

(1) Weighing instrument

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

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

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

(2) Non-automatic weighing instrument

Instrument that requires the intervention of an operator during the weighing process, for example to deposit on or remove from the receptor, the load to be measured and also to obtain the result.

The instrument permits direct observation of the weighing results, either displayed or printed; both possibilities are covered by the word "indication".

Note : Terms such as "indicate", "indicating component" and their derivatives do not include printing.

A non-automatic weighing instrument may be

- graduated or non-graduated,
- self-indicating, semi-self-indicating or non-self indicating.

Note : In this specification, a non-automatic weighing instrument is called an "instrument".

(i) Graduated instrument

Instrument allowing the direct reading of the complete or partial weighing result.

(ii) Self-indicating instrument

Instrument in which the position of

equilibrium is obtained without the intervention of an operator.

(iii) *Semi-self indicating instrument*

Instrument with a self-indication weighing range, in which the operator intervenes to alter the limits of this range.

(iv) *Electronic instrument*

Instrument equipped with electronic devices.

(v) *Instrument with price scales*

Instrument that indicates the price to pay by means of price charts or scales related to a range of unit prices.

(vi) *Price computing instrument*

Instrument that calculates the price to pay on the basis of the indicated mass and the unit price.

(vii) *Price-labelling instrument*

Price computing instrument that prints the weight value, unit price and price to pay for pre-packages.

(viii) *Self-service instrument*

Instrument that is intended to be operated by the customer.

(3) Indication provided by an instrument

(i) *Printing indication*

Indication, signals and symbols that are subject to requirements of this specification

(ii) *Indication, signals and symbols that are not primary indications.*

2. Construction of an instrument

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

(1) Main device

(i) *Load receptor or pan*

Part of the instrument intended to receive the load.

(ii) *Load transmitting device*

Part of the instrument for transmitting the force produced by the load acting on the load receptor, to the load-measuring device.

(iii) *Load-measuring device*

Part of the instrument for measuring the

mass of the load by means of an equilibrium device for balancing the force coming from the load transmitting device, and an indicating or printing device.

(2) Module

Part of an instrument which performs a specific function, can be examined separately and is subject to specified partial error limits.

(3) Electronic parts

(i) *Electronic device*

A device employing electronic subassembly and performing a specific function. An electronic device is usually manufactured as a separate unit and can be independently tested.

Note : An electronic device, as defined above, may be a complete instrument (e.g. instrument for direct sales to the public) or parts of an instrument (e.g. printer, indicator).

(ii) *Electronic sub-assembly*

A part of an electronic device, employing electronic components and having a recognizable function of its own. (e.g. A/D converter, display matrix).

(iii) *Electronic component*

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

(4) Indication device (of a weighing instrument)

Part of the load measuring device on which the direct reading of the result is obtained.

(i) *Indicating component*

Component indicating the equilibrium and/or the result on an instrument with one position of equilibrium it indicate only the equilibrium (so-called zero).

On an instrument with several positions of equilibrium it indicates both the equilibrium and the result. On an electronic instrument, this is the display.

(ii) *Scale mark*

A line or other mark on an indicating component corresponding to a specified value of mass.

(iii) *Scale base*

An imaginary line though the centres of all the shortest scale marks.

(5) Auxiliary indicating devices**(i) Device for interpolation of reading (Vernier)**

Device connected to the indicating element and sub-dividing the scale of an instrument, without special adjustment.

(ii) Complementary indicating device

Adjustable device by means of which it is possible to estimate, in units of mass, the value corresponding to the distance between a scale mark and the indicating component.

(iii) Indicating device with a differentiated scale division

Digital indicating device of which the last figure after the decimal sign is clearly differentiated from other figures.

(6) Extended indicating device

A device temporarily changing the actual scale interval (d) to a value less than the verification scale interval (e) following a manual command.

(7) Supplementary devices**(i) Levelling device**

Device for setting an instrument to its reference position.

(ii) Zero setting device

Device for setting the indication to zero when there is no load on the load receptor.

(a) Non automatic zero setting device

Device for setting the Indication to zero by an operator.

(b) Semi automatic zero setting device

Device for setting the indication to zero automatically following a manual control.

(c) Automatic zero-setting device

Device for setting the indication to zero automatically without the intervention of an operator.

(d) Initial zero-setting device

Device for setting the Indication to zero automatically at the time the instrument is switched on and before it is ready for use.

(iii) Zero tracking device

Device for maintaining the zero indication within certain limits automatically.

(iv) Tare device

Device for setting the indication to zero when a load is on the load receptor;

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

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

It may function as:

a non-automatic devices (load balanced by an operator);

a semi-automatic device (load balanced automatically following a single manual command);

an automatic device (load balanced automatically without the intervention of an operator).

(a) *Tare balancing device* : Tare device without indication of the tare value when the instrument is loaded.

(b) *Tare weighing device* : Tare device that stores the tare value and is capable of indicating or printing it whether or not the instrument is loaded.

(v) Preset tare device

Device for subtracting a preset tare value from a gross or net weight value and indicating the result of the calculation. The weighing range for net loads is reduced accordingly.

(vi) Locking device

Device for immobilizing all or part of the mechanism of an instrument.

(vii) Auxiliary verification device

Device permitting separate verification of one or more main devices of an instrument.

(viii) Selection device for load receptors and load measuring devices

Devices for attaching one or more load receptors to one or more load measuring devices, whatever intermediate load transmitting device are used.

(ix) Indication stabilizing device

Device for maintaining a stable indication under given conditions.

3. Metrological characteristics of an instrument**(1) Weighing capacity (Max)**

(i) **Maximum weighing capacity**, not taking into account the additive tare capacity.

(ii) *Minimum capacity (Min)*

Value of the load below which the weighing results may be subject to an excessive relative error.

(iii) *Self-indication capacity*

Weighing capacity within which equilibrium is obtained without the intervention of an operator.

(iv) *Weighing range*

Range between the minimum and maximum capacities.

(v) *Extension interval of self-indication*

Value by which it is possible to extend the range of self-indication within the weighing range.

(vi) *Maximum tare effect ($T = + \dots, T = - \dots$)*

Maximum capacity of the additive tare device or the subtractive tare device.

(vii) *Maximum safe load (Lim)*

Maximum static load that can be carried by the instrument without permanently altering its metrological qualities.

(2) *Scale divisions*(i) *Scale spacing (instrument with analogue indication)*

Distance between any two consecutive scale marks, measured along the scale base.

(ii) *Actual scale interval (d)*

Value expressed in units of mass of,—
the difference between the values corresponding to two consecutive scale marks, for analogue indication, or
the difference between two consecutive indicated values, for digital indication.

(iii) *Verification scale interval (e)*

Value expressed in units of mass, used for the classifications and verification of an instrument.

(iv) *Scale interval of numbering*

Value of the difference between two consecutive numbered scale marks.

(v) *Number of verification scale intervals (single interval instrument)*

Quotient of the maximum capacity and the verification scale interval:

$$n = \text{Max}/e$$

(vi) *Multi-interval instrument*

Instrument having one weighing range which is divided into partial weighing ranges each with different scale intervals, with the weighing range determined automatically according to the load applied, both on increasing and decreasing loads.

(vii) *Multiple range instrument*

Instrument having two or more weighing ranges with different maximum capacities and different scale intervals for the same load receptor, each range extending from zero to its maximum capacity.

4. Metrological properties of an instrument(1) *Discrimination*

Ability of an instrument to react to small variation of load.

The discrimination threshold, for a given load, is the value of the smallest additional load that, when gently deposited on or removed from the load receptor causes a perceptible change in the indication.

(2) *Repeatability*

Ability of an instrument to provide results that agree one with the other when the same load is deposited several times and in a practically identical way on the load receptor under reasonably constant test conditions.

(3) *Durability*

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

(4) *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 requirements.

5. Indications and errors(1) *Methods of indication*(i) *Balancing by weights :*

Value of metrological controlled weights that balance the load (taking into account the reduction ratio of the load).

(ii) *Analogue indication :*

Indication enabling the evaluation of the equilibrium position to a fraction of the scale interval.

(iii) *Digital indication :*

Indication in which the scale marks are composed of a sequence of aligned figures that do not permit interpolation to fractions of the scale interval.

(2) *Weighing results*

Note : The following definitions apply only when the indication has been zero before the load has been applied to the instrument.

(i) *Gross value (G) :*

Indication of the weight of a load on an instrument, with no tare or preset tare device in operation.

(ii) *Net value (N) :*

Indication of the weight of a load on an instrument after operation of a tare device.

(iii) *Tare value (T) :*

The weight value of a load, determined by a tare weighing device.

(3) *Other weight values*(i) *Preset tare value (PT) :*

Numerical value, representing a weight that is introduced into the instrument.

"Introduced" includes such as keying in, recalling from a data storage, or inserting via an interface.

(ii) *Calculated net value :*

Value of the difference between a gross or net weight value and a preset tare value.

(iii) *Calculated total weight value :*

Calculated sum of more than one weight value and/or calculated net value.

(4) *Reading*(i) *Reading by simple juxtaposition*

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

(ii) *Overall inaccuracy of reading*

The overall inaccuracy of reading of an instrument with analog indication is equal

to the standard deviation of the same indication, the reading of which is carried out under normal conditions of use by several observers.

It is customary to make at least ten readings of the results.

(iii) *Rounding error of digital indication*

Difference between the indication and the result the instrument would give with analog indication.

(iv) *Minimum reading distance*

The shortest distance that an observer is able to freely approach the indicating device to take a reading under normal conditions of use.

This approach is considered to be free for the observer if there is a clear space of at least 0.8 m in front of the indicating device. (See figure 32 A)

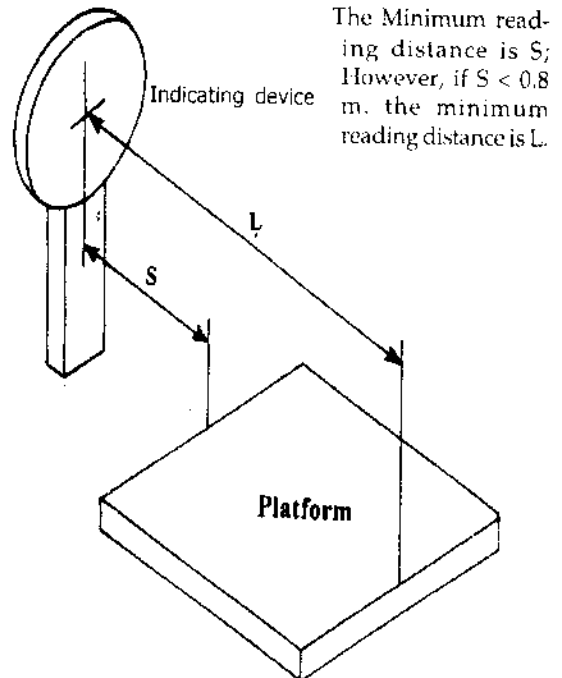


FIGURE- 32 A

(5) *Errors*

(See Figure 32 B for illustration of certain terms used)

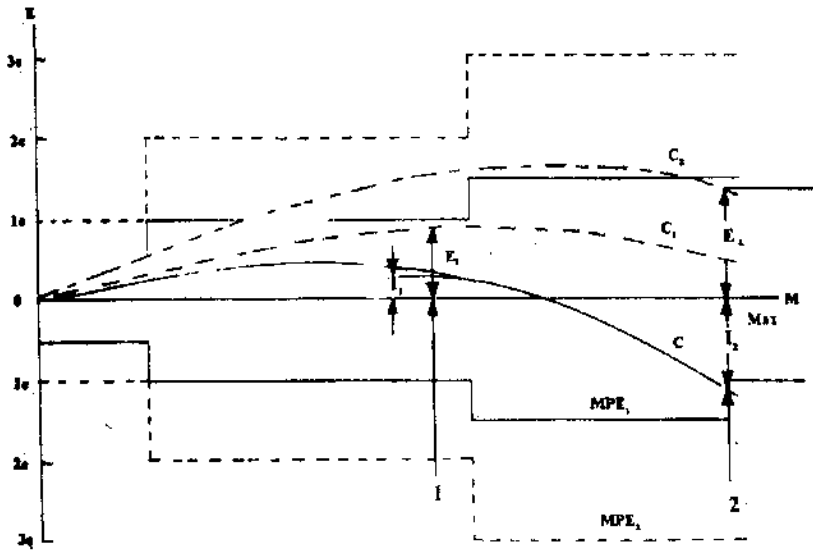


FIGURE-32 B

Illustration of certain terms used

M = mass to be measured

E = error of indication

MPE_1 = maximum permissible error on verification

MPE_2 = maximum permissible error in service (inspection)

C = characteristic under reference conditions

C_1 = characteristic due to influence factor or disturbance

C_2 = characteristic after durability tests

I_1 = intrinsic

DE = durability error

Situation 1 : Shows the error E_1 of an instrument due to an influence factor or a disturbance, I_1 is the intrinsic error. The fault due to the influence factor or disturbance applied equals E_1 minus I_1 .

Situation 2 : Shows the error E_2 of an instrument after the durability test. I_2 is the initial intrinsic error. The durability error equals E_2 minus I_2 .

(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 the performance and span stability tests.

(iv) *Maximum permissible error*

Maximum difference, positive or negative, allowed by regulation between the indication of an instrument and the corresponding true value, as determined by reference standard masses, with the instrument being at zero at no-load, in the reference position.

(v) *Fault*

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

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

(vi) *Significant fault*

A fault greater than e .

Note : For a multi-interval instrument, the value of e is that appropriate to the partial weighing range.

The following are not considered to be significant faults, even when they exceed e :

- Faults arising from simultaneous and mutually independent causes in the instrument.
- Faults implying the impossibility to perform any measurement.
- Faults being so serious that they are bound to be noticed by all those interested in the result of measurement.

- Transitory faults being momentary variations in the indication which cannot be interpreted, memorized or transmitted as a measuring result.

(vii) *Durability error*

The difference between the intrinsic error over a period of use and the initial intrinsic error of an instrument.

(viii) *Significant durability error*

A durability error greater than e .

Note 1 : A durability error can be due to mechanical wear and tear or due to drift and aging of electronic parts. The concept of significant durability error applies only to electronic parts.

Note 2 : For a multi-interval instrument, the value of e is that appropriate to the partial weighing range.

The following are not considered to be significant durability error, even when they exceed e :

Errors occurring after a period of instrument use that are clearly the result of a failure of a device/component, or of a disturbance and for which the indication :

- cannot be interpreted, memorized, or transmitted as a measurement result/or
- implies the impossibility to perform any measurement, or
- is so obviously wrong that it is bound to be noticed by all those interested in the results of measurement.

(ix) *Span stability*

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

6. Influence and reference conditions

(1) Influence quantity

A quantity that is not the subject of the measurement but which influences the values of the measure and 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 specification but outside the specified rated operating conditions of the instrument.

(2) Rated operating conditions

Conditions of use, giving the range of values of influence quantities for which the metrological characteristics are intended to lie within the specified maximum permissible errors.

(3) Reference conditions

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

(4) Reference position

Position of the instrument at which its operation is adjusted.

7. Performance test

A test to verify whether the equipment under test (EUT) is capable of performing its intended functions.

PART II

NON-AUTOMATIC WEIGHING INSTRUMENTS

1. Scope

This specification specifies the metrological and technical requirements for non-automatic weighing instruments and will not be applicable to the following non-graduated instruments :

(1) Beam scale

(2) Counter machine

2. Principles involved

(1) Units of measurement

- The units of mass to be used on an instrument shall be the kilogram (kg) the milligram (mg), the gram (g) and tonne (t).
- For special application e.g. trade with precious stones, the metric carat (1 carat = 0.2 g) may be used as unit of measurement. A symbol for the carat shall be "c".

(2) Metrological requirements

The requirements apply to all instruments irrespective of their principles of measurement.

Instruments are classified according to:

- the verification scale interval,
- the number of verification scale intervals.

The maximum permissible errors are in the order of magnitude of the verification scale interval.

A minimum capacity (Min) is specified to indicate that the instrument should not be used for measuring loads below that limit.

3. Metrological requirements

(1) Principles of classification

(i) Accuracy classes

The accuracy classes for instrument and their symbols shall be as given in Table 15.

TABLE 15

Class	Symbol
Special accuracy	I
High accuracy	II
Medium accuracy	III
Ordinary accuracy	IV

(2) Verification scale Interval

(i) Verification scale interval shall be in the form

$$1 \times 10^k, 2 \times 10^k, 5 \times 10^k$$

k being a positive or negative whole number or equal to zero.

(ii) The verification scale interval for different types of instruments shall be as given in Table 16.

TABLE 16

Type of instrument	Verification scale interval
Graduated, without auxiliary indicating device	$e = d$
Graduated, with auxiliary indicating device	e is chosen by the manufacturer according to requirement in sub-paragraph (3) and clause (iii) of sub-paragraph (5) of this paragraph.
Non-graduated	e is chosen by the manufacturer according to sub-paragraph (3) of this paragraph.

(3) Classification of instruments

(i) The verification scale interval, number of verification scale intervals and the minimum capacity, in relation to the accuracy class of an instrument, shall be as given in Table 17.

TABLE 17

Accuracy class	Verification scale interval e	Number of verification scale intervals $n = \text{Max}/e$		Minimum capacity
		minimum	maximum	
Special I	$0.001 \text{ g} \leq e$	50 000*	—	100 e
High II	$0.001 \text{ g} \leq e \leq 0.05 \text{ g}$	100	100 000	20 e
	$0.1 \text{ g} \leq e$	5000	100 000	50 e
Medium III	$0.1 \text{ g} \leq e \leq 2 \text{ g}$	100	10 000	20 e
	$5 \text{ g} \leq e$	500	10 000	20 e
Ordinary IV	$5 \text{ g} \leq e$	100	1000	10 e

Note : For values of 'e' less than 1 mg in respect of class I accuracy instruments, e shall be taken to be equal to 1 mg for the purpose of verification/inspection.

See for exception in clause (v) of sub-paragraph (5) of this paragraph.

(ii) On multiple range instruments, if the verification scale intervals are e_1, e_2, \dots, e_n with $e_1 < e_2 < \dots < e_n$, Min, n and Max shall be indexed accordingly.

(iii) On multiple range instruments each range shall be treated as an instrument with one range.

(iv) For special application that are clearly marked on the instrument, an instrument

may have weighing ranges in classes I and II or in classes II and III. The instrument as a whole shall then comply with the more severe requirements of sub-paragraph (9) of this paragraph applicable to either of the two classes.

(4) Additional requirements for a multi-interval instrument

(i) Partial weighing range

Each partial range (index $i = 1, 2, \dots$) shall be defined by:

—its verification scale intervals $e_i, e_{i+1} > e_i$
its maximum capacity Max_i

its minimum capacity $\text{Min}_i = \text{Max}_{(i-1)}$ (for $i = 1$ the minimum capacity is $\text{Min}_1 = \text{Min}$)

The number of verification scale intervals n for each partial range is equal to

$$n_i = \text{Max}_i / e_i$$

(ii) *Accuracy class*

e_i and n_i in each partial weighing range, and min_i shall comply with the requirements given in Table 40 according to the accuracy class of the instrument.

(iii) *Maximum capacity of partial weighing ranges*

With the exception of the last partial weighing range, the requirements in Table 18 shall be complied with, according to the accuracy class of the instrument.

TABLE 18

Class	I	II	III	IV
$\text{Max}_i / e_i + 1$	$\geq 50\ 000$	$\geq 5\ 000$	≥ 500	≥ 50

(iv) *Instrument with a tare device*

Requirements concerning the ranges of a multi-interval instrument apply to the net load, for every possible value of the tare.

(5) *Auxiliary indicating devices*

(i) *Type and application*

Only instruments of classes I and II may be fitted with an auxiliary indicating device, which shall be,—

- a device with a rider, or
- a device for interpolation of reading, or
- a complementary indicating device (*) or
- an indicating device with a differentiated scale division (**).

These devices shall be permitted only to the right of the decimal sign.

(ii) A multi-interval instrument shall not be fitted with an auxiliary indicating device.

(iii) *Verification scale interval*

The verification scale interval e shall be determined by the expression

$$d < e \leq 10 d^{***}$$

such that $e = 1 \times 10^k \text{ kg}$, $2 \times 10^k \text{ kg}$, $5 \times 10^k \text{ kg}$ k being a positive or negative whole number, or zero. This condition shall not apply to an instrument of class I with $d < 1 \text{ mg}$. In that case e shall uniformly be 1 mg .

***The value of e , calculated following this rule, are, for example,

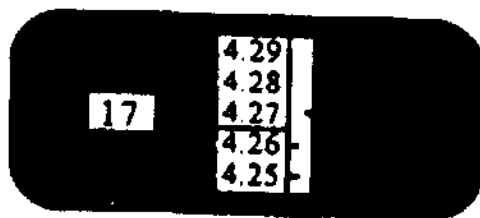
TABLE 20

Maximum permissible errors on verification/re-verification	For loads m expressed in verification scale intervals e			
	Class I	Class II	Class III	Class IV
$\pm 0.5e$	$\text{Min} \leq m \leq 50\ 000$	$\text{Min} \leq m \leq 5\ 000$	$\text{Min} \leq m \leq 500$	$\text{Min} \leq m \leq 50$
$\pm 1e$	$50\ 000 < m \leq 200\ 000$	$5\ 000 \leq m \leq 20\ 000$	$500 \leq m \leq 2\ 000$	$50 < m \leq 200$
$\pm 1.5e$	$200\ 000 < m \leq 500\ 000$	$20\ 000 < m \leq 100\ 000$	$2\ 000 < m \leq 10\ 000$	$200 < m \leq 1\ 000$

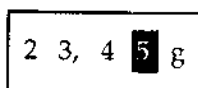
TABLE 19

$d =$	0.1 g	0.2 g	0.5 g
$e =$	1 g	1 g	1 g

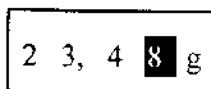
(i) Example of a complementary indicating device (*)



(ii) examples of indicating devices each with a differentiated scale division (**)



last differentiated figure : 5
 $d = 0.01 \text{ g}$ or 0.05 g



$c = 0.1 \text{ g}$
last differentiated figure : 8
 $d = 0.01 \text{ g}$ or 0.02 g
 $e = 0.1 \text{ g}$

Figure 32-C Example of a auxiliary indicating device

(iv) *Minimum capacity*

The minimum capacity of the instrument is determined in conformity with the requirements in Table 17.

(v) *Minimum number of verification scale intervals*

for an instrument of class I with $d < 0.1 \text{ mg}$, n may be less than 50000.

(6) *Maximum permissible errors*

(i) *Values of maximum permissible errors on verification/reverification*

The maximum permissible errors allowed for increasing or decreasing loads shall be as given Table 20.

(ii) *Values of maximum permissible errors in inspection*

The maximum permissible errors during inspection shall be twice the maximum permissible errors allowed on verification.

(iii) *Basic rules concerning the determination of errors*

(a) Influence factors

Errors shall be determined under normal test condition. When the effect of one factor is being evaluated, all other factors are to be kept relatively constant, at a value close to normal.

(b) Maximum permissible errors for net values

The maximum permissible errors apply to the net value of the load for every possible tare load, except preset tare values

(c) Tare weighing device

The maximum permissible error for a tare weighing device is the same, for any tare value as those of the instrument, for the same value of load.

(7) *Permissible difference between results*

Regardless of what variation of results is permitted, the error of any single weighing result shall by itself not exceed the maximum permissible error for the given load.

(i) *Repeatability*

The difference between the maximum and minimum results of several weighings of the same load shall not be greater than the absolute value of the maximum permissible error for the given load.

(ii) *Eccentric loading*

The indications for different positions of a load shall meet the maximum permissible errors, when the instrument is tested according to sub-paragraphs (a) to (d) of this paragraph.

(a) Unless otherwise specified hereafter, a load corresponding to $1/3$ of the sum of the maximum capacity and the corresponding maximum additive tare effect shall be applied.

(b) On an instrument with a load receptor having n points of support,

with $n > 4$, the fraction $1/(n-1)$ of the sum of the maximum capacity and the maximum additive tare effect shall be applied to each point of support.

(c) On an instrument with a load receptor subject to minimal off-centre loading (e.g. tank, hopper) a test load corresponding to one-tenth of the sum of the maximum capacity and the maximum additive tare effect shall be applied to each point or support.

(d) On an instrument used for weighing rolling loads (e.g. vehicle scale, rail suspension instrument) a rolling test load corresponding to the usual rolling load, the heaviest and the most concentrated one which may be weighted, but not exceeding 0.8 times the sum of the maximum capacity and the maximum additive tare effect, shall be applied at different points on the load receptor.

(iii) *Multiple indicating devices*

For a given load the difference between the indications of multiple indicating devices including tare weighing device, shall be not greater than the absolute value of the maximum permissible error, but shall be zero between digital indicating or printing devices.

(iv) *Different positions of equilibrium*

The difference between two results obtained for the same load when the method of balancing the load is changed (in the case of an instrument fitted with a device for extending the self-indication capacity) in two consecutive tests, shall not exceed the absolute value of the maximum permissible error for the applied load.

(8) *Discrimination*(i) *Non-self indicating instrument*

An extra load equivalent to the value of the maximum permissible error for the applied load when gently placed or withdrawn from the instrument at equilibrium shall produce movement as required under sub-paragraph (1) of paragraph 6.

(ii) *Self or semi-self indicating instrument*(a) *Analogue indication*

An extra load equivalent to the

maximum permissible error for applied load when placed gently on or withdrawn from the instrument at equilibrium shall cause a permanent displacement of the indicating element corresponding to not less than 0.7 times the extra load.

(b) Digital indication

An additional load equal to 1.4 times the actual, scale interval, when gently placed on or withdrawn from the instrument at equilibrium shall change the initial indication.

(9) *Variation due to influence quantities and time*

An instrument shall comply, unless otherwise specified, with sub-paragraphs (6), (7) and (8) of this paragraph under the conditions of (ii) and (iii) of sub-paragraph (9) of this paragraph and additionally it shall comply with clauses (i) and (iv) of sub-paragraph (9) of this paragraph.

(i) *Tilting*

- (a) For instrument of class II, III or IV liable to be tilted, the influence of tilting shall be determined under the effect of a lengthwise or transverse tilting equal to 2/1000 or corresponding to the limiting value of tilting marked on, or indicated by a level indicator, whichever is the greater tilt.

The absolute value of the difference between the indication of the instrument in its reference position (not tilted) and the indication in the tilted position shall not exceed:

- at no load, two verification scale intervals, (the instrument having first been adjusted to zero at no load in its reference position) except instruments of class II.
- at self indication capacity and at maximum capacity, the maximum permissible error (the instrument having been adjusted to zero at no load both in the reference and in the tilted position).

An instrument shall be fitted with a levelling device and a level indicator fixed firmly on the instrument in a place clearly visible to the user, unless the instrument is:

freely suspended, or
installed in a fixed position, or
complying with the requirements on tilting when tilted to 5% in any direction.

The limiting value of the level indicator shall be obvious, so that tilting is easily noticed.

Note : Limiting value of tilting : Displacement of 2 mm from a central position.

- (b) On a class I instrument, the limiting value of tilting shall correspond to a tilt of no more than 2/1000 otherwise the instrument shall meet the requirement for instruments of class II.

(ii) *Temperature*

(a) Prescribed temperature limits

If no particular working temperature is stated in the descriptive markings of an instrument, this instrument shall maintain its metrological properties within the following temperature limits:

−10°C + 40°C

(b) Special temperature limits

An instrument for which particular limits of working temperature are stated in the descriptive markings shall comply with the metrological requirements within those limits.

The limits may be chosen according to the application of the instrument.

The ranges within those limits shall be at least equal to:

5 °C for instruments of class (I)

15 °C for instruments of class (II)

30 °C for instruments of class (III) and (IV)

(c) Temperature effect on no-load indication

The indication at zero or near zero shall not vary by more than one verification scale interval for a difference in ambient temperature of 1°C for instruments of class (I) and 5°C for other classes.

For multi-interval instruments and for multiple range instruments this applies to the smallest verification scale interval of the instrument.

(iii) *Mains power supply*

An instrument operated from a mains

power supply shall comply with the metrological requirements if the power supply varies:

in voltage from : -15% to +10% of the value marked on the instrument,

in frequency : from -2% to +2% of the value marked on the instrument, if alternate current is used.

(iv) *Time*

Under reasonably constant environmental conditions, an instrument of class I, II or III shall meet the following requirements.

- (a) When any load is kept on the instrument, the difference between the indication obtained immediately after placing a load and the indication observed during the following 30 minutes, shall not exceed 0.5 e . However, the difference between the indication obtained at 15 minutes and after that at 30 minutes shall not exceed 0.2 e .

If these conditions are not met, the difference between the indication obtained immediately after placing a load on the instrument and the indication observed during the following four hours shall not exceed the absolute value of the maximum permissible error at the load applied.

- (b) The deviation on returning to zero as soon as the indication has stabilized, after the removal of any load which has remained on the instrument for one half hour, shall not exceed 0.5 e .

For a multi-interval instrument, the deviation shall not exceed 0.5 e_1 .

On a multiple range instrument, the deviation on returning to zero from Max_1 shall not exceed 0.5 e_1 . Furthermore, after returning to zero from any load greater than Max_1 and immediately after switching to the lowest weighing range, the indication near zero shall not vary by more than e_1 during the following 5 minutes.

- (c) The durability error due to wear and tear shall not be greater than the value of the maximum permissible error.

Adherence to this requirement is assumed if the instrument has passed the endurance test specified in paragraph 9, which shall be performed only for instrument with

$Max \leq 100$ kg.

(10) *Pattern evaluation tests*

Upon pattern evaluation, the tests given in paragraph 9 and Annexure A shall be performed, to verify adherence to the requirement in sub-paragraphs (6), (7), (8) and clauses (i) to (iv) of sub-paragraph (9) of this paragraph, sub-paragraph (5) and (6) of paragraph 4, sub-paragraph (3) of paragraph 5 and sub-paragraph (1) of paragraph 6. The endurance test shall be performed after all other tests in paragraph 9 and Annexure A.

4. Technical requirements for a self or semi-self indicating instruments

(1) *General requirements of construction*

(i) *Suitability*

- (a) Suitability for application

An instrument shall be designed to suit its intended purpose of use.

- (b) Suitability for use

An instrument shall be solidly and carefully constructed in order to ensure that it maintains its metrological qualities during a period of use.

- (c) Suitability for verification

An instrument shall permit the tests set out in this specification to be performed.

In particular, load receptors shall be such that the standard masses can be deposited on them easily and in total safety. If weights cannot be placed, an additional support may be required.

It must be possible to identify devices that have been subject to a separate type examination procedure (e.g. load cells, printers).

(ii) *Security*

- (a) Fraudulent use

An instrument shall have no characteristics likely to facilitate its fraudulent use.

(b) **Accidental breakdown and 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.

(c) **Controls**

Controls shall be so designed that they cannot normally come to rest in positions other than those intended by design, unless during the manoeuvre all indication is made possible, keys shall be marked unambiguously.

(d) **Securing (Sealing) of components and pre-set controls**

An instrument shall have provisions as required by the director legal metrology, for securing components and preset controls to which access or adjustment likely to affect the metrological characteristics of the instrument, is possible.

On a class I instrument devices to adjust sensitivity may remain unsecured.

(e) **Adjustment**

If an instrument is fitted with an automatic or a semi-automatic span adjustment device, this device shall be incorporated inside the instrument. External influence upon this device shall be practically impossible after sealing.

(f) **Gravity compensation**

A gravity sensitive instrument may be equipped with a device for compensating the effects of gravity variation. After securing, external influence on or access to this device shall be practically impossible.

(2) **Indication of weighing results**(i) **Quality of reading**

Reading of the results shall be reliable, easy and unambiguous under conditions of normal use:

the overall inaccuracy of reading of an analogue indicating device shall not exceed $0.2 e$.

the figures forming the results shall be of a size, shape and clarity for reading to be easy.

The scale, numbering and printing shall permit the figures which form the results to be read by simple juxtaposition:

Provided that this requirement shall not be applicable in the case of steel yard type weighing instruments.

(ii) **Form of the indication**(a) **Weighing results shall contain the names or symbols of the units of mass in which they are expressed.**

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

The scale interval shall be in the form 1×10^k , 2×10^k or 5×10^k , in which the result is expressed, the index k being a positive or negative whole number or equal to zero.

All indicating, printing and tare weighing devices of an instrument shall, within any one weighing range, have the same scale interval for any given load.

(b) **A digital indication shall display at least one figure beginning at the extreme right.**

Where the scale interval is changed automatically the decimal sign shall maintain its position in the display.

A decimal fraction shall be separated from its integer by a decimal sign (comma or dot), with the indication showing at least one figure to the left of the sign and all figures to the right.

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

The unit of mass shall be chosen so that weight values have not more than one non-significant zero to the right. For values with decimal sign, the non-significant zero is allowed only in the third position after the decimal sign.

(iii) **Limits of indication**

There shall be no indication above $\text{Max} + 9 e$

(iv) **Approximate indication device**

The scale interval of an approximate indicating device shall be greater than $\text{Max}/100$ without being smaller than

20 e. This approximate device is considered as giving secondary indications.

(v) *Extending the range of self-indication on a semi-self-indicating instrument*

The extension interval of the range of self-indication shall not be greater than the value of the self-indication capacity.

- (a) The scale interval of extension of the range of the self-indication should be equal to the capacity of self, indication (comparator instruments are excluded from this provision).
- (b) An extension device with accessible sliding poises is subject to the requirements of clause (ii) of sub-paragraph (2) of paragraph 6.
- (c) On an extension device with enclosed sliding poises or mass switching mechanisms each extension should involve an adequate change in the numbering. It should be possible to seal the housing and the adjusting activities of the weights or masses.

(3) *Analogue indicating device*

The following requirements apply in addition to those in clause (i) to (iv) of sub-paragraph (2) of this paragraph.

(i) *Scale marks : Length and width*

Scale shall be designed and numbered so that reading the weighing results is easy and unambiguous.

(a) *Forms of scale marks.*

Scale marks shall consist of lines of equal thickness; this thickness should be constant and between 1/10 and 1/4 of the scale spacing, without being less than 0.2mm. The length of the shortest scale mark should be at least equal to the scale spacing.

(b) *Arrangements of scale marks*

Scale marks should be arranged in accordance with one of the sketches in Figure 32-D (the line joining the end of the scale marks optional).

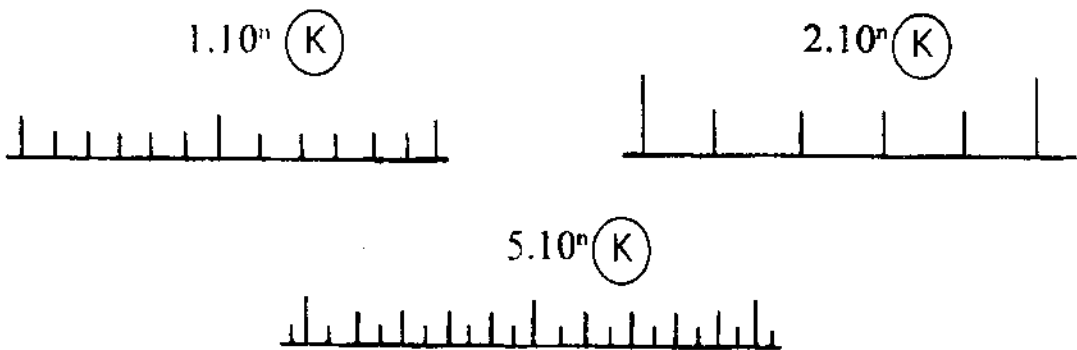


Figure 32 D—Examples of the application to rectilinear scales

(c) *Numbering*

On one scale, the scale interval of numbering should be:

- constant,
- in the form 1×10^k , 2×10^k , 5×10^k units (k being a positive or a negative whole number or equal to zero),
- not greater than 25 times as the scale interval of the instrument.

If the scale is projected on a screen, at least two numbered scale marks

should appear wholly in the projected zone.

The height of the number (real or apparent) expressed in millimetres should be not less than 3 times the minimum reading distance expressed in metre, without being less than 2 mm.

This height should be proportional to the length of the scale mark to which it relates.

The width of a number, measured parallel to the base of the scale,

should be less than the distance between two consecutive numbered scale marks.

(d) *Indicating component*

The width of the pointer of the indicating components should be approximately equal to that of the scale marks and of the length such that the tip is at least level with the shortest mark.

The distance between the scale and the pointer should be at the most equal to the scale spacing, without being greater than 2 mm.

(ii) *Scale spacing*

on an instrument of class (I) or (II);

1 mm for indicating devices;

0.25 mm for complementary indicating devices;

on an instrument of class III and IIII.

1.25 mm for dial indicating devices.

1.75 mm for optical projection indicating devices.

(iii) *Limits of indication*

Stops shall be provided to limit the movement of the indicating component whilst allowing it to travel below zero and above the capacity of self-indication. This re-requirements does not apply to multi-revolution dial instruments.

The stops limiting the movement of the indicating components should permit it to travel across zones of at least 4 scale spacings below zero and above the capacity of self-indication (three zones are not provided with a scale on fan charts and on dials with a single revolution pointer they are called "blank zone").

(iv) *Damping*

Damping should achieve a stable indication within 5 simple half periods of oscillation.

Hydraulic damping elements sensitive to variations in temperature should be provided with an automotive regulating device or an easily accessible manual regulating device.

It should be impossible for the fluid of hydraulic damping elements on portable instruments to spill when the instrument is inclined at 45°.

(4) *Digital indicating and printing devices*

The following requirements apply in addition to those in clauses (i) to (v) of sub-paragraph (2) of this paragraph.

(i) *Change of indication*

After a change in load, the previous indication shall not persist for longer than 1 second.

(ii) *Stable equilibrium*

Equilibrium is deemed to be stable when,—

In case of printing and/or data storage, the requirement in clause (v) of sub-paragraph (4) of this paragraph are met, in case of zero or tare operations clauses (iv), (vi), (vii) of sub-paragraph (5) and (viii) of sub-paragraph (6) of this paragraph, it is sufficiently close to the final equilibrium to allow a correct operation of the device within relevant accuracy requirements.

(iii) *Extended indicating device*

An extended indicating device shall not be used on an instrument with a differentiated scale division.

When an instrument is fitted with an extended indicating device, displaying the indication with a scale interval smaller than 'e' shall be possible only,

during pressing a key, or

for a period not exceeding 5 seconds after a manual command.

In any case printing shall not be possible.

(iv) *Multiple use of indicating device*

Indications other than primary indication may be displayed in the same indicating device, provided that,—

Quantities other than weight values are identified by the appropriate unit of measurement, or symbol thereof, or a special sign.

Weight values that are not weighing results (sub-clause (i) through clause (iii) of sub-paragraph (2) of paragraph 5 Part I) shall be clearly identified, or they may be displayed only temporarily on manual command and shall not be printed.

No restrictions apply if the weighing mode is made inoperative by a special command.

(v) *Printing device*

Printing shall be clear and permanent for the intended use, printed figures shall be at least 2 mm high.

If printing takes place, the name or the symbol of the unit of measurement shall be either to the right of the value or above a column of values.

Printing shall be impossible when the equilibrium is not stable.

Stable equilibrium is considered to be achieved when over a period of 5 seconds following printout, no more than two adjacent values are indicated, one of which being the printed value.

(vi) *Memory storage device*

The storage of primary indications for subsequent indication, date transfer, totalizing, etc, shall be impossible when the equilibrium is not stable. The criterion of stable equilibrium is the same as in clause (v) of sub-paragraph (4) of paragraph 4.

(5) *Zero setting and zero-tracking devices*

An instrument may have one or more zero-setting devices and shall have not more than one zero-tracking device.

(i) *Maximum effect*

The effect of any zero setting device shall not alter the maximum weighing capacity of the instrument.

The overall effect of zero setting and zero tracking device shall be not more than 4% and of the initial zero setting device not more than 20% of the maximum capacity.

(ii) *Accuracy*

After zero setting, the effect of zero deviation on the result of the weighing shall be not more than 0.25 e; however, on an instrument with auxiliary Indicating device this effect shall be not more than 0.5 d.

(iii) *Multiple range instrument*

Zero setting in any weighing range shall be effective also in the greater weighing ranges if switching to a greater weighing range is possible while the instrument is loaded.

(iv) *Control of the zero setting device*

An instrument except an instrument

according to sub-para (13) and (14) of this paragraph,

whether or not equipped with an initial zero-setting device, may have a combined semi-automatic zero-setting device and a semi-automatic tare-balancing device operated by the same key.

If an instrument has a zero device and a tare-weighing device, the control of the zero-setting device shall be separated from that of the tare-weighing device.

A semi-automatic zero setting device shall function only; and when the instrument is in stable equilibrium, it cancels any previous tare operation.

(v) *Zero indicating device on an instrument with digital indication*

An instrument with digital indication shall have device that displays a special signal when the deviation from zero is not more than 0.25 e. This device may also work when zero is indicated after a tare operation.

This device is not mandatory on an instrument that has an auxiliary indicating or a zero-tracking device provided that the rate of zero tracking is not less than 0.25 d/second.

(vi) *Automatic zero setting device*

An automatic zero-setting device shall operate only when,—
the equilibrium is stable, and
the indication has remained stable below zero at least 5 seconds.

(vii) *Zero tracking device*

A zero tracking device shall operate only when,—
the indication is at zero, or at a negative net value equivalent to gross zero, and
the equilibrium is stable, and
the corrections are not more than 0.5 d/second.

When zero is indicated after a tare operation, the zero tracking device may operate within a range of 4% of max around the actual zero value.

(6) *Tare device*(i) *General requirements :*

A tare device shall comply with the relevant provisions of sub-paragraph (1) through (4) of this paragraph.

(ii) *Scale interval :*

The scale interval of a tare-weighing device shall be equal to the scale interval of the instrument for any given load.

(iii) *Accuracy :*

A tare device shall permit setting the indication to zero with an accuracy better than:

$\pm 0.25e$ for electronic instruments and any instrument with analogue indication.

$\pm 0.25e$ for mechanical instruments with digital indication and instruments with auxiliary indication device.

$\pm 0.5e$ for mechanical instruments with digital indication and instruments with auxiliary indication device.

On a multi-interval instrument e shall be replaced by e_1 .

(iv) *Operating range*

The tare device shall be such that it cannot be used at or below its zero effect or above its maximum indicated effect.

(v) *Visibility of operation*

Operation of the tare device shall be visibly indicated on the instrument. In the case of instruments with digital indication this shall be done by marking the indicated net value with the sign "NET" or "Net" or "net".

Note : If an instrument is equipped with a device that allows the gross values to be displayed temporarily while a tare device is in operation, the "NET" symbol disappears while the gross value is displayed.

This is not required for an instrument with a combined semiautomatic zero-setting device and a semi-automatic tare-balancing device operated by the same key.

(vi) *Subtractive tare device :*

When the use of subtractive tare device does not allow the value of the residual weighing range to be known, a device shall prevent the use of the instrument above its maximum capacity or indicate that this capacity has been reached.

(vii) *Multiple range instrument :*

On a multiple range instrument the tare operation shall be effective also in the

greater weighing ranges, if switching to a greater weighing range is possible while the instrument is loaded.

(viii) *Semi-automatic or automatic tare devices*

These devices shall operate only when the instrument is in stable equilibrium.

(ix) *Combined zero setting and tare balancing device*

If the semi automatic zero setting device and semi automatic tare balancing device are operated by the same key; sub clause (ii) and (v) of sub-paragraph (5) of this paragraph and if appropriate sub-clause (vii) of sub-paragraph (5) of this paragraph apply at any load.

(x) *Consecutive tare operations*

Repeat operation of a tare device is permitted.

If more than one tare device is operative at the same time, tare weight values shall be clearly designated when indicated or printed.

(xi) *Printing of weighing results*

Gross weight values may be printed without any designation. For a designation by a symbol, only "G" is permitted.

If only net weight values are printed without corresponding gross or tare values, they may be printed without any designation. A symbol for designation shall be "N". This applies also where semi-automatic zero setting and semi-automatic tare balancing are initiated by the same key.

Gross, net or tare values determined by a multiple range instrument or by a multi-interval instrument need not be marked by a special designation referring to the (partial) weighing range.

If net weight values are printed together with the corresponding gross and/or tare values, the net and tare values shall at least be identified by the corresponding symbol "N" and "T".

However, it is permitted to replace the symbols G, N, T by complete words.

If net weight values and tare values determined by different tare devices are printed separately, they shall be suitably identified.

(7) *Preset tare device*(7)(i) *Scale interval*

Regardless of how a preset tare value is introduced into the device, its scale interval shall be equal or automatically rounded to the scale interval of the instrument. On a multiple range instrument, a preset tare value may only be transferred from one weighing range to another one with a larger verification scale interval but shall then be rounded to the latter. For a multiple interval instrument, the maximum preset tare value shall not be greater than Max_1 and the indicated or printed, calculated net value shall be rounded to the scale interval of the instrument for the same net weight value.

(ii) *Modes of operation*

A preset tare device may be operated together with one or more tare devices provided that:

clause (x) of sub-paragraph (6) of this paragraph is complied, and

a preset tare operation cannot be modified or cancelled as long as any tare device operated after the preset tare operation is still in use.

preset tare devices may operate automatically only if the preset tare value is clearly identified with the load to be measured.

(iii) *Indication of operation*

For the indicating device clause (v) of sub-paragraph (6) of this paragraph applies. It shall be possible to indicate the preset tare value at least temporarily.

Provisions of clause (xi) of sub-paragraph (6) of paragraph 4 applies accordingly provided that

if the calculated net value is printed, at least the preset tare value is printed as well, with the exception of an instrument covered by sub-paragraphs (13), (14) or (16) of this paragraph.

Preset tare values are designated by the symbol "PT"; however, it is permitted to replace the symbol "PT" by complete words.

(8) *Locking positions*(i) *Prevention of weighing outside the "weight" position*

If an instrument has one or more locking device, these devices shall only have two

stable positions corresponding to "locked" and "weigh"; and weighing shall only be possible in the "weigh" position.

A "pre-weigh" position may exist on any instrument of class I or II, except under sub-paragraphs (13), (15) or (16) of this paragraph.

(ii) *Indication of position*

The "locked" and "weigh" positions shall be clearly shown.

(9) *Auxiliary calibration devices (removable or fixed)*(i) *Devices with one or more platform*

The nominal value of the ratio between the weights to be placed on the platform to balance a certain load and this load shall not be less than 1/5000 (it shall be visibly indicated just above the platform).

The value of the weights needed to balance a load equal to the verification scale interval shall be an integer multiple of 0.1g

(ii) *Numbered scale devices*

The scale interval of the auxiliary verification devices shall be equal to or smaller than 1/5 of the verification scale interval for which it is intended.

(10) *Selection of weighing ranges on a weighing scale on a multiple range instrument*

The range which is actually in operation shall be clearly indicated.

(a) *Manual selection of the weighing range is allowed*

—from a smaller to a greater weighing range at any load;

—from a greater to a smaller weighing range when there is no load on the load receptor and the indication is zero at a negative net value. The tare operation receptor shall be cancelled and the zero shall be set to $\pm 0.25 e$ both automatically.

(11) *Device for selection (or switching) between various load receptors—Load transmitting devices and various load measuring devices*(i) *Compensation of no load effect*

The selection device shall ensure compensation for the unequal no load effect

of the various load receptors-load transmitting devices, in use.

(ii) *Zero setting*

Zero setting of an instrument with any multiple combination of various load measuring devices and various load receptors shall be possible without any ambiguity and in accordance with the provisions of sub-paragraph (5) of paragraph 4.

(iii) *Impossibility of weighing*

Weighing shall not be possible while selection devices are being used.

(iv) *Identification of the combination use*

Combination of load receptors and load measuring devices used shall be readily identifiable.

(12) *"Plus" and "minus" comparative instrument*

For the purpose of verification a "heavy" or "plus" and "light" or "minus" comparators instrument is considered to be a semi-self indicating instrument.

(i) *Distinction between "plus" and "minus" zone*

On an analogue indicating device, the zones situated on either side of zero shall be distinguished by "+" and "-".

On a digital indicating device, an inscription nearer the indicating device shall be given.

range \pm gram (kg, t)

range gram (kg, t)/+gram (kg, t)

(ii) *Form of scale*

Scale of a comparator instrument shall have at least one scale division d equal to e ($d = e$) on either side of zero. The corresponding value shall be shown at either end of the scale.

(13) *Additional requirement for an instrument for direct sales to the public*

The following requirements apply to an instrument of class II, III, or IV with a maximum capacity not more than 100 kg capacity designed for direct sale to the public.

(i) *Primary indication*

On an instrument for direct sale to the public, the primary indications are the weighing results and the information

about the correct zero position, tare, and pre-set tare operation.

(ii) *Zero setting device*

An instrument for direct sale to the public shall not be fitted with a non-automatic zero setting device unless operated with a tool.

(iii) *Tare device*

A mechanical instrument with a weight receptor shall not be fitted with a tare device.

An instrument shall not be fitted with a device which can recall the gross value while a tare or pre-set tare device is in operation.

(a) *Non-automatic tare device*

A displacement of 5 mm of a point of the control shall be at the most equal to one verification scale interval.

(b) *Semi-automatic tare device*

An instrument may be fitted with semi automatic tare device if—

the action of the tare device does not permit the reduction of the tare; and

their effect can only be cancelled when there is no load on the load receptor.

In addition, the instrument shall comply with at least one of the following requirements :

the tare value is indicated permanently in a separate display,

the tare value is indicated with a sign "-" (minus), when there is no load on the load receptor, or

the effect of the device is cancelled automatically when the indication returns to zero when unloading the load receptor after the stable net weighing results greater than zero has been indicated.

(c) *Automatic tare device*

An instrument shall not be fitted with an automatic tare devices.

(iv) *Preset tare device*

A preset tare device may be provided if the preset tare value is indicated as a primary indication on a separate display

which is clearly differentiated from the weight display sub-clause (b) of clause (iii) of sub-paragraph (13) of this paragraph, applies.

It shall not be possible to operate a pre-set tare device, if a tare device is in use.

Where a preset tare is associated with a price look up (PLU), the preset tare value may be cancelled at the same time, as the PLU is cancelled.

(v) *Impossibility of weighing*

It shall be impossible to weigh or to guide the indicating element during the normal locking operation or during the normal operation of adding or subtracting weights.

(vi) *Visibility*

All primary indications shall be displayed clearly and simultaneously to both the vendor and the customer.

On digital devices that display primary indications, the numerical figures on either set shall be of the same dimension and at least 10 mm high, with a tolerance of 0.5 mm

On an instrument to be used with weights, it shall be, possible to distinguish the value of the weights.

(vii) *No auxiliary and extended indicating device*

An instrument shall not be fitted with any auxiliary indicating device nor an extended indicating device.

(viii) *Instrument of class II*

An instrument of class II shall comply with the requirements given in sub-paragraph (9) of paragraph 3 for an instrument of class III.

(ix) *Significant fault*

When a significant fault has been detected, a visible or audible alarm shall be provided for the customer, and data transmission to any peripheral equipment shall be prevented. This alarm shall continue until such time as the user takes action or the cause disappears.

(x) *Counting ratio*

The counting ratio on a mechanical counting instrument shall be 1/10 or 1/100.

(14) *Additional requirements for an instrument for direct sale to the public with price indication*

The following requirements are to be applied in addition to sub-para (13) of this rule :

(i) *Primary indications*

On a price indicating instrument, the supplementary primary indication are unit price and price to pay and if applicable, number, unit price and price to pay for non-weighed articles and price totals. Price charts, such as fan charts, are not subject to the requirements of this specification.

(ii) *Instrument with price scales*

For unit price and price-to-pay scales, sub-paragraph (2) of this paragraph and clauses (i) to (iii) of sub-paragraph (3) of this paragraph apply accordingly. The decimal shall be indicated to two places.

Reading from price scales shall be so possible that the absolute value of the difference between the product of the indicated weight W and unit price U and the indicated price to pay P is not greater than the product of e and the unit price of that scale.

$$|W.U - P| \leq e.U$$

(iii) *Price computing instrument*

(a) The price to pay shall be calculated and rounded to the nearest interval of price to pay, by multiplication of weight and unit price, both as indicated by the instrument. The device which performs the calculations in any case considered a part of the instrument.

(b) The unit price is restricted to price/100g or price/kg.

(c) Notwithstanding the provisions in clause (i) of sub-paragraph (4) of this paragraph, the indication of weight unit price and price to pay, shall remain visible after the weight indication is stable and after any introduction of the unit price, for at least one second and while the load is on the load receptor.

(d) Notwithstanding the provisions in clause (i) of sub-paragraph (4) of this paragraph, these indications

may remain visible for not more than 3 seconds after removing the load, provided that the weight indication has been stable before and the indication would otherwise be zero. As long as there is a weight indication after removing the load, it shall not be possible to introduce or change a unit price.

(e) If transaction performed by the instrument is printed, weight, unit price and price-to-pay shall all be printed.

(f) The data may be stored in a memory of the instrument before printing. The same data shall not be printed twice on the ticket for the customer.

Instrument that can be used for price labelling purpose, must comply with sub-paragraph (16) of this paragraph as well.

(iv) *Special applications of a price computing instrument*

Only if all transaction performed by the instrument or by connected peripheral are printed on a ticket or label intended for the customer, a price computing instrument may perform additional functions which facilitate trade and management. These functions shall not lead to confusion about the results of weighing and price computing.

Other operations or indications not covered by the following provisions may be performed, provided that no indication which could possibly be misunderstood as a primary indication, is presented to the customer.

(a) Non-weighed articles

An instrument may accept and record positive or negative prices to pay one of several non-weighed articles, provided the weight indication is zero or the weighing mode is made inoperative. The price-to-pay for one or more of such articles, shall be shown in the price-to-pay display.

If the price to pay is calculated for more than one equal article, the number of such articles shall be shown on the weight display, without being possibly taken for a weight

and the price for one article on the unit price display, unless supplementary display are used to show the number of articles and articles price.

(b) Totalization

An instrument may totalize transaction on one or several tickets; the price total shall be indicated on the price-to-pay display and printed, accompanied by a special word or symbol, either at the end of the price-to-pay column or on a separate label ticket with appropriate reference to the commodities whose prices to pay have been totalized; all prices to pay that are totalized shall be printed and the price total shall be the algebraic sum of all these prices as printed.

An instrument may totalize transaction performed on other instruments linked to it, directly or over metrologically controlled peripherals, and if the price-to-pay scale intervals of all connected instruments are identical.

(c) Multi-vendor operation

An instrument may be designed to be used by more than one vendor or to serve more than one customer at the same time provided that the connection between the transactions and the relevant vendor or customer is appropriately identified.

(d) Cancellation

An instrument may cancel previous transaction, where the transaction has already been printed, the relevant price-to-pay cancelled shall be printed with an appropriate comment. If the transaction to the cancelled is displayed to the customer, it shall be clearly differentiated from normal transaction.

(e) Additional information

An instrument may print additional information if this is clearly correlated to the transaction and does not interfere with the assignment of the weight value to the unit symbol.

(v) *Self service instrument*

A self service instrument need not have two sets of scales displayed.

If a ticket or label is printed, the primary indications shall include a designation of the product when the instrument used to sell different products.

(15) *Instruments similar to one normally used for direct sale to the public*

An instrument similar to one normally used for direct sale to the public which does not comply with the provisions of sub-paragraphs (13) and (14) of this paragraph shall carry near the display, the indelible marking :

"NOT TO BE USED FOR DIRECT SALE TO THE PUBLIC"

(16) *Price labelling instrument*

Clause (viii) of sub-paragraph (13), sub-clauses (a) and (e) of clause (iii) of sub-paragraph (14), sub-clause (a) of clause (iv) of sub-paragraph (14) and sub-clause (e) of clause (iv) of sub-paragraph (14) of this paragraph respectively apply.

A price labelling instrument shall have at least one display for the weight. It may be used temporarily for set-up purpose such as supervision of setting weight limits, unit price, preset tare values, commodity names.

It shall be possible to verify, during use of the instruments, the actual values of unit price and preset tare value.

Printing below minimum capacity shall not be possible.

Printing of labels with fixed values of weight, unit price and price-to-pay is allowed provided that the weighing mode is made in-operative.

(17) *Mechanical counting instrument with unit-weight receptor*

For the purpose of verification, a counting instrument is considered to be a semi-self indicating instrument.

(i) *Indicating device*

To permit verification, a counting instrument shall have a scale with at least one scale division $d = e$ on either side of zero, the corresponding value shall be shown on the scale.

(ii) *Counting ratio*

The counting ratio shall be shown clearly just above each counting platform or each counting scale mark.

5. Requirements for electronic instruments

In addition to paragraphs 3 and 4, an electronic instrument shall comply with the following requirements.

(1) *General requirements*

(i) An electronic instrument shall be designed and manufactured such that when it is exposed to disturbances :

either;

(a) significant faults do not occur, or

(b) significant faults are detected and acted upon.

Note:

A fault equal to or smaller than e is allowed irrespective of the value of the error of indication.

(ii) The requirements in sub-paragraphs (6), (7), (8) and (9) of paragraph 3 and clause (i) of sub-paragraph (1) of this paragraph shall be met durably in accordance with the intended use of the instrument.

(iii) A pattern of an electronic instrument is presumed to comply with the requirements in clause (i) and (ii) of sub-paragraph (1) and clause (ii) of sub-paragraph (3) of this paragraph, if it passes the examinations and tests specified in sub-paragraph (4) of this paragraph.

(iv) The requirements in (i) of sub-paragraph (1) of this paragraph may be applied separately to—

(a) each individual clause of significant fault, and/or;

(b) each part of the electronic instrument

The choice, where sub-clause (a) or (b) of clause (i) of sub-paragraph (1) of paragraph 5 is applied, is left to the manufacturer.

(2) *Acting upon significant faults*

When a significant fault has been detected, the instrument shall either be made inoperative automatically 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.

(3) Functional requirements

- (i) Upon switch on (switch-on of indication), a special procedure shall be performed that shows all relevant signs of the indicator in the active and non-active state sufficiently long to be checked by the operator.
- (ii) In addition to the sub-paragraph (9) of paragraph 3 an electronic instrument shall comply with the requirements under relative humidity of 85% at the upper limit of the temperature range. This is not applicable to an electronic instrument of class I and of class II, if e is less than 1 g.
- (iii) Electronic instruments, class I instruments exempted, shall be subjected to the span stability test specified in clause (iv) of sub-paragraph (4) of this paragraph. The error near maximum capability shall not exceed the maximum permissible error and the absolute value of the difference between the errors obtained for any two measurements shall not exceed half the verification scale interval or half the value of the maximum permissible error, whichever is greater.
- (iv) When an electronic instrument is subjected to the disturbances specified in clause (iii) of sub-paragraph (4) of this paragraph, the difference between the weight indication without the disturbance (intrinsic error), shall not exceed e or the instruments shall detect and react to a significant fault.
- (v) During the warm-up time of an electronic instrument there shall be no indication or transmission of the weighing result.
- (vi) An electronic instrument may be equipped with interfaces permitting the coupling of the instrument to any peripheral devices or other instruments.

An interface shall not allow the metrological functions of the instruments measurement data to be inadmissibly influenced by the peripheral devices (for example computers), by other interconnected instruments, or by disturbances acting on the interface.

Functions that are performed or initiated via an interface shall meet the relevant requirements and conditions of clause (iv) of this sub-paragraph.

Note : An "interface" comprises all mechanical, electrical and logic properties at the data

interchange point between an instrument and peripheral devices or other instruments.

- (a) It shall not be possible to introduce into an instrument, through an interface, instructions or data intended or suitable to:
 - display data that are not clearly defined and could be mistaken for a weighing result,
 - falsify displayed, processed or stored weighing results,
 - adjust the instrument or change any adjustment factor; however instructions may be given through the interface to carryout an adjustment procedure using a span adjustment device incorporated inside the instrument or for instruments in class I, using an external standard mass,
 - falsify primary indication displayed in case of direct sales to the public.
- (b) An interface through the functions mentioned in sub-clause (a) of clause (vi) of sub-paragraph (3) of this paragraph cannot be performed or initiated, need not be secured. Other interface shall be secured as per sub-clause (d) of clause (ii) of the sub-paragraph (1) of paragraph 4.
- (c) An interface intended to be connected to a peripheral device to which the requirements of this (Schedule) apply, shall transmit data relating to primary indication in such a manner that the peripheral device can meet the requirements.
- (vii) A battery operated electronic instrument shall either continue to function correctly or not indicate any weight values, whenever the voltage is below the manufacturer's specified value.

(4) Performance and span stability tests**(i) Test considerations :**

All electronic instruments of the same category, whether or not equipped with checking facilities, shall be subjected to the same performance test programme.

(ii) State of instrument under test :

Performance tests shall be carried out on fully operational equipment in its normal

operational state or in a status, as similar as possible thereto.

If an electronic instrument is equipped with an interface permitting the coupling of the instrument to external equipment, the instrument shall, during the tests mentioned in sub-paragraphs (2), (3) and (4) of paragraph 3 of Annexure A be coupled to external equipment, as specified by the test procedure.

(iii) *Performance test*

Performance tests shall be performed according to paragraphs 2 and 3 of Annexure A.

TABLE 43-A

<i>Tests</i>	<i>Characteristic under test</i>
Static temperature	Influence factor
Damp heat, steady state	Influence factor
Power voltage variations	Influence factor
Short time power reductions	Disturbance
Bursts (transients)	Disturbance
Electrostatic discharge	Disturbance
Electromagnetic susceptibility	Disturbance

(iv) *Span stability test*

Span stability test shall be performed according to paragraph 4 of Annexure A.

6. Technical requirements for a non-self indicating instrument

A non-self-indicating instrument shall comply, as far as applicable, with paragraphs 3 and 4.

(1) *Minimum sensitivity*

An extra load equivalent to the absolute value of the maximum permissible error for the applied load, shall be placed on the instrument at equilibrium and shall cause a permanent displacement of the indicating element of at least

1 mm for an instrument of class I or II

2 mm for an instrument of class III or IV with Max. 30 kg

5 mm for an instrument of class III or IV with Max. 30 kg

The sensitivity tests shall be carried out by placing extra loads with a slight impact in order to eliminate the effects of discrimination threshold.

(2) *Indicating device*

(i) *General provisions*

(a) *Equilibrium indicating component*

If two indices are provided, with one fixed and another movable then the thickness of the two indicating components shall be equal and the distance between them shall not exceed their thickness.

However, this distance may be equal to 1 mm, if the thickness of the indices is less than this value.

(b) *Securing*

It shall be possible to secure the sliding poises, the removable masses and the adjusting cavities or the housings of such devices as prescribed by Director.

(c) *Printing*

If the device permits printing, this should be possible only if sliding bars or poises or a mass switching mechanism are each in a position corresponding to a whole number of scale divisions. Except for accessible sliding poises or bars, printing should be possible only if the equilibrium indicating component is in the reference position to within the nearest half scale interval.

(ii) *Sliding poise device*

(a) *Form of scale marks*

On bars on which the scale interval is the verification scale interval of the instrument, the scale marks shall consist of lines of constant thickness. On other major (or minor) bars, the scale marks shall consist of notches.

(b) *Scale spacing*

The distance between scale marks shall not be less than 2 mm and be of sufficient length so that the normal machining tolerance for notches or scale marks does not cause an error in the weighing result exceeding 0.2 of the verification scale interval.

(c) *Stops*

The displacement of sliding poises on major and minor bars shall be limited

to the graduated part of major and minor bars.

(d) Indicating component

Each sliding poise device shall be provided with an indicating component.

(e) Accessible sliding poise device

There shall be no moving parts in sliding poises, except sliding minor bars.

There shall be no cavity on sliding poises that could accidentally hold foreign bodies.

It shall be possible to secure parts that are detachable.

The displacement of sliding poises on major and minor bars shall require a certain effort.

(iii) *Indication by use of proportional weights*

The reduction ratios shall be in the form 10^k , k being an integer or zero.

On an instrument intended for direct sale to the public, the height of the raised edge of the weights receptor platform should not exceed one-tenth of the greatest dimension of the platform, without being more than 25 mm.

(3) *Condition of construction*

(i) *Equilibrium indicating component*

An instrument shall be provided with two moving indices or one moving indicating component and a fixed datum mark, the respective position of which indicates the reference position of equilibrium.

On an instrument of class III or IV designed to be used for direct sale to the public, the indices shall allow the equilibrium to be seen from the opposite sides of the instrument.

(ii) *Knives, bearings and friction plates.*

(a) *Types of connection*

Levers shall be fitted with knives only and these shall be pivoted on bearings.

The line of contact of the knives and bearing shall be a straight line.

Counter beams shall be pivoted on knife edges.

(b) *Knives*

The knives shall be fitted to the

levers in such a way that the invariability of the ratios of the lever arms is assured. They shall not be welded or soldered.

The edges of the knives of one and the same lever shall be practically parallel and shall be situated in one plane.

(c) *Bearings :*

The bearings shall not be welded or soldered to their supports or in their mountings.

It shall be possible for bearings of an instrument with ratio platforms and steelyards to oscillate in all directions on their supports or in their mountings. On such instruments anti-disconnection devices shall prevent the disconnection of articulated parts.

(d) *Friction plates :*

The longitudinal play of the knives shall be limited by friction plates. There shall be point contact between knife and friction plates and it shall be situated on the extension of the line(s) of contact between knife and bearing(s).

The friction plate shall form a plane through the point of contact with the knife and its plane shall be perpendicular to the line of the contact between knife and bearing. It shall not be welded or soldered to the bearings or their support.

(iii) *Hardness*

Contact parts of knives, bearings, friction plates, inter levers, inter lever supports and links shall have a hardness of at least 58 Rockwell C.

(iv) *Protective coating*

A protective coating may be applied to the parts in contact of jointed components provided that this does not lead to changes of metrological properties.

(v) *Tare devices*

No instrument shall be fitted with a tare device.

(4) *Simple sliding poise instrument (steelyard)*

(i) *General*

(a) *Scale marks :* The scale marks shall be lines or notches, either on the

edge, or on the flat of the graduated shank.

The minimum scale spacing is 2 mm between notches and 4 mm between lines.

- (b) Pivots : The load per unit length on the knives shall be not more than 10 kg/mm.

The bores of bearing in the form of an annulus shall have a diameter at least equal to 1.5 times the largest dimension of the cross section of the knife.

- (c) Equilibrium indicating component

The length of the equilibrium indicating component, if provided taken from the edge of the fulcrum knife-edge of the instrument, shall be not less than 1/15 of the length of the graduated part of the major sliding poise bar.

- (d) Distinctive mark

The head and the sliding poise of an instrument with detachable sliding poises shall bear the same distinctive mark.

- (ii) Instrument with single capacity

- (a) Minimum distance between knife-edges

The minimum distance between knife-edges is,—

25 mm for maximum capacities less than or equal to 30 kg.

20 mm for maximum capacities exceeding 30 kg.

- (b) Graduation

The graduation shall extend from zero to the maximum capacity.

- (c) Zero setting

If an instrument of class III or IV is provided with a zero-setting device, this shall be a captive screw or nut arrangement with a maximum effect of 4 verification scale intervals per revolution.

(5) Instrument with a load measuring device with accessible sliding poises (of steelyard type)

- (i) General

The provisions of sub-paragraph (2) of paragraph 6 relating to load measuring

devices with accessible sliding poises shall be observed.

- (ii) Range of numbered scale

The numbered scale of the instrument shall permit continuous weighing from zero to the maximum capacity.

- (iii) Minimum scale spacing

The scale spacing i_x of the different bars ($x = 1, 2, 3, \dots$)

$i_x \geq d_x / (e \times 0.05)$ mm but $i_x \geq 2$ mm

- (iv) Ratio platform

If an instrument is provided with a ratio platform for extending the indicating range of the numbered scale, the ratio between the value of the weights placed on the platform to balance a load and the load itself shall be 1/10 or 1/100.

This ratio shall be indicated legibly and permanently on the beam in a position close to the ratio platform, in the form 1 : 10, 1 : 100 or 1/10, 1/100.

- (v) Zero setting

An instrument shall have a zero-setting device consisting:

either of a cup with greatly convex cover or of a captive screw or nut arrangement with a maximum effect of 4 verification scale intervals per revolution.

- (vi) Locking of the beam

An instrument shall have a manual device for locking the beam, the action of which prevents the equilibrium indices coinciding when at rest.

- (vii) Wooden parts

If certain parts of an instrument, such as the frame, the platform or the board are of wood, this shall be dry and free from defects. It shall be covered with a paint or an effective protective varnish.

No nails shall be used for the final assembly of wooden parts.

7. Marking of an instrument

- (1) Descriptive markings

All instruments shall carry, in order, the following markings :

- (i) Compulsory in all cases

- manufacturer's mark, or name written in full,

- indication of accuracy class in the form
 - for special accuracy I
 - for high accuracy II
 - for medium accuracy III
 - for ordinary accuracy IV
- maximum capacity in the form Max
- minimum capacity in the form Min
- verification scale interval in the form $e =$

(ii) *Compulsory if applicable*

- mark of manufacturer's agent for an imported instrument,
- identification mark on each unit of an instrument consisting of separate but associated units.
- pattern approval mark,
- scale interval if $d < e$ in the form $d =$
- maximum additional in the form $T = + \dots$ tare effect
- maximum subtractive in the form $T = - \dots$ tare effect if different from Max
- maximum safe load in the form $Lim =$
- the special temperature in the form $^{\circ}C/$ limits within $\dots \dots \dots ^{\circ}C/$ which the instrument complies with the prescribed conditions of correct operation

- counting ratio on a in the form 1 : counting instrument $\dots \dots$ or $1/\dots \dots$
- range of plus/minus $\pm \dots \dots$ mg/g/kg/t indication of a digital comparator instrument

(iii) *Presentation of descriptive markings*

The descriptive marking shall be indelible and of a size shape and clarity allowing easy reading.

They shall be grouped together in a clearly visible place either on a descriptive plate fixed to an instrument, or on a part of the instrument itself.

The markings: Max.....
Min.....
 e
 d if $d = e$ and
Accuracy class.....

shall also be shown near the display of the result if they are not already located there.

It shall be possible to seal the plate bearing the descriptive marking.

(a) *Markings in special cases :*

In special case, some of the markings shall be in the form of a table as illustrated below:—

<i>For a multi-interval instrument</i>	<i>For an instrument with more than one weighing range (W_1, W_2) :</i>		<i>For an instrument with weighing ranges in different classes</i>	
	W_1	W_2	W_1	W_2
Max 2/5/15 kg	Max 20 kg	100 kg	II Max 1000 g	III 5000 g
Min 20 g	Min 200 g	1 kg	Min 5 g	40 g
$e = 1/2/5$ g	$e = 10$ g	50 g	$e = 0.1$ g	2 g
			$d = 0.02$ g	2 g

(b) *Dimensions :*

When several plates are placed one above the other (as for example in the case of an instrument consisting of several separate devices) they should be of the same width. This common width is fixed at 80 mm.

(c) *Fixing :*

The plate shall be fixed by rivets or screws with one of the rivets of red copper or material having qualities recognised as similar. It should be possible to secure the head of one of the screws by means of a

lead cap inserted in a device that cannot be dismantled. The diameter of the rivet or of the lead cap should be able to accommodate a stamp 4 mm in diameter.

(d) *Dimension of the letters :* The height of capital letters should be at least 2 mm.

(iv) *Specific cases*

(a) *Instrument having several load receptors and load measuring devices*

Each load measuring device which is connected or can be connected to one or

more load receptors, shall bear the descriptive markings relating to these viz.

identification mark,

maximum capacity,

minimum capacity,

verification scale interval and

if appropriate, maximum safe load and maximum additive tare effect.

- (b) Instruments consisting of separately built main parts

If main parts cannot be exchanged without altering the metrological characteristics of the instrument, each unit shall have an identification mark which shall be repeated in the descriptive markings.

(2) Verification marks

(i) Position

An instrument shall have a place for the application of verification marks.

This place shall,—

be such that the part on which it is located cannot be removed from the instrument without damaging the marks

allow easy application of the marks without changing the metrological qualities of the instrument

be visible without the instrument having to be moved, when it is in service.

(ii) Mounting

An instrument required to bear verification marks shall have a verification mark support, at the place provided for above, which ensures the conservation of the marks:

- (a) When the mark is of the self-adhesive type, a space shall be provided on the instrument for the application of the mark.

8. Metrological control

(1) Verification

(i) Visual inspection

Before testing, the instrument shall be visually inspected for

metrological characteristics, i.e., accuracy class, Min, Max e, d.

prescribed inscription and position for verification and control marks.

model approval number wherever applicable.

(ii) Tests

Tests shall be carried out to verify compliance with the following requirements :

- clause (1) of sub-para (6) of paragraph 3—Value of maximum permissible error,
- sub-clauses (b) and (c) of clause (iii) of sub-paragraph (6) of paragraph 3—Maximum permissible error for net and tare values,
- clause (ii) of sub-paragraph (6) of paragraph 3—Scale interval of the tare weighing device,
- clause (iii) of sub-paragraph (7) of paragraph 4 operation of the tare device shall be visible.
- clause (i) of sub-paragraph (7) of paragraph 3 repeatability (3 weighing on classes III and IV and 6 weighing for I and II)
- clause (ii) of sub-paragraph (7) of paragraph 3—Eccentric loading
- sub-paragraph (8) of paragraph 3—Discrimination

(iii) Stamping

Verification shall be testified by verification marks. All components whose dismantling or maladjustment might alter the metrological characteristics of the instrument should be secured by a seal.

(2) Inspection

During inspection the following tests shall be carried :

- maximum permissible error; clause (i) of sub-paragraph (6) of paragraph 3,
- Eccentric loading; clause (ii) of sub-paragraph (7) of paragraph 3,
- the seal applied during verification shall remain intact.

9. Test procedure during verification and inspection

(1) Evaluation of error

At a certain load L, the indicated value, I is noted. Additional weights of say $1/10$ e are successively added until the

indication of the instrument is increased unambiguously by one scale interval ($I + e$). The additional load L added to the load receptor gives the indication P , by using the formula

$$P = I + (1/2)e - \Delta L$$

The error is $E = P - L$

$$= I + (1/2)e - L - \Delta L \\ \leq mpe$$

(2) Weights

- (i) The standard weights used for verification of an instrument shall not have an error greater than $1/3$ of the maximum permissible error of the instrument for the applied load.
- (ii) Substitution of standard weights : While verifying instrument with maximum of 1 tonne and more, instead of standard weights, any other constant load may be used, provided that standard weights of at least 1 tonne or 50% of maximum, whichever is greater, is used.

(3) Weighing tests

Apply test loads from zero up to and including Max. and similarly remove the test loads back to zero. During verification 5 test loads shall be selected and during inspection 3 test loads.

The test loads selected shall include Max., Min and values at or near those at which the maximum permissible error changes. When loading or unloading, the weights shall be progressively increased or decreased. If the instrument is provided with an automatic zero setting device, it shall remain in operation during test. Error is calculated as given in sub-para (1) above.

(4) Weighing test using substitution method

Apply the test loads from zero up to and including maximum portion of the standard weights. Determine the error and then remove the weights so that the no load indication, or in the case of an instrument with a zero tracking device, the indication of say $10e$, is reached.

Substitute the previous weights with substitution material until the same changeover point, as used for the determining of the error is reached. Repeat the above procedure until Max. of the instrument is reached.

Unload in reverse order to zero, i.e. unload the weights and determine the change over point. Place the weights back and remove the substitution material until the same changeover point is reached. Repeat this procedure until no-load is reached.

(5) Tare

(i) Tare weighing

Weighing tests shall be performed at least at two different tare values. At least 5 steps may be selected including Min. loads close to values at which mpe changes and the value close to the maximum possible load (or maximum additive tare if provided).

(6) Eccentricity test

Large weights should be used in preference to several small weights. The load shall be applied centrally in the segment if several weights are used.

The location of the load shall be marked on a sketch in the report.

The automatic zero-setting device shall not remain in operation during the sets.

(i) Instrument with load receptor having not more than four points of supports

The four quarter segments roughly equal to $1/4$ of the surface of the load receptor shall be loaded in turn.

(ii) Instruments with a load receptor having more than four points of support

The load shall be applied over each support on an area of the same order of the magnitude as the fraction of $1/n$ of the surface area of the load receptor, where n is the number of points of support.

(iii) Instrument with special load receptor (tank, hopper)

The load shall be applied to each point of support.

(iv) Instrument used for weighing rolling loads

A rolling load shall be applied at different positions on the load receptor. These positions shall be at the beginning, the middle and at the end of the load receptor in the normal driving direction. The positions shall then be tested in the reverse direction.

(7) Discrimination test

The following tests shall be performed with three different loads, i.e. Min, 1/2 load and Max.

(i) Non-self indication and analogue indication

An extra load shall be placed gently on or removed from the load receptor while the instrument is at equilibrium.

(ii) Digital indication :

A load plus sufficient additional weights (say 10 times 1/10 of e) shall be placed on the load receptor. The additional weights shall then be removed until the indication, I is decreased unambiguously by one actual scale interval i.e. I-d. One of the additional weights shall be replaced and a load equal to 1.4 e shall then be placed gently on the load receptor and give a result, increased by one actual scale interval above the initial indication, i.e. I+d.

(8) Repeatability test

Two series of weighing shall be performed; one at 1/2 load and the other at max. Readings shall be taken when the instrument is loaded and unloaded.

(9) Creep test

Load the instrument close to Max. Take one reading as soon as the indication has stabilized and then note the indication while the load remains on the instrument for a period of four hours. During this test the temperature should not vary more than 2°C.

The test may be terminated after 30 minutes if the indication differs less than 0.5e during the first 30 minutes and the difference between 15 and 30 minutes is less than 0.2e.

(10) Zero return test

The deviation in the zero indication before and after a period of loading with a load close to Max for half an hour, shall be determined. The reading shall be taken as soon as the indication has stabilized.

For multiple range instruments, continue to read the zero indication during the following 5 minutes after the indication has stabilized.

If the instrument is provided with automatic zero-setting or zero-tracking, it shall not be in operation.

Test for the stability of equilibrium (instruments with printing and/or data storage devices)

Load the instrument up to 50 per cent of Max. Manually disturb the equilibrium and initiate the command for data printing or data storage as soon as possible. Read the indicated value 5 seconds after printing. Perform the test 5 times.

(11) Influence factors**(i) Tilting**

The instrument shall be tilted both forwards and backwards longitudinally, and from side to side transversely.

In the text that follows, class II instrument intended for direct sales to the public are designated class II* and class II instrument not intended for direct sale to the public are designated class II.

In practice the tests (no load and loaded) can be combined as follows :

After zero setting in the reference position, the indication is determined at no load and at the two test loads. The instrument is then unloaded and tilted (without a new zero setting), after which the indication at no load and at the two test loads are determined. This procedure is repeated for each of the tilting directions.

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.

If the instrument is provided with automatic zero-setting or zero tracking, it shall not be in operation.

Tilting class II, III and IIII instruments

(a) Tilting at no-load (class II*, III and IIII) :

The instrument shall be set to zero in its reference position (not tilted). The instrument shall then be tilted longitudinally up to 2/1000 or the limiting value of the level indicator,

whichever is greater. The zero indication is noted. The test shall be repeated with transverse tilting.

- (b) Tilting when loaded (class II, II*, III and IIII) :

The instrument shall be set to zero in its reference position and two weighings shall be carried out at a load close to the lowest load where the maximum permissible error changes, and at a load close to Max. The instrument is then unloaded and tilted longitudinally and set to zero. The tilting shall be 2/1000 or the limiting value of the level indicator, whichever is greater. Weighing tests as described above shall be performed. The test shall be repeated with transverse tilting.

- (c) Tilting class I instrument :

The instrument shall be tilted longitudinally up to the limiting value of the level indicator. Check the tilt. Repeat with transverse tilting.

If the tilt is not greater than 2/1000, no further testing is required. Otherwise test as per "tilting when loaded (class II, II* III and IIII)" in (b) above.

- (d) Instrument without level indicator :

For an instrument liable to be tilted and not fitted with a level indicator the test "tilting class II, III and IIII" as given in (a) and (b) shall be performed except that the instrument shall be tilted 5% instead of 0.2%.

(12) Warm up time test

An instrument using electric power shall be disconnected from the supply for a period of at least 8 hours prior to the test. The instrument shall then be connected and switched on and as soon as the indication has stabilized, the instrument shall be set to zero and the error at zero shall be determined. Calculation of error shall be made. The instrument shall be loaded with a load close to Max. These observations shall be repeated after 5, 15 and 30 minutes.

For instruments of class I, the provisions

of the operating manual for the time following connection to the mains shall be observed.

(13) Temperature tests

See Figure 32 E for practical approach to performing the temperature tests.

- (i) *Static temperature tests :*

The test consists of exposure of the equipments under test (EUT) to constant temperatures within the range stated under free air conditions, for a 2 hour period after the EUT has reached temperature stability.

The weighing tests (loading and unloading) shall be carried out

- at a reference temperature (normally 20°C but for class I instruments the mean value of the specified temperature limits);
- at the specified high temperature;
- at the specified low temperature or at a temperature of 5°C if the specified low temperature is below 10°C; and
- at the reference temperature.

The change of temperature shall not exceed 1°C/min during heating and cooling down.

For class I instruments changes in barometric pressure shall be taken into account.

The absolute humidity of the test atmosphere shall not exceed 20 g/m³, unless the operating manual gives different specifications.

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

The instrument shall be set to zero and then changed to the prescribed highest and lowest temperature as well as at 5°C if applicable. After stabilisation the error of the zero indication shall be determined. The change in zero indication per 1°C (class I) instrument or per 5°C (other instruments) shall be calculated. The changes of these errors per 1°C (class I instruments) or per 5°C (other instruments) shall be calculated for any two consecutive temperature of this test.

This test may be performed together with the temperature test. The errors at zero shall then be additionally determined immediately before changing to the next temperature and after the 2 hour period after the instrument has reached stability at this temperature.

Note : Pre-loading is not allowed before these measurements.

If the instrument is provided with automatic zero-setting or zero-tracking, it shall not be in operation.

(14) Voltage variation

Stabilize the EUT under constant environmental conditions.

The test consists of subjecting the EUT to variations of AC mains voltage.

The test shall be performed with test loads of 10e and a load between 1/2 Max and Max.

Test severity : Voltage variations : Upper limit V + 10%
 Lower limit V - 15%

Where V is the value marked on the instrument.

Maximum allowable variations : All functions shall operate as designed, and all indications shall be within the maximum permissible errors. If the instrument is provided with an automatic zero-setting or a zero tracking device, it may be in operation during the test.

(15) Endurance test :

(Applicable only to instruments of class II, III and IIII with Max ≤ 100 kg)

The endurance test shall be performed after all other tests.

Under normal conditions of use, the instrument shall be subjected to the repetitive loading and unloading of a load approximately equal to 50% of Max. The load shall be applied 100 000 times. The frequency and speed of application shall be such that the instrument attains an equilibrium when loaded and when unloaded. The force of the load applied shall not exceed the force attained in a normal loading operation.

A weighing test in accordance with the procedure shall be performed before the endurance test is started to obtain the intrinsic error. A weighing test shall be performed after the completion of the loadings to determine the durability error due to wear and tear. If the instrument is provided with automatic zero-setting or zero-tracking device it may be in operation during the test.

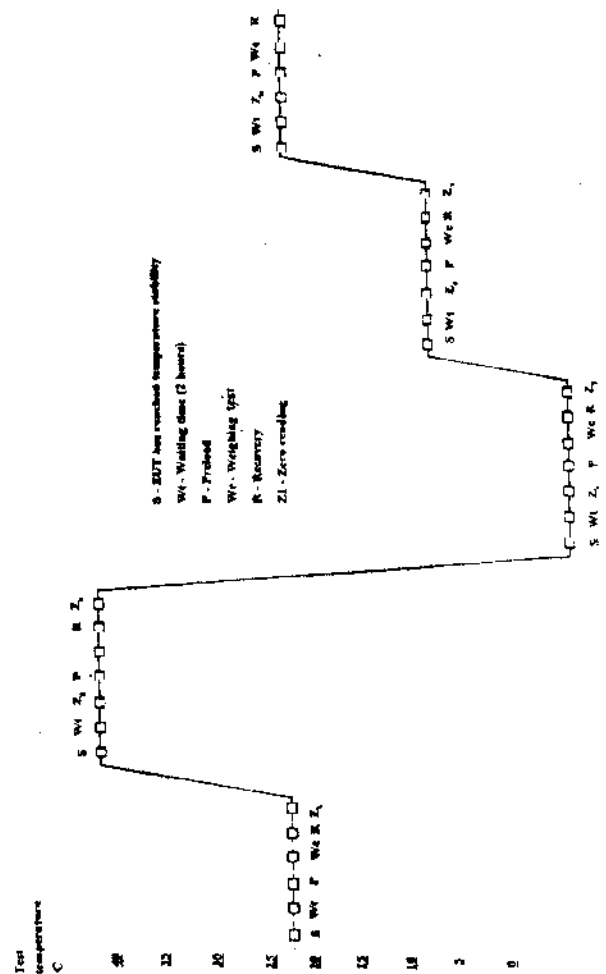


FIGURE 32 E

Proposed test sequence for tests given in clauses (i) and (ii) of sub-paragraph (13) of Paragraph 9 of Part-II

(temperature test where the temperature limits are +40°C / - 10°C)

Annex-A

ADDITIONAL TESTS FOR ELECTRONIC INSTRUMENTS FOR MODEL APPROVAL

1. General requirements for electronic instruments under test (EUT)

Energise the EUT for a time period equal to or greater than the warm up time specified by the manufacturer and maintain the EUT energised for the duration of the test.

Adjust the EUT as closely as practicable to zero prior to each test, and do not re-adjust it at any time during the test, except to reset it if a significant fault has been indicated. 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.

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

2. Performance tests for influence factors

2(1) Static temperatures.

2(2) Damp heat, steady state

(not applicable to class I instrument or class II instruments where e is less than 1 gram).

Test procedure in brief : The test consists of exposure of the EUT to a constant temperature and a constant relative humidity. The EUT shall be tested with at least five different test loads.

- at the reference temperature (20 °C or the mean value of the temperature range whenever 20°C is outside this range) and a relative humidity of 50% following conditioning.
- at the high temperature of the range specified in clause (ii) of sub-paragraph (9) of paragraph 3 of Part II and a relative humidity of 85%, two days following temperature and humidity stabilization, and
- at the reference temperature and relative humidity of 50%.

Maximum allowable variations : All functions shall operate as designed.

All indications shall be within maximum permissible errors.

3. Power voltage variations

Performance tests for disturbances

(1) Short time power reductions

Test procedure in brief : Stabilize the EUT under constant environmental conditions.

A test generator capable of reducing the amplitude of one or more half cycles (at zero crossings) or the AC mains voltage shall be used. The test generator shall be adjusted before connecting the EUT. The mains voltage reduction shall be repeated ten times with an interval of at least 10 seconds.

The test shall be performed with test loads of $10e$ and a load between $1/2$ Max and Max.

Test severity	Reductions	100%	50%
Number of half cycles		1	2

Maximum allowable variations : The difference between the weight indication due

to the disturbance and the indication without the disturbance shall either not exceeds e or the instrument shall detect and react to a significant fault.

(2) Burst

The test consists in exposing the EUT to specified bursts of voltage spikes.

Before any test stabilize the EUT under constant environmental conditions.

The test shall be applied separately to:
power supply lines,

I/O circuits and communications lines, if any.

The test shall be performed with test loads of $10e$ and a load between $1/2$ Max and Max.

Test severity : Open circuit output test voltage for:

- power supply lines 1 kV
- I/O signal 1, data and control lines 0.5kV.

Maximum allowable variations : The difference between the weight indication due to the disturbance and the indication without the disturbance shall either not exceeds e or the instrument shall detect and react to a significant fault.

(3) Electrostatic discharge

The test, consists in exposing the EUT to specified, direct and indirect, electrostatic discharges.

This test includes the point penetration method, if appropriate, for direct discharges the air discharge shall be used where the contact discharge method cannot be applied.

Before any test stabilize the EUT under constant environmental conditions.

At least 10 direct discharges and 10 indirect discharges shall be applied. The time interval between successive discharges shall be at least 10 seconds.

The test shall be performed with test loads of $10e$ and a load between $1/2$ Max. and Max.

Maximum allowable variations : The difference between the weight indication due to the disturbance and the indication without the disturbance shall either not exceeds e or the instrument shall detect and react to a significant fault.

(4) Immunity to radiated electromagnetic fields

The test consists in exposing the EUT to specified electromagnetic fields.

Before any test, stabilize the EUT under constant environmental conditions.

The EUT shall be exposed to electromagnetic fields of the strength and character as specified by the severity level.

The test shall be performed with one small test load only :

Frequency range	26-1000	MHz
Field strength	3	V/m
Modulation	80% AM	1 kHz sine wave

Maximum allowable variations : The difference between the weight indication due to the disturbance and the indication without the disturbance either shall not exceed e or the instrument shall detect and react to a significant fault.

4. Span stability test

(Not applicable to class I instruments)

Test procedure in brief : The test consists in observing the variations of the 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 test shall include the temperature test and if applicable, the damp heat test; they shall not include any endurance test; other performance test in this Annexure and in paragraph 9 shall be performed.

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

For the conduct of this test the manufacturer's operating instructions shall be considered.

The EUT shall be stabilised at sufficiently constant, ambient conditions after switch-on for at least 5 hours, but at least 16 hours after the temperature and damp heat test have been performed.

Test duration : 28 days or the period necessary for the performance tests to be carried out, whichever is shorter.

Time between measurements : Between 1/2 and 10 days.

Test load : Near Max : The same test weights shall be used throughout this test.

Number of measurement at least 8.

Test sequence : Stabilize all factors at sufficiently constant ambient conditions.

Adjust the EUT as close to zero as possible.

Automatic zero-tracking shall be made inoperative and automatic built in span adjustment device shall be made operative.

Apply the test weight(s) and determined the error.

At the first measurement immediately repeat zeroing and loading four times to determine the average value of the 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 measurements is more than 0. 1e.

Record the following data:—

- (a) data and time
- (b) temperature
- (c) barometric pressure
- (d) relative humidity
- (e) test load
- (f) indication
- (g) errors
- (h) changes in test locations

and apply all necessary corrections resulting from variations of temperature, pressure, etc. between the various measurements.

Allow full recovery of the EUT before any other test is performed.

Maximum allowable variations

The variation in the errors of indication shall not exceed half the verification scale interval or half the absolute value of the maximum permissible error on initial verification or the test load applied, whichever is greater, on any of the n measurements.

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

SEVENTH SCHEDULE**HEADING - B****(See rule 13)****GENERAL REQUIREMENTS****1. Category**

Weighing instruments of the following categories are included in this Part:

- (a) Beam Scales
- (b) Counter Machines