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Guidelines for the establishment of simplified metrology regulations



GUIDELINES for the ESTABLISHMENT of SIMPLIFIED METROLOGY REGULATIONS

A number of developing countries are experiencing difficulties in drafting legal metrology regulations. This brochure has been written by a BIML staff member in an attempt to assist such countries by proposing simplified solutions to the technical problems encountered in making regulations. These suggestions have no official standing and have received no official endorsement by the Organisation.

The author has endeavoured to follow as much as possible the relevant OIML Recommendations. However, on a few points, concerning in particular weighing machines, it has been felt that some simplifications were necessary so as to adapt the regulations to the supposed technical capacity of a small or medium-sized developing country.

Explanations, where necessary, are given in preceding comments. It is considered that the simplified text proposed may be used as a start and that it can later be modified in accordance with the needs and the development of the national metrology service so as to follow closer the OIML Recommendations concerned.

The requirements as regards maximum permissible errors are on the whole equal or larger than those specified in the OIML Recommendations.

At present the guidelines are limited to a few classical fields of legal metrology, i.e. measurement of mass, length and volume.

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LEGAL LANGUAGE

Laws and regulations are intended for the public and the court of law and must be formulated in a form and language accepted by the legal authorities of the country. Usually, a legal draftsman is consulted for this purpose. It is thus hazardous for us to formulate phrases of regulations in the way they would be directly acceptable. We are, however, attempting to avoid the use of technical or other terms which are likely to be opposed by legal draftsmen.

LAW OF METROLOGY

Any regulation of legal nature must refer, at least broadly, to one or several laws on metrology. Such laws shall contain references to:

- the legal and authorized units of measurement and their field of application,
- the national Institution having the custody of the measurement standards or charged with the realization of the units,
- the type of activity for which legal control of measures and measuring instruments is required,
- the type of activity for which metrological control of product quantity is prescribed (such as prepackages),
- the national body (or bodies) in charge of legal metrological control,
- the mode of operation of legal control (pattern approval, verification stamping, legal power, etc.),
- offences and legal proceedings.

As laws generally take a long time between their drafting and the time they come into force, it is advisable that the text should not contain technical elements subject to frequent changes. Furthermore, it is advisable not to introduce the rather abstruse definitions of the basic SI units but to refer to the decisions of the General Conference of Weights and Measures.

The list of permitted units of measurement and a conversion table may suitably be included as an annex (schedule) to the law.

Definitions of the derived SI units may probably not be required except possibly in a few cases (temperature, force, pressure, etc.). However, if such definitions are felt to be necessary, it may be preferable to include them in a regulation rather than in the basic law. The OIML International Document D 2 "Legal units of measurement" gives details of how such formulations may be written.

The OIML International Document D 1 "Law of metrology" gives some indications as to the contents of the metrology law. More detailed examples of laws which follow the above-mentioned principles are found in:

- Federal Law of Switzerland (French version published in OIML Bulletin n° 72, September 1978),
- Weights and Measures Act, 1980 Republic of Seychelles (available from BIML).

REGULATIONS

The regulations usually start with an index or summary.

1 – INTRODUCTION

Comments

The main text starts by stating the reference to the metrology law, the Ministry enacting the Regulations and the date when they come into force.

The general terms used in the Regulations and which require definition from the legal point of view are then listed under the heading: Definitions (or Interpretation). For the purpose of simplifying the requirements for weights and weighing machines, it may be suitable to introduce the following terms or their equivalents:

- "General trade" meaning commercial transactions with the exception of trade in valuable goods,
- "Trade in valuable goods" meaning commercial transactions in precious metals, jewellery or pharmaceutical products.

In this brochure, we have used the term "limits of error" which is frequently appearing in regulations written in the English language and the equivalent term "maximum permissible error" when referring to OIML Recommendations.

Other definitions which may be needed can generally be found in the OIML Vocabulary of Legal Metrology.

The fields of application of the regulations are then stated: instruments and measurements for use in commercial transactions, measurements involving human health and safety or safety of property, etc.

2 -PATTERN APPROVAL, INITIAL and SUBSEQUENT VERIFICATION, VERIFICATION STAMPS, SEALS, etc.

Comments

The formulation of this chapter of the regulations will depend mainly on the extent and manner in which pattern approval will be conducted. The main law should already mention that instruments imported, manufactured or used in connection with commercial transactions or involving human safety and health shall be of a pattern approved by the legal control authority. If the law does not provide sufficient detail on the procedures for granting pattern approval, this may be done by means of regulations. However, in many countries, it may be advisable to adopt a flexible attitude as to the detailed procedures and examinations of instruments and not to include too much detail (if any) in regulations which in any case are assimilated to a law.

The law may leave it up to the Head of the metrology service to take decisions as to the basis on which a pattern approval (or admission for use) should be made. Such approvals may in fact be based upon foreign

pattern approval examinations, provided there is enough evidence that the instruments conform to the national (and OIML) regulations. Identification evidence (serial numbers, etc.) may then also be required ^(*). In such case, the procedure of pattern approval may be subject to circulars by the Head of the Metrology Service on case to case basis, rather than prescribed in regulations.

The initial verification requirements, which apply to new or repaired instruments before legal authorization of their use are generally internationally harmonized.

The in-service requirements which apply to instruments in actual use vary greatly from country to country depending on the structure of the inspection services, its staff and facilities, repair service agreements, use of statistical inspection methods instead of periodic verification, etc. It may be appropriate to describe such requirements individually in subsequent chapters for each type of instrument. See OIML D 3 "Legal qualification of measuring instruments".

Instruments which, where applicable, are found to have no seals or broken seals should generally be verified against the initial verification requirements.

The second chapter of a regulation shall also describe the verification stamps and the rejection stamp and their respective use as well as the issue of verification (or inspection) certificates when applicable, etc.

3 – WEIGHTS

Comments

The weights subject to legal control may for reasons of simplicity be divided only into two categories according to the type of trade (see Part I):

- general trade weights,
- weights for trade with valuable goods.

All stamping of weights shall be made using the limits of error applicable to new (or readjusted) weights (initial verification).

Weights for general trade usually comprise sets of cast iron weights down to 100 g combined where necessary with brass or bronze weights for the lower values, down to 5 g or sometimes 1 g.

The shape may be hexagonal (for weights down to 100 g) or cylindrical, and for weights of 5 kg and more preferably parallelepipedic according to OIML R 2.

In Table 1, the proposed limits of error for general trade weights

^(*)Note: The Metrology Service may for instance require that the imported instruments have been duly pattern approved according to OIML Recommendations by the legal metrology service of the country of manufacture.

correspond to OIML class M₃.

For trade with valuable goods or materials including pharmaceutical products the error limits require to be smaller and should fit the weighing instruments. The weights which best correspond to this requirement are those of class M₁ described in OIML R 20.

For weights below 1 g, the error limits may however for in-situ verifications be rounded to the lower tolerance limit of 0.5 mg.

The use of special carat weights should not be encouraged as milligram weights can be used as well along with a conversion chart (1 carat = 200 milligrams).

It is considered that weights below 10 mg should not be subject to verification.

The proposed error limits for weights for trade with valuable goods are indicated in the third column of Table 1.

Following the above considerations the regulations concerning weights used for trade may be written in the following simplified form:

Regulations

3.1 Weights for general trade

(1) A weight for general trade shall:

- (a) be of a denomination specified in Table 1 and have that denomination marked on its top surface,
- (b) be made of iron, brass, bronze or an approved material,
- (c) if made of iron, be of a denomination of 100 g or greater,
- (d) be hexagonal or cylindrical in shape; a rectangular block shape being acceptable for weights of 5 kg and higher denominations,
- (e) have no part which can be removed without breaking a ring, handle or seal,
- (f) be free from flaws and smooth on all surfaces except for markings of denomination or other identification,
- (g) if marked with the manufacturer's identification, have that marking
 - without figures, and
 - with no letters larger than one-half of the size of the letters or figures marking the denomination,

- (h) have not more than one adjusting hole which shall
 - be partly filled with lead and permitting future adjustment,
 - be tapered so as to prevent the lead from being dislodged by shock and wear,
 - (i) have, when new or readjusted, no error greater than the limit of error for its denomination specified in the second column of Table 1.
- (2) The Inspector shall test the limit of error with working standard weights calibrated to national standard weights within errors less than one-third of the limit of error specified in second column of Table 1.
- (3) If a weight for general trade does not conform to section (1), an Inspector shall not pass it as correct at verification.
- (4) Subject to section (5), where an Inspector passes a weight for general trade as correct at verification, he shall stamp it:
- (a) if the weight has an adjusting hole, on the lead in that hole,
 - (b) in any other case, on the base surface of the weight.
- (5) It shall be permitted to use stamped weights for general trade which in service have errors not exceeding the double of the limit of error specified in the second column of Table 1.

3.2 Precision weights for trade with valuable goods

- (1) A weight for trade in valuable goods shall be a precision weight which:
- (a) is of a denomination specified in Table 1 and subject to (e) has that denomination marked on its top surface,
 - (b) is made of brass, bronze, stainless steel or another approved corrosion resistant material,
 - (c) if made of aluminium alloy is of a denomination of 500 mg or less,
 - (d) if it has a protective coating, this coating being made of corrosion and friction resistant material,
 - (e) is cylindrical in shape, or, if of a denomination of 500 mg or less, is a wire shaped into one, two or five sections to indicate its denomination, or is a flat sheet,
 - (f) has, when new or readjusted, no error greater than the limit of error for its denomination as specified in the third column of Table 1.
- (2) The Inspector shall test the limit of error with working standard weights calibrated to national standard weights within errors less than one-third of the limit of error specified in the third column of Table 1.

- (3) If a precision weight for trade with valuable goods does not conform to section(1) an Inspector shall not pass it as correct at verification.
- (4) Subject to section (5), where an Inspector passes a precision weight for trade with valuable goods as correct at verification, he shall stamp:
- (a) the weight on its base surface if it is of a denomination of 200 g or more,
 - (b) the identification plate on top of the storage box for weights of a denomination of 100 g and less.
- (5) It shall be permitted to use precision weights for trade with valuable goods which are stamped in accordance with section (4) and have no errors exceeding the double of the limits of error specified in the third column of Table 1.

4 - WEIGHING INSTRUMENTS

Comments

Before presenting detailed suggestions for the formulation of simplified requirements for weighing machines, we think it is useful to review, point by point, the reasons behind them and to compare them with the OIML Recommendation R 76.

Trade requirements

In principle, the regulations pertaining to error limits should be related to the intended main use of the instrument rather than to its mode of construction. This has not always been the case and one may find, at least in some old national regulations, different error limits depending whether it is a beam scale, a Roberval or Beranger counter balance or a self-indicating machine.

The aim for general retail trade should be that products for general consumption should on average be weighed to better than 1% so as to bring this sale in line with the practice for prepackages. When weighing heavier quantities (above 10 kg) this percentage should, in most cases, be further reduced.

For the weighing of jewellery, one should aim for an average of 0.1% whereas for pharmaceutical dispensing the absolute value of the weighing error may be of greater importance.

Minimum limit for weighing (Min)

A related problem is the minimum value of the mass for which a machine can be used without giving raise to excessive relative weighing errors, i.e. at loads which are small compared to the maximum capacity of the machine.

This is a difficult problem to solve in practice since for the same type of construction, the absolute error generally increases with the

capacity of the machine. A retail dealer can in fact not be expected to have a full range of weighing machines with varying capacities but will use one which covers the complete range of his usual sales. Thus, it happens frequently that the weighing machine is used with rather low loads compared to its maximum capacity.

The OIML Recommendation specifies that a minimum capacity (Min) value shall be clearly indicated on the weighing machine corresponding to 20 scale intervals for a class (III) machine (i.e. 100 g for a machine graduated in 5 g intervals). Therefore the relative weighing error at this load for a machine in service may in the worst case reach 5%. Unless special devices are used to avoid or cancel the indications below the Min value such machines are frequently used below this limit.^(*)

Non-graduated weighing machines frequently do not carry such indications at all (though this could be recommended if new products of this type are put on the market). It should be stressed however that relative weighing errors due to low loads are equally likely to be of advantage to the consumer as to the seller. For non-graduated machines, it may prove sufficient to regulate the discrimination and sensitivity as well as the limits of error of the set of weights used.

For machines used for general trade on which a Min value is not indicated, it is also possible to prescribe that Weighing for sale of goods should not take place at a load below 2% of the maximum capacity of the machine. However, for the more accurate machines used for trade with valuable goods and for pharmaceutical dispensing the setting of such a limit is not advisable.

Classification

The suggested classification of the type of trade into two categories "general trade" and "trade with valuable goods" as defined in the Introduction simplifies the drafting of regulations for weighing machines.

In general, weighing instruments used for:

- general trade should correspond to OIML class III ^(**)
- trade with valuable goods (i.e. with jewellery, precious metals and for pharmaceutical dispensing) should correspond to OIML class II.

Construction (design) requirements

For a developing country, it may not be feasible to go into too much detail as regards constructional requirements. If most of the weighing

^(*)The problem of the minimum capacity is practically solved in electronic multi-range weighing machines in which both the range and the scale intervals change automatically depending on the load.

^(**)With a view of obtaining sufficient accuracy at low loads (low Min value) it is suggested to increase the lowest number of permissible scale intervals from 500 to at least 1000 for maximum capacities of 5 kg and more. For some applications, such as use in slaughter-houses, machines with only 500 scale intervals should however be permitted. The maximum permissible error expressed in mass remains unchanged.

instruments of advanced design are imported, it is advisable that the legal metrology service simply requires a certificate issued by the national metrology service in the country of manufacture stating that the imported instruments (model and serial numbers) conform to OIML Recommendations for the above-mentioned classes. (In addition they must comply with Tables 2 and 3).

Locally made ungraduated instruments using external weights such as beam-scales and counter machines of the Roberval or Beranger pattern may then be covered by simplified national regulations based on the intended use and capacity of the instruments.

In this way, the regulations will put greater emphasis on testing requirements than on construction.

Some important constructional requirements are however necessary for some instruments such as weighbridges due to the fact that errors here may have a greater economical impact than in the usual retail trade and that their performance depends on the local installation conditions.

Spring balances of low capacity such as are sometimes found in market places are subject to problems: on the one hand, such instruments may not comply with the usual error limit requirements and, on the other hand, they may be subject to fraudulent use due to faulty zero adjustment, the possibility of a loose weigh pan, etc. Taking into account their low cost compared with more sophisticated instruments, it may however prove difficult to prohibit their use for the sale of cheap goods. Their admission for use should therefore be subject to case to case decisions by the Head of the legal metrology service.

Discrimination and sensitivity

The discrimination of a measuring instrument is its ability to react to small changes of the quantity measured. The sensitivity is expressed by the change of indication for a corresponding (small) change of load. Sensitivity is thus a feature of construction aiming to facilitate reading of the weighing machine by producing a sufficient change of the position of the index whereas discrimination is due to factors such as friction or back-lash in mechanical machines and dead-band in machines incorporating electronics.

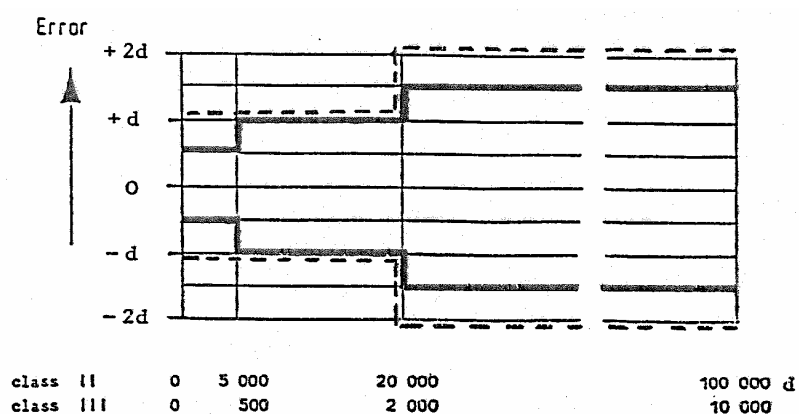


Fig. 1 — Maximum permissible errors for the verification of self-indicating weighing instruments with non automatic loading as a function of the load expressed in scale intervals d .

Class II = trade with valuable goods

Class III = general trade

Thick lines according to R 76. Dotted lines according to simplification proposed on page 10.

For an analogue indicating instrument like a beam-scale or a self-indicating machine fitted with a pointer, it seems reasonable to prescribe that it shall, over the full load range, react visibly to gentle load changes equal to half the prescribed limit of error.^(*)

The sensitivity of a non-self-indicating instrument should be such that the limit of error corresponds to a permanent displacement of the index of at least 2 mm ^(**). This value shall be increased to 5 mm for mechanical platform machines and weighbridges.(The sensitivity is in practice frequently tested with a greater change of load than the limit of error so as to avoid the influence of discrimination).

For self-indicating analogue machines it may be sufficient to specify that the graduations should be so separated that they are clearly legible at normal reading distance of the operator and the customer.

For a digital or electronic machine, the discrimination requirement should correspond basically to \pm one digital scale interval which however in practice has to be tested with a somewhat higher load due to the rounding error of such machines. (The OIML R 76 prescribes a load increment of up to 1.4 times the digital scale interval).

Limits of error

By construction, the weighing machines usually have intrinsic errors which in part are constant over their weighing range and in part increase with the load.

In the OIML Recommendations, one has adopted an intermediate solution with absolute values of error limits which are constant within three load zones, the extent of each zone being expressed in terms of scale intervals.

^(*)The OIML R 76 specifies a visible reaction for 0.4 times the maximum permissible error for non-self-indicating machines. For analogue self-indicating machines, the displacement of the index shall correspond to at least 0.7 times an extra load equal to the maximum permissible error.

^(**)For non-self-indicating machines of OIML class II the Recommendation R 76 specifies a minimum displacement of only 1 mm for a load change corresponding to the maximum permissible error which however at zero load is only half (or one third) of the maximum permissible error at full load. The suggested simplified sensitivity requirement is thus not more restrictive for most well constructed precision balances allowed for trade.

Thus, for a graduated machine of class III:

Load	Maximum permissible error on initial verification
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0 to 500 d (inclusive)	± 0.5 d
over 500 to 2000 d (inclusive)	± 1 d
over 2000 d	± 1.5 d

where d is the scale interval expressed in units of mass. For class II, the corresponding load zones have 10 times higher values.

In both cases, the applicable in-service maximum permissible errors are twice the above values.

For non-graduated weighing instruments, errors in actual weighing will depend on the method of use of the instrument, the errors of the weights used and on the sensitivity and reproducibility of the machine. The OIML Recommendation R 76 leaves it up to the manufacturer to state the verification scale interval and the accuracy class. This may not always be suitable in a developing country taking into account the number of instruments already in use to which the regulations will have to apply and also due to the fact that many non-graduated instruments may be manufactured individually in small workshops.

Some countries which are adhering to the principles of R 76 as regards pattern examination and construction of instruments use more simplified rules as regards the verification of weighing machines. In general, the construction of most modern weighing machines is such that if a discrimination and sensitivity requirement is stated, together with an absolute value of the error limits for the full capacity of the machine, the errors at intermediate loads will automatically be smaller since they are, to a large extent, proportional to the load. As mentioned at the beginning of this chapter, it would not seem equitable, at least from the trade viewpoint, to specify different error tolerances for different types of weighing machines, especially in countries where large numbers of non-graduated or mechanical self-indicating machines are still in use.

These considerations have caused the author to propose the use of verification error limits in relation to the capacity of the weighing machines as listed in Tables 2 and 3.

Special requirements for self-indicating weighing machines

The largest permissible scale intervals for self-indicating machines with analogue or digital indication shall be those indicated in the columns "Limits of error, initial verification" in Tables 2 and 3.

Smaller scale intervals shall be permitted, provided that:

- they are expressed in permitted units of mass using exclusively the figures 1, 2 or 5 divided or multiplied by 10, as appropriate,
- the limits of error of the machine do not exceed 1 scale interval on initial verification and 2 scale intervals in service.

With a view of not being more restrictive than the present OIML Recommendation R 76, the limits of error when defined in terms of scale intervals should be increased by the factor 1.5 for loads above 2000 scale intervals for class III instruments and above 20000 scale intervals for class II instruments. However, due to possible difficulties in the interpretation of half scale intervals in the case of digital instruments it is suggested to use the factor 2 for reasons of simplicity (See Fig. 1). In-service errors should in any case not be permitted to exceed 3 scale intervals.

Repeatability

For all weighing machines repeated weighings with the same load shall not show differences, between the extreme indications, which exceed the limit of error (absolute value without regard to sign).

Based upon the above discussion we may formulate simplified regulations for weighing machines as follows.^(*)

Regulations

4.1 Definitions

In this part of these Regulations, unless the context otherwise requires:

"automatic weighing machine" means a weighing instrument in which self-acting machinery carries out an automatic feed of the load and which does not require an operator for carrying out the weighing process,

"beam scale" means an equal-arm oscillating weighing instrument with pans below the beam,

"counter Machine" means an equal-arm oscillating weighing instrument with pans above the beam, or a self-indicating machine to be used on a counter for general trade, any of which having a capacity of not more than 50 kg,

"crane machine" means a suspended self-indicating, electronic, hydraulic or spring-actuated weighing machine of a capacity of 1000 kg or greater,

"discrimination" means the ability of a weighing instrument to react to small variations of load specified in Regulations 4.9 (1),

"electronic weighing machine" means any self-indicating weighing machine in which the load produces electrical signals which are processed so as to indicate or record weight,

"error of a weighing machine" means the difference, when the machine is loaded with a standard weight, between the indicated weight and the value assigned to that standard weight,

^(*)This text is a technically amended version of similar formulations used by legal draftsmen in some Commonwealth countries. (It has been supposed in the text that the use of spring balances and steelyards is subject to special restrictions).

"load receptor" means the part of a weighing instrument on which goods being weighed are placed or hooked,

"oscillating weighing instrument" means a weighing instrument with a beam or steelyard which oscillates about or returns to the position of equilibrium when disturbed from that position,

"platform machine" means a weighing instrument (other than a weighbridge) with the load receptor being a platform 3 m or by 2 m in size or less, and a capacity of 5000 kg or less, and includes any similar instrument prescribed as a platform machine by (the Minister by notice in ...),

"self-indicating weighing machine" means a weighing instrument (other than a spring balance) on which the whole or part of the weight of the goods being weighed is indicated by a pointer moving over a scale or chart graduated in units of mass, or a graduated chart moving in relation to a fixed pointer, or a digital display, or by means of a printed record,

"sensitivity" in relation to a weighing instrument not equipped with digital indication means the displacement of the index produced by a small change of load specified in Regulation 4.9,

"spring balance" means a mechanical weighing instrument in which the weight is determined by the extension or compression of a spring, such extension or compression being indicated by a pointer on a dial or by a moving graduated scale,

"steelyard" means an unequal-arm single-lever weighing instrument, the shorter arm of which carries a load-hook suspended from knife-edges whilst the longer arm has a poise weight moving over a graduated scale to indicate the weight of the load, and includes an instrument where it is part of a platform machine, weighbridge or other similar weighing instrument,

"wall beam" means an unequal-arm multi-lever weighing instrument which is designed to be fixed to a wall, has a load-hook suspended from knife-edges on the lower lever, and has poise weights moving over graduated scales to indicate the weight of the load,

"weighbridge" means a weighing instrument for weighing a load carried by a vehicle where the load and vehicle are supported on rails or a platform either of which is linked to a system of levers or load-cells, and includes any similar instrument prescribed as a weighbridge by (the Minister by notice in ...).

4.2. Permitted weighing instruments

A weighing instrument for use in accordance with the Act shall be:

- (a) an oscillating equal-arm beam scale, either suspended without arrestment device or otherwise supported with or without arrestment device, or
- (b) a counter machine of Roberval or Beranger pattern designed for equal load on each load receptor, but not a counter machine with sliding or tare weights nor a machine with unstable position of equilibrium, or

- (c) a steel-yard or wall beam of a capacity exceeding 50 kg but not exceeding 1000 kg, for use only for weighing animals or bulk agricultural products, or
- (d) if individually approved by the (Head of the Legal Metrology Service) for a particular use, a spring balance or a crane machine, or
- (e) one of the following if it complies with the specifications of the competent official authority in the country of manufacture:
 - a platform machine,
 - a weighbridge,
 - a precision balance,
 - a self-indicating weighing instrument (including a price computing and/or printing electronic weighing machine), an automatic weighing machine,
- (f) if not used for trade indelibly and clearly marked NOT FOR TRADE USE.

4.3. General requirements for weighing instruments A weighing instrument shall:

- (a) be properly constructed,
- (b) not be of or have any part of a material, mode of construction, nature or condition likely to make it unsuitable for use,
- (c) not have unusual or novel features unless the (Head of the Legal Metrology Service) has confirmed that it is likely to be admitted for verification,
- (d) be complete in itself,
- (e) be sufficiently strong to withstand the wear and tear of normal use,
- (f) be clean,
- (f) not bear a manufacturer's or other mark which might be mistaken for a verification stamp,
- (h) not have interchangeable or reversible parts, unless interchange or reversal of the parts, as the case may be, does not affect its accuracy,
- (i) not have removable parts if removal of the parts affects its accuracy, unless it is impossible to use the instrument for weighing without the removable parts,
- (j) not have a broken part (including a scoop, pan or plate) if that part is essential for its use,
- (k) not have a load receptor of a size or shape which may cause incorrect weighing by fouling the housing of the instrument, or because contact between the knife edge and the bearings is disturbed,

- (l) not have a load receptor which is readily absorbent because of imperfect glazing, or extensive cracks or chips,
- (m) have any friction plate, friction stay, friction hook or friction loop made of hardened steel or an approved material,
- (n) not have bearings or knife-edges which in the opinion of the Inspector:
 - are loose,
 - not properly aligned,
 - worn out, or
 - otherwise defective for proper operation of the instrument.

4.4. Marking of capacity

The capacity of a weighing instrument, expressed as "Maximum Load" or "Max" shall be clearly and conspicuously, so that it is readily visible when the instrument is in normal use:

- (a) stamped on the beam or on a metal plate permanently secured to an essential part of the instrument, or
- (b) cast in the framework of the instrument, or
- (c) in the case of a self-indicating weighing instrument or an electronic balance, permanently marked on the chart or display of the instrument.

4.5. Graduations

(1) The graduations on a weighing instrument shall:

- (a) be distinct and clearly legible to the operator and the customer,
- (b) be uniformly spaced, and
- (c) be expressed in permitted units of mass corresponding to the figures 1, 2 or 5 divided or multiplied by 10 as appropriate,
- (d) for self-indicating weighing machines have scale intervals not greater than the limit of error on initial verification stated in Tables 2 and 3 provided that greater scale intervals are permitted for weighing machines used for animal weighing and weighing of bulk agricultural products on condition that the total number of scale intervals of the machine is no less than 500.

(2) The graduations on a steelyard shall be:

- (a) notches or incised or embossed lines, and
- (b) in one plane at right angles to the beam and parallel to each other, and the poise weight must show clearly which graduation it marks.

4.6. Balance

(1) Balance shall be indicated on a weighing instrument as follows:

<u>Type of weighing instrument</u>	<u>Indication of balance</u>
(a) Oscillating	Beam returns to position of equilibrium when disturbed from it.
(b) Self-indicating by pointer or with graduated indicating plate, or with difference chart	Pointer or plate comes to rest at the position of equilibrium or zero scale mark, the bubble of any spirit level being in its correct position.
(c) Counter machine of Beranger pattern	Two pointers, each attached to a subsidiary beam, coming to rest directly opposite each other.
(d) Indicating by digital display or printed statement	The figure zero (0) being indicated or printed at no load.

(2) Any balance box or balance screw or gravity ball on a weighing instrument shall be adjustable only by the use of a mechanical appliance.

4.7. Installation and use

(1) No person shall use a weighing instrument which is:

- (a) erected on a loose, weak or unstable base,
- (b) not leveled as its construction requires,
- (c) exposed to wind or draught which effects the indication.

(2) No person shall use a weighing instrument for a load greater than its capacity.

(3) No person shall use a weighing instrument for retail trade in the presence of a purchaser unless it is constructed and sited so that the weighing of the goods and the indicated weight are simultaneously clearly visible to the purchaser.

(4) No person shall use a platform machine or weighbridge unless its platform or rails support the load completely.

4.8. Verification

- (1) At verification of a new or repaired weighing instrument an Inspector shall:
 - (a) visually inspect all parts of the instrument including those which may be dismantled and reassembled without, changing the correct operation of the instrument,
 - (b) check whether it conforms to Regulations 4.2 to 4.7,
 - (c) carry out the applicable tests in Regulations 4.9 to 4.10,
 - (d) carry out other tests which he considers necessary in relation to the intended use of the instrument.
- (2) At in-service inspection (supervision) of a weighing instrument the Inspector shall carry out the applicable parts of inspection and testing under Section (1) and Shall in addition visually inspect any stamps and seals on the instrument and/or the verification certificate as appropriate.
- (3) The Inspector shall verify a weighing instrument at the site of its intended use.

Provided that the user shall present a portable instrument for verification at such place and at such time as may be fixed by an Inspector.
- (4) The Inspector shall test the limit of error of a weighing instrument with working standard weights calibrated to national standard weights within errors of less than one-third of the limit of error for that instrument.
- (5) If a weighing instrument does not conform to Regulations 4.2 to 4.7 or pass the applicable tests in Regulations 4.9 and 4.10 an Inspector shall not pass it as correct at verification.
- (6) Subject to section (1), where an Inspector passes a weighing instrument as correct at verification, he shall stamp it either:
 - (a) on, or
 - (b) on a lead plug inserted in

a conspicuous and easily accessible part of the instrument, so as not to damage the instrument.
- (7) If an instrument can be opened for adjustment, the Inspector shall also affix a seal to prevent access without breaking the seal.

4.9. General tests at verification

The Inspector shall carry out the following tests on each weighing instrument at verification.

(1) Discrimination

- (a) When a weighing machine not equipped with digital indication is at rest and in balance and a load equal to half the limit of error specified in section (6), is applied without shock to the load receptor, both at no load and at full load, the machine shall show a clearly visible change of indication,
- (b) When a weighing machine with digital indication is at rest both at no load and at full load its indication shall change when an extra load of not more than one and a half scale intervals is applied without shock to the load receptor.

(2) Sensitivity

A non-self-indicating weighing instrument Shall have a sensitivity such that, for any load, a change of load equal to the limit of error specified in section (6) corresponds to a permanent displacement of the index of at least:

- 2 mm for weighing instruments other than mechanical platform machines and weighbridges
- 5 mm for platform machines and weighbridges.

(3) Repetition of indication

When the same load is weighed 3 or more times, the difference between the indication of any two weighings shall not exceed the absolute value of the limit of error specified in section (6).

(4) Position of load

When a load of one-third of the capacity of the instrument is displaced from the centre of the load receptor to a position off-centre, the indicated weight shall remain within the limit of error specified in section (6).

(5) Interchangeability

When, for a balanced equal-armed weighing instrument, the load and working standard weights are interchanged on the load receptors, the indicated weight shall not change by more than twice the absolute value of the limit of error specified in section (6).

(6) Limit of error

(a) Initial verification

The error of a new or repaired weighing instrument shall, at any load, not exceed the limit of error specified in Tables 2 and 3 or, for a self-indicating or an automatic weighing machine, 1 scale interval whichever value is the smaller provided that

- for a self-indicating weighing machine used for general trade, or an automatic weighing machine, having a capacity of more than 2000 scale intervals the limit of error at initial verification shall be increased to 2 scale intervals for loads exceeding 2000 scale intervals, and that

- for a self-indicating weighing machine used for trade with valuable goods having a capacity of more than 20000 scale intervals the limit of error at initial verification shall be increased to 2 scale intervals for loads exceeding 20000 scale intervals.

The scale interval referred to in this regulation is the one marked on the chart, display or identification label and if not so marked the smallest value of the scale division or any other value decided by (the Head of the Metrology Service).

(b) In-service

It shall be permitted to use for trade a weighing instrument which in service has errors not exceeding the double of the limit of error at initial verification defined in (a) or, for self-indicating machines, 3 scale intervals whichever value is the smaller.

(c) Test loads

Except where otherwise provided in Regulation 4.10, tests are carried out for all weighing instruments at the following loads

- zero load
- half load
- maximum load, including if applicable maximum additive tare
- loads at which the method of balancing is modified by addition or subtraction of a unit weight.

Self-indicating weighing machines are in addition tested at

- capacity of self-indication if different from maximum load
- loads at which the limit of error defined in (a) changes
- at as many loads as the Inspector may consider desirable in view of the particular construction.

4.10. Tests on platform machines and weighbridges

- (1) The Inspector shall carry out the following tests on a platform machine or weighbridge at verification.

(a) Linearity

The upper surface or edge of the steelyard must be in one plane from the zero scale mark to the nose end,

(b) Removable parts

The instrument must not have readily removable parts (except any counterbalance supporting counterpoise weights),

(c) Stops

The instrument must have stops to prevent any poise weight from moving past the zero scale mark,

(d) Load rail

Any load rail must be not less than 10 mm from other rails and if two load rails overlap or have a bridging piece, there must be not less than 5 mm gap between overlapping or bridging parts,

(e) Travel of steelyard

The travel of the pointer of the steelyard each way from the horizontal position must not be less than 10 mm,

(f) Position of load

Tests for position of load are made in accordance with Regulation 4.9 (4).

Provided that weighbridges may be tested using a vehicle with a total load not exceeding 80 per cent of the sum of the maximum capacity and maximum tare which is successively immobilized at different points of the load receptor,

(g) Limit of error

Tests for discrimination, sensitivity and limit of error are carried out according to Regulation 4.9 provided that procedures and means for applying high test loads are established by the (Head of the Legal Metrology Service) according to the pattern of construction of the weighbridge and available test equipment.

(2) The Inspector shall check that a weighbridge has:

(a) Drainage

Adequate drainage with no accumulation of water, mud or debris in the pit,

(b) Approaches

Smooth, straight and horizontal approaches for a distance of at least half the length of the platform at each end of the weighbridge,

(c) Clear view

The building with the dial or steelyard so constructed that the operator has an unobstructed view of the whole platform,

(d) Platform protection

The platform so protected that vehicles can only go onto it or leave it at the ends,

(e) Foundations

Adequate foundations to support it at maximum load without movement,

(f) Counterpoise weight

If not fitted with a tare-beam, a counterpoise weight (of distinctive shape from other counterpoise weights for the instrument) which accurately compensates for the weight of any loose receptor or frame used with the instrument and which has the words "TARE WEIGHT" legibly and conspicuously stamped on its edge.

5 - MEASURES OF LENGTH

Comments

For general use in trade, length measures should in most cases correspond to accuracy class II of OIML Recommendation R 35.

The in-service errors listed in Table 4 have been established accordingly by increasing the maximum permissible errors for initial verification stated in R 35 so as to allow for temperature deviations of maximum ± 10 °C from the reference temperature (usually + 20 °C) for which the length measures are manufactured. (The supposed coefficient of thermal expansion used for calculating this allowance was 16.10^{-6} K⁻¹).

It has been felt that calipers when Used in trade of materials such as rods and sheets should also be included in the regulations although the exact measurement of thickness will sometimes depend on the measurement pressure (soft materials) and also vary considerably from one point of measurement to another.

Length measures are generally only stamped on initial verification at the manufacturer and withdrawn from use or destroyed if found to be out of the limits of error when in-use.

Regulations

5.1. Measures of length

- (1) A measure of length (other than calipers) for use for trade shall:
 - (a) Material
be made of brass, hardened steel, hardwood, woven tape or an approved material,
 - (b) Protection
be protected against corrosion,
 - (c) If it is a measure made of wood have both ends capped with metal,
 - (d) Subdivision
be subdivided only in all or any of metres, centimetres or millimetres, and
 - (e) have all marks and inscriptions so arranged as not to interfere with the reading of lengths,
 - (f) Limit of error
have, when tested in accordance with section (2), no error greater than the limit of error for its denomination or any intermediate value of graduation specified in Table 4.
- (2) The Inspector shall test a measure of length on verification:
 - (a) against a standard measure of length having errors not exceeding one third of the limits specified in Table 4,

- (b) at a temperature of not less than + 10 °C, but not exceeding 30 °C,
- (c) in the case of a tape measure, while it is supported horizontally over its complete length, and is subjected to the tensile force indicated on that measure or if not indicated 50 newton in the case of t. metal measure, or 10 newton in the case of a measure not made of metal.

(3) If a measure of length (other than calipers) does not conform to section (1) or pass the tests in section (2) an Inspector shall not pass it as correct at verification.

5.2. Calipers

(1) A caliper measure for the measurement of thickness or diameter shall:

(a) Material

be made of steel, steel alloy or an approved material,

(b) Play

have no more play than needed for easy movement,

(c) Limit of error

except in the case of timber calipers, have no error greater than

0.2 mm for calipers for measuring less than 200 mm, or

0.5 mm for calipers for measuring 200 mm or greater but not

more than 500 mm,

for timber calipers have no error greater than 1 mm.

(2) Calipers other than used for trade are not subject to verification except on request.

6 - MEASURES OF VOLUME OF LIQUIDS

Regulations

6.1. A measure of volume of liquids for use for trade shall: Denomination

- (a) subject to regulation 6.5 be of a denomination specified in Table 5 and have that denomination indelibly marked on the outside of such measure in legible figures or letters,
- (b) when provided with subdivisions have any intervals of subdivisions only corresponding to the figures 1, 2 or 5 divided or multiplied by 10 as appropriate.

Material

- (c) be made of glass, aluminium, brass, bronze, copper, nickel, sheet iron, silver, steel (including stainless steel), tin plate, white metal or an approved material; provided that for protection it may be anodised, electro-plated, enamelled, galvanised, tinned or otherwise protected by an approved process,
- (d) if made of brass, bronze or copper, unless otherwise coated, have the inside surface well tinned with pure tin,
- (e) if coated, have no signs of peeling,
- (f) be made of hard and sufficiently thick material. Form
- (g) not visibly deform during filling, (h) not be seriously damaged or deformed,
- (i) have no strengthening rib or ring which might be mistaken for a scale mark,
- (j) have no false bottom,
- (k) if made of metal, not have a bottom rim deeper than necessary to protect the bottom of the measure,
- (l) have no lip or retaining edge which increases its capacity by more than 10 per cent.

Draining

- (m) if it has no tap, drain completely when tilted to an angle of 30° below the horizontal,
- (n) if it has a tap, drain completely without a prolonged dribble when the tap is open and the measure is leveled.

Marking of capacity

- (o) have its capacity marked on the upper part of its body or on a metal plate permanently secured to that upper part,
- (p) if it is made of glass and has the capacity defined by a line, have the capacity indelibly marked near that line,
- (q) have its capacity clearly defined in terms of regulation 6.2, (r) if it is a graduated glass measure, conform to regulation 6.3. of_error
- (s) have no error greater in excess or deficiency than the limit of error for its denomination or for the graduation concerned as specified in Table 5.

6.2. The capacity of a measure of volume (other than a graduated glass measure) shall be clearly defined as follows:

Type of measure	Definition of capacity
(a) with lip or retaining edge	Bottom of lip or retaining edge
(b) in form of milk can	Bottom of neck of Can
(c) glass measure not graduated	Brim of measure, or indelible line (to mark the bottom of the meniscus of the liquid)
(d) any other type not graduated	Brim of measure.

6.3. A graduated glass measure shall:

- (a) be conical or cylindrical,
- (b) have a level base at right angles to the axis of the measure, and
- (c) have scale marks which are:
 - parallel to the base of the measure,
 - not less than 1.5 mm apart, and
 - in the case of back scale marks, on the same horizontal plane as the front scale marks
When the base of the measure is horizontal.

6.4. An Inspector shall test a measure of volume other than a laboratory measure made of glass:

- (a) by filling it to its capacity with the liquid for which the measure is used, or, except when that liquid is oil or is of high viscosity, with water, and
- (b) by emptying those contents into a standard test measure having limits of error not exceeding one fourth of those specified in Table 5 and by allowing a drainage time of 30 seconds.

6.5. If it is used in a laboratory, and conforms in shape, marking, denomination and limits of error to international standards, a measure made of glass or having a denomination below 50 mL shall not be subject to verification or stamping.

6.6. If a measure of volume does not conform to this Regulation, an Inspector shall not pass it as correct at verification.

6.7. When an Inspector passes a measure of volume as correct at verification, he shall stamp it:

- (a) at the bottom of the inside of any lip or retaining edge of a metal measure, or
- (b) in any other case near the marking of capacity.

7 - FUEL DISPENSING INSTRUMENTS

Regulations

In this regulation:

"bulk meter" includes a vehicle tank meter and means a measuring instrument designed to measure fuel for individual deliveries of 500 litres or more whether or not individual deliveries of less than 500 litres may also be made with the same instruments,

"fuel" means liquid fuel, lubricants or any mixture of liquid fuel and lubricants,

"petrol pump" means a measuring instrument for fuel which:

- (a) has a meter or one or more measuring chambers, and
- (b) is designed to measure individual deliveries of 500 L or less (even if the instrument can also make individual deliveries of more than 500 L),

"price indicator" means an indicator showing the value in money of fuel delivered,

"vehicle tank meter" means a bulk meter installed on a vehicle,

"volume indicator" means an indicator showing the volume of fuel delivered.

7.1. Petrol pumps

(1) A petrol pump shall be of a pattern approved by (the Head of the Legal Metrology Service) and

- (a) be constructed to deliver fuel at only one outlet,
- (b) have a clear and legible volume indicator,
- (c) have no counter or totalizing device which might be confused with the volume indicator,
- (d) have no leakage,
- (e) have any delivery hose 5 m or less in length, unless:
 - the pump has a delivery hose longer than 5 m to refuel ships or aircraft, or
 - the Head of the Legal Metrology Service has given written permission for a delivery hose longer than 5 m.

The length of a delivery hose:

- includes the length of the nozzle, but
- excludes the length of any swing or radial arm, and
- in the case of a retractable delivery hose, is measured when fully extended and from where it emerges from its housing.

- (f) if it is of fixed type:
 - be securely mounted on a solidly constructed level base,
 - be sited so that a purchaser has an unobstructed view of the volume indicator, and of any price indicator,
 - be sited so that the adjusting mechanism and the plug and seal for the verification stamp are readily accessible.
 - (g) if used to measure lubricating oil, have its delivery hose permanently filled to the nozzle,
 - (h) have any price indicator fitted with a device which clearly indicates the price per litre and regulates the registration on the indicator,
 - (i) have the maker's name marked on the instrument.
- (2) A petrol pump equipped with a meter shall:
- (a) not deliver fuel unless the volume indicator and any price indicator have been reset to zero,
 - (b) have an air separator and a cut-off valve which ensures nonregistration if the supply of fuel stops, and
 - (c) have a delivery hose permanently filled to the nozzle.
- (3) A petrol pump which has one or more measuring chambers shall:
- (a) except when fitted with valves for automatic filling and emptying the chambers, have visual indication that a chamber is full or is empty,
 - (b) have the delivery hose so positioned as to allow complete discharge of the liquid measured from the delivery outlet of the pump,
 - (c) and if it has more than one measuring chamber:
 - have a valve to prevent the liquid flowing from one chamber into another, and
 - have each chamber denominated.
- (4) A petrol pump, when new or in service, shall have no error greater than ± 0.5 % of the volume purported to be delivered or 50 mL whichever value is greater. ^(*)

^(*)Note: The maximum permissible error according to OIML R 57 "Measuring assemblies for liquids other than water fitted with volume meters" is for minimum deliveries of 2 L and more not lower than 1% of the minimum delivery defined at pattern approval of the assembly.

The minimum absolute error that can be obtained in a measuring assembly of the full hose type depends on the dilation of the flexible hose. Thus some meters with 0.01 L scale intervals may due to this restriction have minimum deliveries of either 2 L or 5 L depending on the hose with which it is assembled. The corresponding minimum values of error limits are then 20 mL or 50 mL.

(5) An Inspector shall test a petrol pump:

- (a) if it has a measuring chamber, after passing 5 L or more of fuel through the delivery hose,
- (b) using standard test measures having limits of error not exceeding 0.1 %,
- (c) by delivering the fuel into the test measures in such number and volumes of deliveries as he thinks necessary,
- (d) if it has a meter, in addition to other tests, by a slow test at a rate of delivery not greater than 10 L per minute,
- (e) to ensure that the pump works correctly whether the fuel is delivered rapidly or slowly,
- (f) to ensure that when a delivery has been completed, no further operation can take place until the indicator for quantity has been reset to zero,
- (g) to ensure that over a number of deliveries, the indications on the price indicator correspond with the indications on the volume indicator and with the price per litre,
- (h) to ensure that, if it has nozzle control valve, no fuel is delivered when that valve is open and the pump is not operating,
- (i) to ensure that if it has 2 volume indicators or 2 price indicators, both agree after a delivery.

To avoid this difficulty we have suggested to use the minimum error limit for in-service verification of 50 mL (though 20 mL would be appropriate for meters of the empty hose type such as used for lubricants or for light motor-cycle fuelling). See Fig.2.

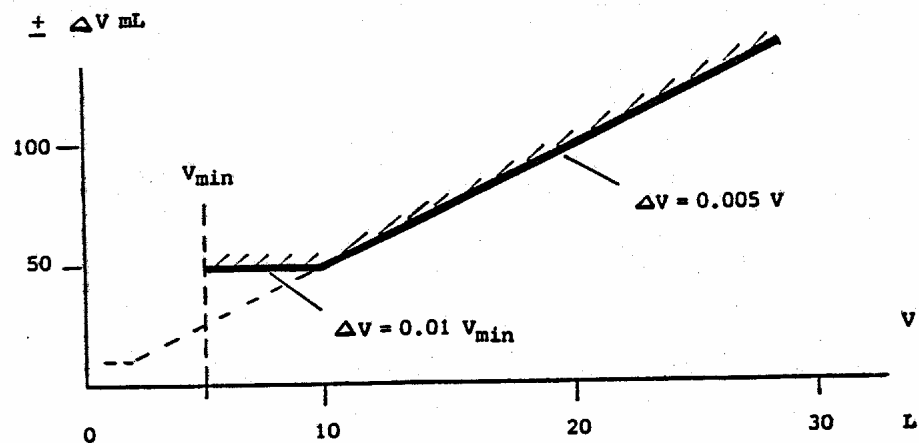


Fig. 2 — Limits of error for a petrol pump installation with a minimum delivery of 5 L

- (6) If a petrol pump does not conform to this Regulation, an Inspector shall not pass it as correct at verification.
- (7) Where an Inspector passes a petrol pump as correct at verification, he shall stamp it on a lead plug inserted in a conspicuous and easily accessible part of the pump and shall affix a seal to prevent access without breaking the seal to the adjusting device (provided that such seal may be broken by an authorized repair service on condition of immediately notifying the Head of the Legal Metrology Service).

7.2. Bulk meters

- (1) A bulk meter, including a vehicle tank meter, shall be of a pattern approved by the (Head of the Legal Metrology Service) and:
- (a) have devices which:
 - prevent air from passing through the meter to such an extent as to affect the accuracy of delivery, and
 - ensure that no registration takes place when the supply of fuel fails,
 - (b) have no leakage,
 - (c) have figures on any indicator which are indelible, clear and legible,
 - (d) have the maker's name marked on the instrument,
 - (e) have the maximum and minimum rates of flow in litres or cubic meters per minute clearly marked,
 - (f) have primary indicating or recording elements which can advance only by the flow of the liquid through the meter, provided that the meter reading may be cleared by an advance movement which cannot be stopped before zero is reached,
 - (g) when a pre-set mechanism is incorporated, automatically stop delivery registration and flow when the pre-set volume has been delivered.
- (2) A bulk meter shall be tested:
- (a) after any dry hose has been flushed and the instrument reset to zero,
 - (b) using standard test measures or a calibrated master meter or a proving loop, any of which having limits of error not exceeding 0.15 %,
 - (c) by passing the liquid intended to be normally used through the meter into standard test measures in as many deliveries and of such volumes as the Inspector considers necessary or by comparison of the indication of the meter under test with the indication of a calibrated master meter or proving loop/ and
 - (d) with varying heads of liquid or with varying bore by manipulation of the delivery valve as far as is practicable.

- (3) The limit of error allowed on a bulk meter, when new or in service, is ± 0.5 % of the quantity tested, or 2 L whichever is greater.
- (4) The verification stamp shall be stamped upon a lead plug inserted in a conspicuous and easily accessible part of the meter. Seals shall be affixed to prevent access to the working parts or adjusting device without the seals being broken. ^(*)

7.3. Delivery from vehicle tanks

- (1) Except where permitted in accordance with section (2) no person shall sell or in a commercial transaction deliver fuel in bulk from a mobile tanker except through a petrol pump, or through a bulk meter.
- (2) Vehicle tanks or compartments of vehicle tanks are permitted for trade of fuel provided that
 - (a) they have been approved, verified and stamped by the Legal Metrology Service within errors not exceeding $\pm 0.5\%$ of the entire content of each tank compartment,
 - (b) they are used for one individual delivery of the entire content of one or more compartments,
 - (c) they are so positioned during delivery as to assume complete emptying of the compartments.

^(*)Note: Experience seems to show that vehicle tank meters should be subject to verification by the Legal Metrology Service after any repair and thus not allowed to be used at all with broken protective seals.

TABLE 1 –

PROPOSED LIMITS OF ERROR FOR WEIGHTS USED FOR TRADE

Denomination (as marked)	Limit of error (at stamping)	
	Weights for general trade	Weights for trade with value goods
10 mg		± 0.5 mg
20	-	0.5
50	-	0.5
100	-	0.5
200	-	1
500	-	1
1 g	± 10 mg	1.0
2	12	1.2
5	15	1.5
10	20	2
20	25	2.5
50	30	3
100	50	5
200	100	10
500	250	25
1 kg	500	25
2	1 000	100
5	2 500	250
10	5 000	500
20	10 000	1 000

IN-SERVICE CONTROLS

It is suggested to permit the use of weights for trade, which have been duly stamped at initial verification, as long as the errors during subsequent controls do not exceed the double of the limits of error indicated in the table above.

In case of periodic subsequent verification it is not advised to prescribe renewal of the stamping of a weight unless the in-service errors are exceeded and the weight requires readjustment. The limits of error after such readjustment are identical to those for new weights.

Precision weights used for trade with valuable goods and which have a denomination of 100 g or less shall preferably not be stamped by the national legal metrology service otherwise than on a compulsory identification plate on top of the storage box.

TABLE 2 - PROPOSED LIMITS OF ERROR FOR ON-SITE VERIFICATION OF WEIGHING

**MACHINES USED FOR GENERAL TRADE
NON-SELF-INDICATING WEIGHING MACHINES**

equal to or greater than	Maximum capacity and	lower than	Limit of error
100 g		500 g	± 0.5 g
500		1 kg	1
1 kg		2.5	2
2.5		10	5
10		20	10
20		50	20
50		100	50
100		200	100
200		500	200
500		1 000	500
1 000		2 000	1 kg
2 000		5 000	2
5 000		10 000	5
10 000		20 000	10
20 000		50 000	20
50 000		100 000	50

SELF-INDICATING WEIGHING MACHINES

The scale interval *d* shall generally not be greater than the limits of error indicated in the table above within a view of ensuring sufficient accuracy at low loads (low Min-value). The minimum number of scale intervals for capacities of 5 kg and more shall thus be at least 1 000. For some applications such as use in slaughter-houses and weighing of bulk agricultural products machines with only 500 scale intervals shall however be permitted.

For reasons of simplification it is proposed to accept for on-site verification a limit of error of 1 scale interval except for loads exceeding 2 000 scale intervals where the limit of error at verification is increased to 2 scale intervals.

IN-SERVICE CONTROLS

During controls of machines in service when seals have not been broken the errors shall not exceed the double of the limits of error, however not be more than 3 scale intervals for self-indicating machines at loads exceeding 2 000 scale intervals.

TABLE 3 - PROPOSED LIMITS OF ERROR FOR ON-SITE VERIFICATION OF WEIGHING INSTRUMENTS FOR VALUABLE GOODS (precious metals, pharmaceutical products etc.)

NON-SELF-INDICATING INSTRUMENTS

Maximum capacity			Limit of error
equal to or greater than	and	lower than	
2 g		50 g	± 2 mg
50		100	5
100		200	10
200		500	20
500		1 kg	50
1 kg		2.5	100
2.5		10	200
10		20	500
20		100 (included)	1000

SELF-INDICATING INSTRUMENTS

The scale interval d shall not be greater than the limit of error indicated in the table above for the respective weighing capacity.

For reasons of simplification it is proposed to accept for on-site verification a limit of error of 1 scale interval except for loads exceeding 20 000 scale intervals where the limit of error at verification is increased to 2 scale intervals.

IN-SERVICE CONTROLS

During control of instruments in use when seals have not been broken the errors shall not exceed the double of the limits of error, however not be more than 3 scale intervals for self-indicating instruments at loads exceeding 20 000 scale intervals.

TABLE 4 - MEASURES OF LENGTH

Denomination or value of graduation	Limit of error	
	End measurement	Line measurement
0.5 m	± 1 mm	± 0.5 mm
1 m	1 mm	0.7 mm
1.5 m	2 mm	1 mm
2 m	2 mm	1 mm
3 m	2 mm	2 mm
4 m	-	2 mm
5 m	-	2 mm
10 m	-	4 mm
15 m	-	6 mm
20 m	-	8 mm
25 m	-	10 mm
30 m	-	11 mm
50 m	-	18 mm
60 m	-	22 mm
100 m	-	36 mm

TABLE 5 - MEASURES OF VOLUME OF LIQUIDS

Capacity of measure or value of graduation	Limit of error
50 mL	± 2 mL
100 mL	3 mL
200 mL	5 mL
250 mL	5 mL
500 mL	10 mL
1 L	10 mL
2 L	20 mL
5 L	50 mL
10 L	50 mL
20 L or more	0.5 per cent