

INTERNATIONAL  
RECOMMENDATION

**OIML R 35-1**

Edition 2007 (E)

**Including Amendment 2014**

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Material measures of length for general use  
Part 1: Metrological and technical requirements

Mesures matérialisées de longueur pour usages généraux  
Partie 1: Exigences métrologiques et techniques

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**Amendment 2014 to  
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Amendment 2014 to OIML R 35-1 Edition 2007 (E)



ORGANISATION INTERNATIONALE  
DE MÉTROLOGIE LÉGALE

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INTERNATIONAL ORGANIZATION  
OF LEGAL METROLOGY

**Amendment (2014) to OIML R 35-1 Edition 2007**  
*Material measures of length for general use.*  
*Part 1: Metrological and technical requirements*

**Section II, Metrological requirements, 4.4.1 Temperature, is amended to read:**

The temperature limits shall be the reference temperature  $\pm 8$  °C or the temperature indicated on the measure  $\pm 8$  °C. The temperature limits of  $\pm 8$  °C shall be disregarded if there is a thermal expansion coefficient marked on the measure or if the measure carries temperature correction information. In this way, for each measurement taken, the change of length at the working temperature can be calculated and confirmed.

**Section III, Technical requirements, 6.2:**

The words “.....plus all other errors.....” should be deleted for the above reasons and because it would contradict 4.4.1.

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Material measures of length for general use.  
Part 1: Metrological and technical requirements

Mesures matérialisées de longueur pour usages généraux.  
Partie 1: Exigences métrologiques et techniques

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## Foreword

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This publication - reference OIML R 35-1, Edition 2007 (E) - was developed by the OIML Technical Subcommittee TC 7 *Measuring instruments for length and associated quantities*. It was approved for final publication by the International Committee of Legal Metrology in 2007 and will be submitted to the International Conference of Legal Metrology in 2008 for formal sanction.

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# Material measures of length for general use

## SECTION I – GENERAL

### 1 Scope

1.1 This Recommendation applies to material measures of length for general use, hereinafter called “measures”.

1.2 This Recommendation specifies the technical, metrological and administrative conditions which are mandatory for these measures.

1.3 This Recommendation includes the requirements for digital readouts on the cases of tapes, whether electronic or mechanical.

1.4 This Recommendation does not apply to high-precision measures used by industry in the field of mechanics or in geodesy (for example: gauge blocks, geodetic wires, precision line measures).

1.5 This Recommendation does not address safety aspects, for example the use of material measures with electronic devices in hazardous areas. Guidelines for these aspects should be followed in accordance with the applicable international, regional or national regulations, which are often detailed in standards.

### 2 Terminology

#### 2.1 Metrological characteristics

##### 2.1.1 Material measure of length

Material measure provided with scale marks, the distances between which are indicated in legal units of length.

##### 2.1.2 Nominal length

Length by which the measure is designated.

##### 2.1.3 Principal scale marks

Two scale marks, the distance between which represents the nominal length of the measure.

##### 2.1.4 Scale

Set of all the scale marks and associated numbering.

##### 2.1.5 Scale interval

Value expressed in units of length of:

- the difference between the values corresponding to two consecutive scale marks, for analog indication; or
- the difference between two consecutive indicated values, for digital indication.



## **2.2 Types of measures**

### **2.2.1 End measure**

Length measure which has the principal scale marks formed by two end surfaces or edges of the measure.

### **2.2.2 Line measure**

Length measure which has the principal scale marks formed by two lines, holes or marks.

### **2.2.3 Composite measure**

Length measure which has one of the principal scale marks formed by an end surface or edge and the other by a line, hole or mark.

### **2.2.4 Supplementary devices**

Devices such as one or more fixed or movable hooks, rings, handles, tips, winding devices, and verniers intended to facilitate and extend the utility of the measure.

### **2.2.5 Indicating device**

Part of the measure which displays the measurement result either continuously or on demand. An electronic indicating device shall comprise of a sensor, transducer, calculator and indicator.

### **2.2.6 Ancillary device**

Device intended to perform a particular function, directly involved in elaborating, transmitting or displaying results.

## **2.3 Influences and reference conditions**

### **2.3.1 Influence quantity**

Quantity that is not the subject of the measurement but which influences the values of the measurand or the indication of the instrument.

### **2.3.2 Influence factor**

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

### **2.3.3 Disturbance**

Influence quantity having a value within the limits specified in this Recommendation, but outside the specified rated operating conditions of the instrument.

### **2.3.4 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.

### **2.3.5 Reference conditions**

Set of specified values of influence factors fixed to ensure valid intercomparison of the results of measurements.

## **3 Unit of measurement**

The unit of length is the metre (symbol m) together with the authorized multiples and sub-multiples.

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## SECTION II – METROLOGICAL REQUIREMENTS

### 4 Accuracy classes and maximum permissible errors

#### 4.1 Accuracy classes

The material measures of length covered by this Recommendation belong to one of three accuracy classes, designated by the numbers I, II, and III, according to their accuracy.

#### 4.2 Maximum permissible error on initial verification, under rated operating conditions

4.2.1 The maximum permissible error on initial verification, positive or negative,

a) for the nominal length, and

b) for any other distance between any two non-consecutive scale marks,

is expressed by the formula:

$$(a + b L) \text{ mm,}$$

where:  $L$  is the value of the length in question, rounded up to the nearest whole number of metres,

$a$  and  $b$  are coefficients the values of which are given, for each accuracy class, in Table 1.

Table 1 – Accuracy classes

| Accuracy class | $a$ | $b$ |
|----------------|-----|-----|
| I              | 0.1 | 0.1 |
| II             | 0.3 | 0.2 |
| III            | 0.6 | 0.4 |

4.2.2 The maximum permissible error, positive or negative, for the scale interval,  $i$ , less than or equal to 1 cm, is given for each accuracy class in Table 2.

Table 2 – Maximum permissible errors

| Scale interval, $i$                  | Maximum permissible error<br>for the accuracy class<br>(mm) |     |     |
|--------------------------------------|---|-----|-----|
|                                      | I   | II  | III |
| $i \leq 1 \text{ mm}$                | 0.1   | 0.2 | 0.3 |
| $1 \text{ mm} < i \leq 1 \text{ cm}$ | 0.2   | 0.4 | 0.6 |

For the scale interval greater than 1 cm, the maximum permissible error is expressed as a function of the length of the interval, by the formula:

$$(a + b L) \text{ mm},$$

where the values of the coefficients are equal to the values given in 4.2.1 and  $L$  is the value of the length in question, rounded up to the nearest whole number of metres.

4.2.3 The maximum permissible difference between the lengths,  $i$ , of two consecutive scale intervals, having a value less than or equal to 1 cm, is given for each accuracy class, in Table 3.

Table 3 – Maximum permissible difference

| Scale interval, $i$                  | Maximum permissible difference for the accuracy class (mm) |     |     |
|--------------------------------------|--|-----|-----|
|                                      | I  | II  | III |
| $i \leq 1 \text{ mm}$                | 0.1  | 0.2 | 0.3 |
| $1 \text{ mm} < i \leq 1 \text{ cm}$ | 0.2  | 0.4 | 0.6 |

For the scale interval greater than 1 cm, the maximum permissible difference between the lengths of two consecutive scale intervals is expressed, as a function of the length of the interval, by the formula:

$$(a + b L) \text{ mm},$$

as defined in 4.2.2.

4.2.4 However, for end or composite measures, the maximum permissible error, positive or negative, for the length of the terminal scale interval bounded by an end surface, is increased by:

- 0.1 mm for measures of class I,
- 0.2 mm for measures of class II,
- 0.3 mm for measures of class III.

Moreover, the requirements set out in 4.2.1 and 4.2.3 do not apply:

- when one of the two non-consecutive scale marks, referred to in 4.2.1 b, is formed by an end surface;
- when one of the two consecutive scale intervals, referred to in 4.2.3, is a terminal scale division bounded by an end surface.

### 4.3 Maximum permissible error in service

The maximum permissible error in service, positive or negative, equals twice the maximum permissible error on initial verification given in 4.2.

#### **4.4 Rated operating conditions**

The rated operating conditions for material measures of length shall be as follows:

##### **4.4.1 Temperature**

The temperature limits shall be the reference temperature  $\pm 8$  °C or the temperature indicated on the measure  $\pm 8$  °C.

##### **4.4.2 Humidity**

The manufacturer shall specify whether the instrument is designed for condensing or non-condensing humidity.

##### **4.4.3 Electrical voltage**

###### **4.4.3.1 Batteries**

- Upper limit ( $U_{\text{bmax}}$ ): the voltage of a new or fully charged battery of the specified type;
- Lower limit ( $U_{\text{bmin}}$ ): as specified by the manufacturer.

###### **4.4.3.2 Mains power voltage variations**

- $-15$  % to  $+10$  % of nominal voltage.

#### **4.5 Reference conditions**

Testing shall be performed under the following reference conditions unless otherwise specified by the manufacturer:

- the measure is at the reference temperature:  $20$  °C or the temperature indicated on the measure (see 10.2). Tolerance  $\pm 2$  °C;
- ambient relative humidity range:  $45$  % to  $55$  %;
- power source: the nominal (battery) voltage, or the voltage of a new of fully charged battery according to the manufacturer's specification;
- when the tension is specified, the measure shall be supported on a horizontal surface over the total length under test, practically without friction, and shall be stretched out by the tension indicated on the measure.

### **SECTION III – TECHNICAL REQUIREMENTS**

#### **5 Nominal length**

5.1 The nominal length of the measures shall be an integral multiple of  $0.5$  m up to  $15$  m. Any nominal length between  $15$  m and  $100$  m shall be an integral multiple of  $5$  m, and any nominal length over  $100$  m shall be an integral multiple of  $50$  m.

5.2 Other values may be deemed appropriate for specific applications provided that the specific application is clearly indicated on the measure.

5.3 Land surveying measures shall have nominal lengths of  $5$  m,  $10$  m,  $20$  m,  $50$  m,  $100$  m or  $200$  m, as stipulated in 22.1.

## **6 Materials**

6.1 The measures and their supplementary devices shall be made of materials which, under normal conditions of use, are sufficiently durable, stable, and resistant to environmental influences.

6.2 The properties of the materials used shall be such that:

- the expansion due to a temperature change of  $\pm 8$  °C from the reference temperature or the temperature indicated on the measure plus all other errors shall not exceed the maximum permissible error for the accuracy class to which the measure belongs;
- for measures which have to be used under a specified tension, a variation of  $\pm 10$  % of this tension does not produce a variation in length exceeding the maximum permissible error.

## **7 Construction**

7.1 The measures and their supplementary devices shall be well and robustly constructed, and carefully finished.

7.2 The dimensions and shape of the cross-section of measures shall be such that, under normal conditions of use, measurements can be made with the degree of accuracy required for the accuracy class to which the measures belong.

7.3 Tape measures shall be made in such a way that when the tape is stretched out on a flat surface, its edges are virtually straight and parallel.

7.4 The surfaces forming the two principal scale marks (end surfaces) of end measures shall be flat and perpendicular to the longitudinal axis of the measure.

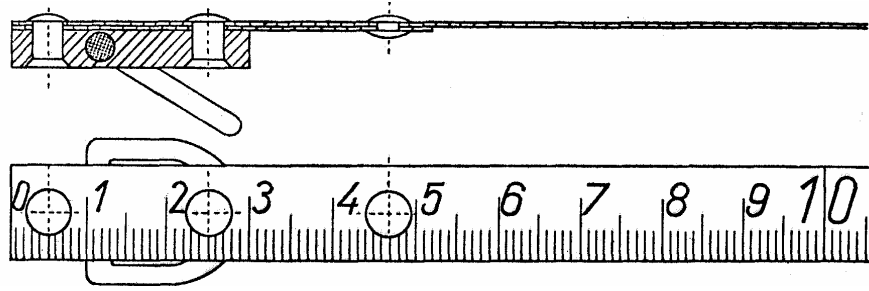
7.5 The end surfaces of an end or composite measure made of wood or other material of durability equal to or less than that of wood shall be provided with a bracket, plate, or end fitting which is resistant to wear and impact damage, and suitably attached to the measure.

7.6 Supplementary devices are permissible, provided they cannot cause confusion; they shall be designed and attached to the measure in such a way that, under normal conditions of use, it is virtually impossible for the measurement uncertainty to increase.

7.7 Winding devices for tape measures shall be made in such a way that they do not cause any permanent deformation of the tape.

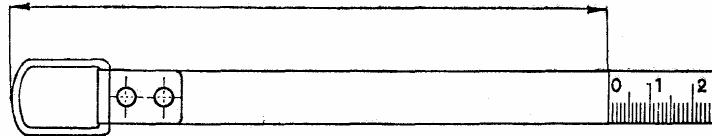
7.8 On certain types of measures, a blank length of the measure, extending beyond the principal scale mark at the end of the measure and long enough for verification purposes, may be provided.

End measure: zero end

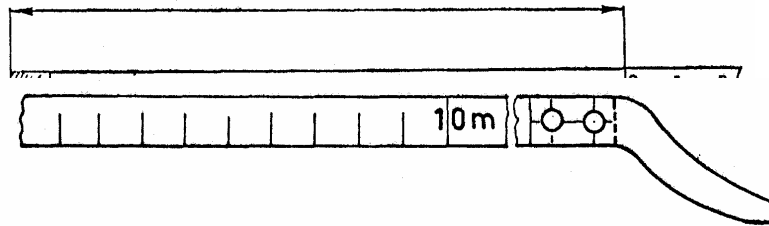


Line measures: zero end

$\geq 20$  mm



$\geq 20$  mm



Nominal length end

Specific examples of scales and numbering

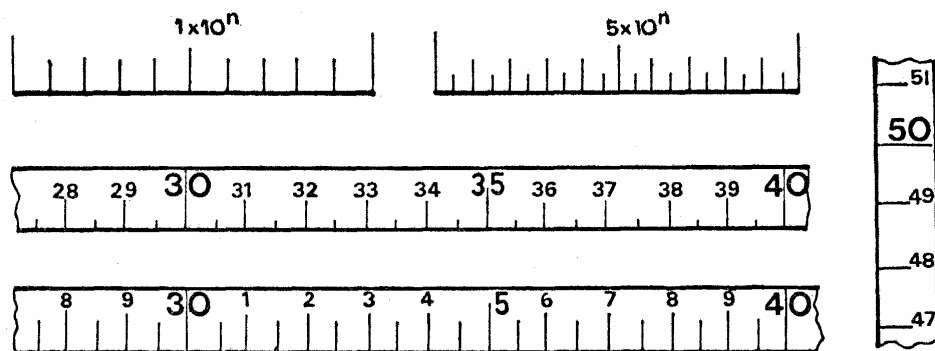


Figure 1 – Examples illustrating certain requirements

## 8 Scale

8.1 The scale marking shall be clear, regular, indelible, and carried out in such a way that reading is definite, easy and unambiguous.

Some non-numbered scale marks, not exceeding the number of scale marks between two consecutive numbered scale marks on the measure, may extend beyond the principal scale mark at the end of the measure.

8.2 The scale interval shall take the form:

$$1 \times 10^n, 2 \times 10^n \text{ or } 5 \times 10^n \text{ metres,}$$

$n$  being a positive or negative whole number or zero.

Furthermore, the scale interval shall not exceed:

- 1 mm for measures with a nominal length of 0.5 m or 1 m, in relation to their accuracy;
- 1 cm for measures with a nominal length not greater than 2 m;
- 10 cm if the nominal length is greater than 2 m and less than 10 m;
- 20 cm if the nominal length is equal to or greater than 10 m and less than 50 m;
- 50 cm if the nominal length is equal to or greater than 50 m.

However, these values may be exceeded for specific applications, provided the specific application is indicated on the measure.

8.3 When the scale marks are lines, these shall be straight, perpendicular to the axis of the measure, and shall all have the same width, which shall be constant throughout their length.

The length of the lines shall be related to the corresponding unit of measurement. The lines shall be such that they form a distinct and clear scale and that their width does not cause any measurement uncertainty.

The maximum permissible width of the lines, in relation to the accuracy class and the scale interval of the measure is given in Table 4.

An arrowhead or other equivalent symbol may be used to distinguish certain important scale marks.

Table 4 – Maximum width of lines

| Scale interval of the measure                       | Maximum width of the lines for the accuracy class |                            |
|---|---|----------------------------|
|   | I   | II and III                 |
| Less than or equal to 2 mm                          | 0.2 mm  | 0.2 mm                     |
| Greater than 2 mm<br>and less than or equal to 2 cm | 0.2 mm  | 10 % of the scale interval |
| Greater than 2 cm                                   | 0.2 mm  | 2 mm                       |

8.4 Certain sections of the scale, particularly towards the ends, may be subdivided into decimal sub-multiples of the scale interval adopted for the measure as a whole.

In that case, the width of the lines may be less in the areas of reduced scale intervals than on the rest of the measure.

8.5 Scale marks may also take the form of holes, if the scale interval is greater than or equal to 1 cm, or other marks, if the scale interval is greater than or equal to one decimetre, provided that these marks ensure sufficiently precise reading, taking into account the accuracy class to which the measure belongs.

8.6 A measure may have more than one scale, for which the scale intervals may be different.

## **9 Numbering**

9.1 Numbering shall be clear, regular, indelible, and carried out in such a way that reading is definite, easy, and unambiguous; the number of numbered scale marks shall be determined accordingly.

9.2 Numbering may be fully sequential, or partially sequential and partially repetitive.

In the case covered by 8.4 above, the numbering in parts with reduced scale intervals may be different from that for the rest of the measure.

9.3 The position, dimensions, shape, color and contrast of the numbers shall be appropriate to the scale and the associated scale marks.

Depending on how the measure is to be read, numbers may be inscribed parallel or perpendicular to the edge of the measure.

9.4 Whatever the scale interval, the numbers shall represent millimetres, centimetres, decimetres, or metres and shall not be accompanied by the corresponding symbols.

If the numbered unit is not the metre, the scale marks corresponding to metres may be numbered in metres, in which case these numbers shall be followed by the symbol “m”; furthermore, the number of preceding metres may be repeated in the same way in front of the other numbered scale marks.

Millimetre scales shall be numbered every centimetre.

When the scale interval of a line measure is in the form of  $2 \times 10^n$  and not less than 2 cm, all scale marks shall be numbered.

9.5 On a measure with several scales, the numbering of these scales may be different and the numbering systems may increase in the same direction or in the opposite direction.

## **10 Inscriptions**

10.1 The following inscriptions are mandatory in all cases:

- nominal length (optional in a rectangle);
- the numeric code, trade mark or trade name of the manufacturer and/or of his representative;
- designation of accuracy class: I, II or III, in an oval.



10.2 The following inscriptions are mandatory in certain cases:

- reference temperature, if other than 20 °C (see 4.4);
- tension, if specified;
- specific use for which the measure is intended, in the cases covered by clauses 5 (nominal length) and 8.2 (scale interval).

10.3 Nominal length, temperature, and tension shall be expressed in one of the units specified in OIML International Document D 2 *Legal units of measurement*, followed by the corresponding legal symbol.

10.4 All of these inscriptions shall be clearly visible and readable, and placed at the beginning of the measure or on the case of the measure if the case and measure are not separable.

10.5 In addition, any other non-metrological inscriptions specified in particular regulations or authorized by competent national authorities may appear on the measure.

10.6 Advertising inscriptions may appear on the measures, provided the requirement of 10.7 is met.

10.7 All inscriptions shall be arranged so that they do not interfere with the reading of the measure.

10.8 Under the sole responsibility of the manufacturer, the thermal expansion coefficient of the material of which the measure is made, may be indicated in the form  $\alpha = \dots/^\circ\text{C}$  or  $\alpha = \dots \text{K}^{-1}$ .

## **11 Indicating devices**

### **11.1 General aspects**

11.1.1 Indicating devices may be used with semi-rigid steel tape measures with readout, telescopic measures and flexible steel tape measures with tensioning weight or sinker equipped with electronic sensing.

11.1.2 The indicating device shall be in addition to the scale marks on the blade. It shall provide an easily read, reliable and unambiguous visual indication of the indicated length throughout the whole length of the measure.

11.1.3 The indicating device shall be able to display the indicated length up to and including the nominal length of the measure.

11.1.4 The indicated length shall be expressed in metres (symbol “m”) or authorized multiples or sub-multiples. The appropriate symbol shall appear immediately adjacent to the indicated length.

11.1.5 The indicated length shall be given by a line of adjacent digits appearing in one or more apertures. The advance of a given digit shall be completed while the digit of the next immediately lower decade changes from 9 to 0.

11.1.6 The length indicated on the display shall agree with the measurement made by the blade to the nearest scale interval of the blade.

11.1.7 There shall be no ambiguity in distinguishing between the length currently being measured and alternative displays.

## **11.2 Electronic indicating devices**

11.2.1 If the power source voltage drops below the manufacturer's specified minimum value, the device either continues to function correctly, indicates an error signal or automatically goes out of service.

11.2.2 On switch-on and optionally on demand, it shall be possible to visually check the correct operation of the entire display. This shall comprise:

- displaying all the elements ("eights" test);
- blanking all the elements ("blank" test);
- displaying "zeros" ("zeros" test).

Each step of the sequence shall last at least 0.5 s.

## **SECTION IV – METROLOGICAL CONTROLS**

### **12 Metrological controls**

When material measures of length are subject to an individual country's metrological controls, these controls may include some or all of the controls below (according to the country's national legislation).

#### **12.1 Type approval**

Each type of measure from each manufacturer is subject to type approval. Documentation to assist type approval examination shall be supplied by the manufacturer or his authorized representative.

No modifications may be made on an approved type without special authorization.

#### **12.2 Initial verification**

New, repaired and readjusted measures shall undergo initial verification tests. Documentation to assist initial verification testing shall be supplied by the manufacturer or his authorized representative.

#### **12.3 Periodic verification**

Periodic verification shall be carried out at fixed intervals on certain types of measures in use, as required by national regulations.

#### **12.4 Uncertainty of measurement**

The uncertainty of measurement should not be added to the error when determining compliance with the maximum permissible error (see 4.2).

### **13 Verification (or control) marks**

Measures shall be constructed so that they can accommodate the verification (or control) marks prescribed by national regulations; a space shall be provided for this purpose near the beginning of the measure.

## **SECTION V – TECHNICAL REQUIREMENTS PARTICULAR TO VARIOUS TYPES OF MEASURES**

In addition to the general requirements covering all material measures of length, special technical requirements which shall be met by certain types of measures are given below.

This applies to two types of measures indicated in the section numbers below. The sections are described more fully later.

### **A – Measures for short lengths**

- 14 Semi-rigid steel tape measures in a case,
- 15 Semi-rigid steel tape measures with digital readout,
- 16 One-piece rigid or semi-rigid measures,
- 17 Flexible tape measures made of fibreglass and plastics or other suitable non-metallic materials, not in a case,
- 18 Folding measures made of metal or other materials,
- 19 Telescopic measures made of metal or other materials,
- 20 Telescopic measures made of metal or other materials with digital readout.

### **B – Measures for long lengths**

- 21 Flexible steel tape measures with winding device not designed for measuring lengths greater than their nominal length by repeated use of the same tape,
- 22 Flexible steel tape measures with tensioning weight or sinker,
- 23 Flexible steel tape measures with tensioning weight or sinker equipped with electronic sensing,
- 24 Flexible steel surveyor's tapes designed for measuring lengths greater than their nominal length by repeated use of the same tape,
- 25 Flexible tape measures made of fibreglass and plastics or other suitable non-metallic materials.

Measures with a nominal length from 5 m to 10 m may be made to conform to the two types, either A (14, 15, 16, 17, 18, 19, 20) or B (21, 22, 23, 24, 25).

*Note:* The drawings on the following pages are given for guidance only. Manufacturers have complete freedom in the manufacture of the measures, provided that they meet the statutory requirements.

## A – MEASURES FOR SHORT LENGTHS

### 14 Semi-rigid steel tape measures in a case

#### 14.1 Nominal length

These measures have nominal lengths between 0.5 m and 15 m; they are of the end, line, or composite type.

#### 14.2 Construction

14.2.1 If the zero end is of a squared end type and is fitted with a ring, this ring may be included in the nominal length of the measure.

14.2.2 The means of fastening a supplementary device to the end of a measure shall be permitted to obscure the scale marks at the beginning of the measure only under the following conditions:

- if the nominal length is less than 5 m, no scale marks may be obscured;
- if the nominal length is between 5 m and 10 m, not more than the first 15 mm may be obscured;
- if the nominal length is greater than 10 m, not more than the first 30 mm may be obscured.

14.2.3 These measures may be contained in a case, one of the dimensions of which may be included in the range of the scale, in particular for measurement of internal dimensions; in this case, the dimension in question shall be indicated on the case and the zero end shall be of the end type and shall be provided with a fixed or sliding hook or tongue.

14.2.4 These measures may include a belt clip or carrying strap. These must not obscure the dimensions marked on the side of the case or interfere with internal measurements (i.e. must not prevent the end of the case touching the object being measured).

14.2.5 The blade lock, if fitted, shall be strong enough to hold the blade at all extensions up to and including fully extended.

14.2.6 The cross-section of the blade shall be cambered (i.e. the blade shall be of curved cross-section).

14.2.7 These tapes do not require a tractive force to be applied.

#### 14.3 Scale

14.3.1 These measures may have two scales with the same point of origin on the same face and may also have a scale on the other face.

14.3.2 The scale interval shall be less than or equal to 1 cm.

#### 14.4 Accuracy classes

These measures shall conform to accuracy class I or II.

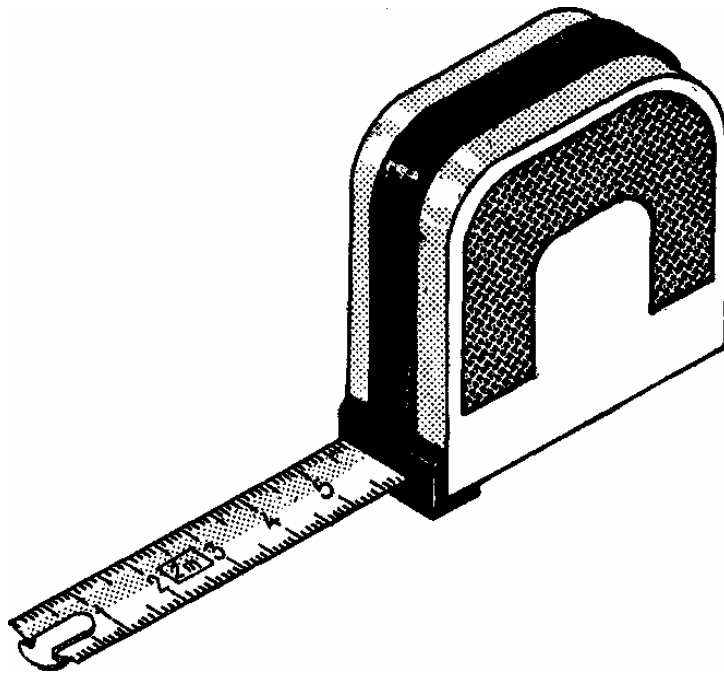


Figure 2 – Semi-rigid steel tape measure in a case

## **15 Semi-rigid steel tape measures with digital readout**

### **15.1 Nominal length**

These measures have nominal lengths between 0.5 m and 15 m; they are of the end, line, or composite type.

### **15.2 Construction**

15.2.1 If the zero end is of a squared end type and is fitted with a ring, this ring may be included in the nominal length of the measure.

15.2.2 These measures shall be contained in a case, one of the dimensions of which may be included in the range of the scale, in particular for measurement of internal dimensions; in this case, the dimension in question shall be indicated on the case and the zero end shall be of the end type and shall be provided with a fixed or sliding hook or tongue.

15.2.3 The blade lock, if fitted, shall be strong enough to hold the blade at all extensions up to and including fully extended.

15.2.4 The cross-section of the blade shall be cambered (i.e. the blade shall be of curved cross-section).

15.2.5 These tapes do not require a tractive force to be applied.

### **15.3 Scale**

15.3.1 These measures may have two scales with the same point of origin on the same face and may also have a scale on the other face. The digital readout should clearly indicate which scale is being used.

15.3.2 The scale interval shall be less than or equal to 1 cm.

### **15.4 Power supply**

15.4.1 If the indicating device is powered, the power source compartment shall form an integral part of the measure.

15.4.2 The manufacturer shall give precise rules for the replacement or recharging of the power source.

15.4.3 The manufacturer shall specify the maximum internal impedance of the power source.

### **15.5 Accuracy classes**

These measures shall conform to accuracy class I or II.

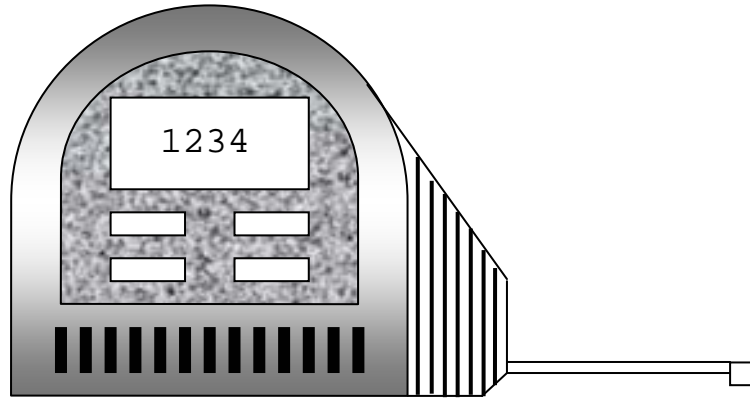


Figure 3 – Semi-rigid steel tape measure in a case with digital readout

## 16 One-piece rigid or semi-rigid measures

*Note:* One-piece rigid or semi-rigid measures include dipsticks or gauge rods used for gauging the level of liquids in tanks used as measuring containers.

### 16.1 Nominal length

These measures have nominal lengths between 0.5 m and 5 m; they are of the end, line, or composite type.

### 16.2 Construction

16.2.1 These measures are made of metal or other suitable materials.

16.2.2 If the zero scale mark of a dipstick is its end, this end shall be provided with an impact and wear resistant heel or tip made of a material not liable to cause sparking on impact.

### 16.3 Scale

These measures may have a scale on each of the two faces.

### 16.4 Accuracy classes

These measures shall conform to accuracy class I or II.

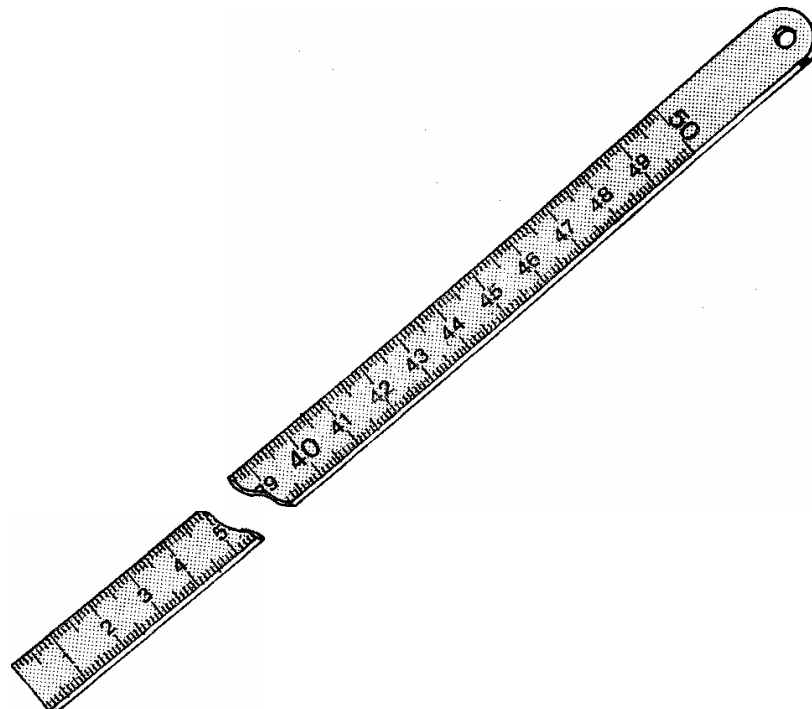


Figure 4 – One-piece rigid or semi-rigid measure



**17 Flexible tape measures made of fibreglass and plastics or other suitable non-metallic materials, not in a case**

**17.1 Nominal length**

These measures have nominal lengths between 0.5 m and 5 m; they are of the end, line, or composite type.

**17.2 Construction**

17.2.1 The free ends of end or composite measures shall be provided with wear-resistant bands or tips which are firmly attached to the tape.

17.2.2 On end measures, one end may be fitted with a ring, which may be included in the nominal length of the measure.

17.2.3 The specified tension shall be approximately 10 N to 20 N, and shall be indicated on the measure.

17.2.4 On line measures, the zero scale mark shall be located at a distance of at least 20 mm from the nearest end of the measure, if the latter is not fitted with a ring, or from the outer edge of the ring, if it is fitted with a ring.

**17.3 Accuracy classes**

These measures shall conform to accuracy class I, II or III.

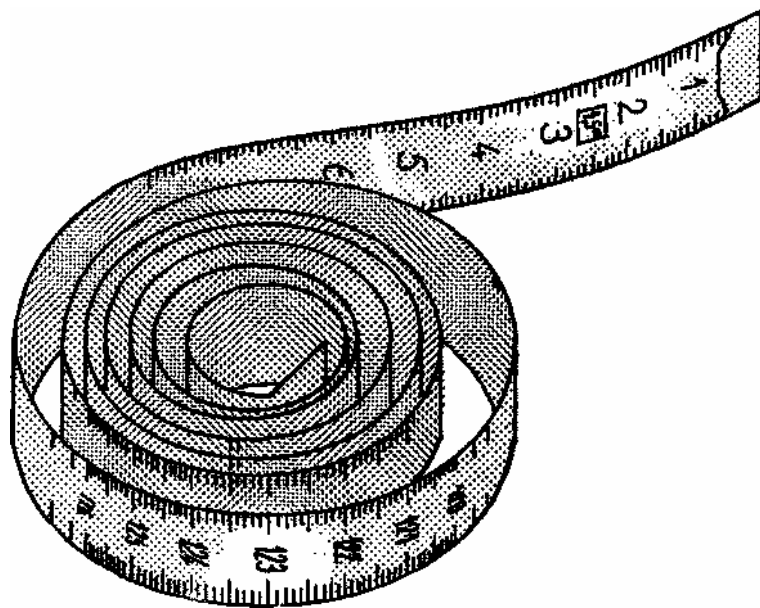


Figure 5 – Flexible tape measure made of fibreglass and plastics or other suitable non-metallic materials

## 18 Folding measures made of metal or other materials

### 18.1 Nominal length

These measures have nominal lengths between 0.5 m and 5 m; they are of the end type.

### 18.2 Construction

18.2.1 All parts which are jointed at both ends shall have the same length between their jointing axes.

18.2.2 Jointing and alignment of the unfolded measure shall be ensured by an effective device. Any errors, positive or negative, introduced by this device shall not exceed:

0.3 mm for measures of class II,

0.5 mm for measures of class III.

These errors are irrespective of the number of joints and are in addition to the maximum permissible errors detailed in 4.2.

### 18.3 Scale

These measures may have a scale on each of the two faces.

### 18.4 Accuracy classes

These measures shall conform to accuracy class II or III.

*Note:* Screw-assembly type jointed measures also exist. For this type of measure accuracy class I is admissible.

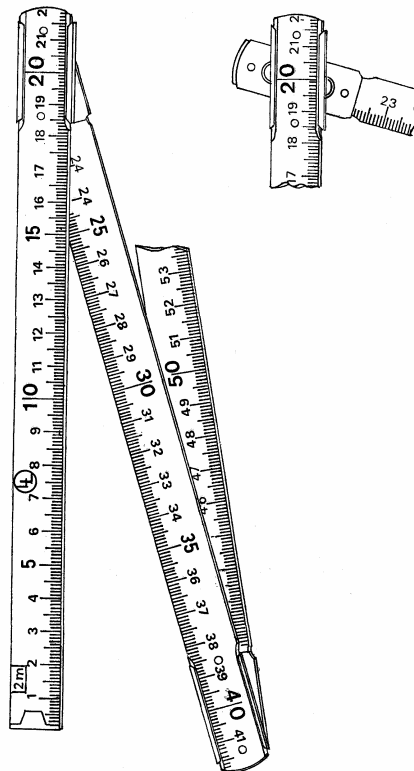


Figure 6 – Folding measure made of metal or other materials

## **19 Telescopic measures made of metal or other materials**

### **19.1 Nominal length**

These measures have nominal lengths between 0.5m and 5 m; they are of the end type.

### **19.2 Construction**

19.2.1 Jointing and alignment of the unfolded measure shall be ensured by an effective device. Any errors, positive or negative, introduced by this device shall not exceed:

- 0.3 mm for measures of class II,
- 0.5 mm for measures of class III.

These errors are in addition to the maximum permissible errors detailed in 4.2.

19.2.2 These measures are made of metal or other suitable materials.

19.2.3 The terminal surface of the measure shall be flat and perpendicular to the longitudinal axis of the measure.

19.2.4 The end of the measure shall be provided with an impact and wear resistant heel or tip made of a material not liable to cause sparking on impact.

### **19.3 Scale**

19.3.1 Measures which are circular in cross-section shall have only one scale along their length.

19.3.2 Measures which are rectangular in cross-section may have a scale on each of the two faces.

### **19.4 Accuracy classes**

These measures shall conform to accuracy class II or III.

## **20 Telescopic measures made of metal or other materials with digital readout**

### **20.1 Nominal length**

These measures have nominal lengths between 0.5 m and 5 m; they are of the end type.

### **20.2 Construction**

20.2.1 Jointing and alignment of the unfolded measure shall be ensured by an effective device. Any errors, positive or negative, introduced by this device shall not exceed:

- 0.3 mm for measures of class II,
- 0.5 mm for measures of class III.

These errors are in addition to the maximum permissible errors detailed in 4.2.

20.2.2 These measures are made of metal or other suitable materials.

20.2.3 The terminal surface of the measure shall be flat and perpendicular to the longitudinal axis of the measure.

20.2.4 The end of the measure shall be provided with an impact and wear resistant heel or tip made of a material not liable to cause sparking on impact.

### **20.3 Scale**

20.3.1 Measures which are circular in cross-section shall have only one scale along their length.

20.3.2 Measures which are rectangular in cross-section may have a scale on each of the two faces.

### **20.4 Accuracy classes**

These measures shall conform to accuracy class II or III.

### **20.5 Power supply**

20.5.1 If the digital readout is powered, the power source compartment shall form an integral part of the measure.

20.5.2 The manufacturer shall give precise rules for the replacement or recharging of the power source.

20.5.3 The manufacturer shall specify the maximum internal impedance of the power source.

## **B — MEASURES FOR LONG LENGTHS**

### **21 Flexible steel tape measures with winding device not designed for measuring lengths greater than their nominal length by repeated use of the same tape**

#### **21.1 Nominal length**

These measures have nominal lengths between 5 m and 200 m; they are of the line or composite type.

#### **21.2 Construction**

21.2.1 For measures in class I, the free end shall be provided with a handle or ring, which is not included in the nominal length.

For measures in class II, the free end shall be provided with a handle or ring which may be included in the nominal length; in this case, the beginning of the scale shall be clearly indicated.

21.2.2 The means of fastening a supplementary device to the end of a measure shall be permitted to obscure the scale marks at the beginning of the measure only under the following conditions:

- if the nominal length is between 5 m and 10 m, not more than the first 15 mm may be obscured;
- if the nominal length is greater than 10 m, not more than the first 30 mm may be obscured.

21.2.3 These measures may include a belt clip or carrying strap, which must neither obscure the dimensions marked on the side of the case nor interfere with internal measurements (i.e. they must not prevent the end of the case from touching the object being measured).

21.2.4 The specified tension shall be approximately 50 N or greater, and shall be indicated on the measure.

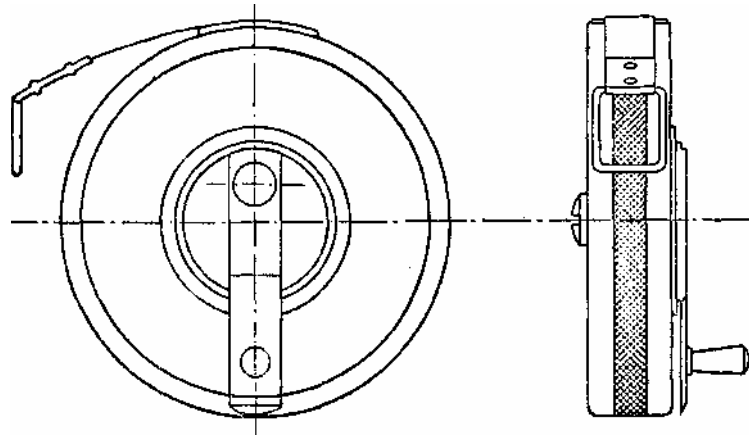
#### **21.3 Scale**

21.3.1 These measures may have a scale on each of the two faces.

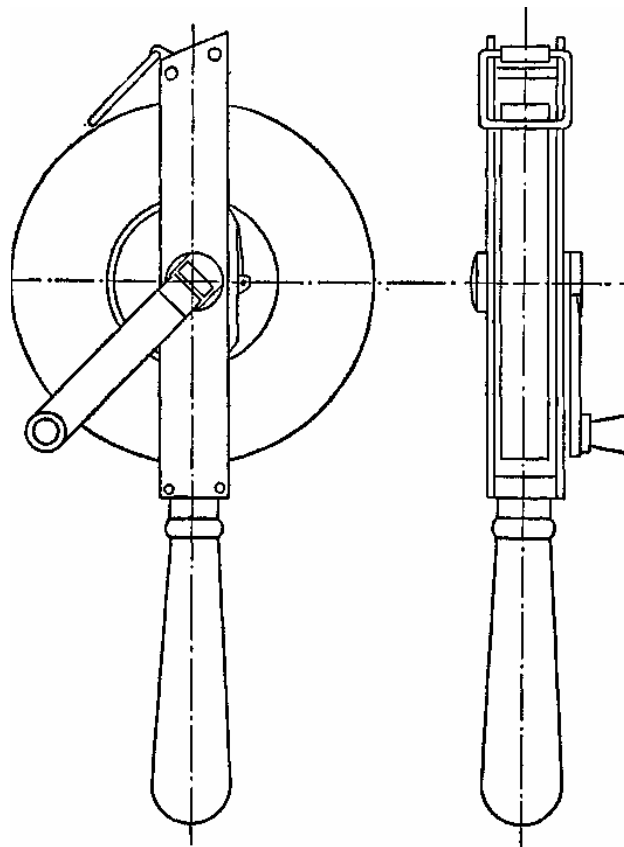
21.3.2 The reference temperature, if other than 20 °C, shall be indicated on the measure (see 10.2).

#### **21.4 Accuracy classes**

These measures shall conform to accuracy class I or II.



Winding device case



Handle type winding device

Figure 7 – Flexible steel tape measures with winding device

## **22 Flexible steel tape measures with tensioning weight or sinker**

Flexible steel tape measures with tensioning weight or sinker are frequently referred to as “oil gauging tapes” or “dip tapes” and are used for gauging the level of liquids in tanks used as measuring containers.

### **22.1 Nominal length**

These measures have nominal lengths between 5 m and 50 m; they are of the composite type.

### **22.2 Reference conditions**

The tension is approximately equal to the weight of the sinker in air. The mass of the sinker shall be indicated to within  $\pm 10$  g, on both the measure and the sinker.

### **22.3 Construction**

22.3.1 The sinker shall have a sufficient mass to stretch out the tape properly and shall be made of a material not liable to cause sparking on impact.

22.3.2 The sinker may be detachable or permanently attached to the tape.

22.3.3 This attachment or joint shall be such that additional measurement uncertainty is minimized.

22.3.4 The other end of the measure may be provided with a winding device.

### **22.4 Scale**

The scale shall be regular, with a scale interval of 1 mm. The base of the sinker constitutes the principal scale mark at the zero end of the scale. The scale starts on a flat face of the sinker and continues along the entire length of the tape.

### **22.5 Accuracy classes**

These measures shall conform to accuracy class I or II.

However, for any length between any two scale marks, one of which is on the sinker and the other on the tape, the maximum permissible error is  $\pm 0.6$  mm when application of the formula in 4.2.1 gives a value less than 0.6 mm.

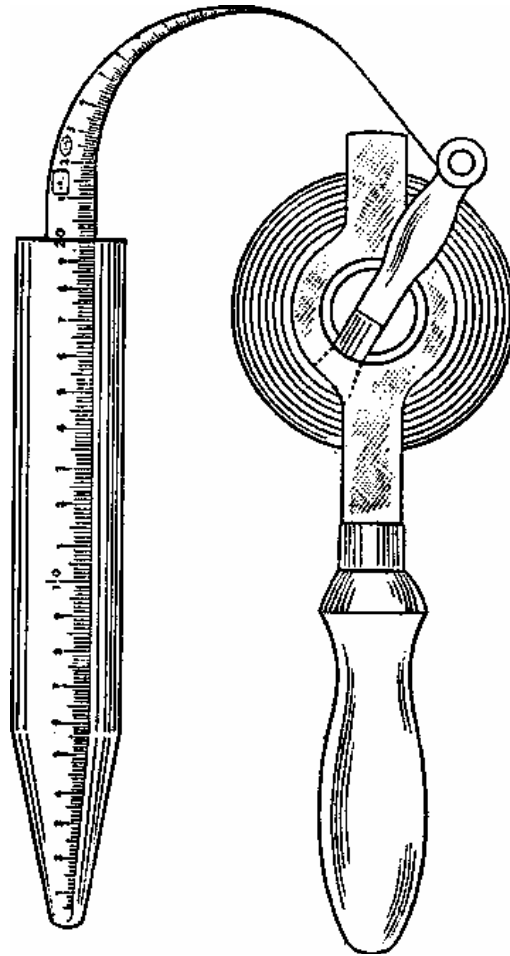


Figure 8 – Flexible steel tape measure with tensioning weight or sinker



## **23 Flexible steel tape measures with tensioning weight or sinker equipped with electronic sensing**

Flexible steel tape measures with tensioning weight or sinker equipped with electronic sensing are frequently referred to as “oil gauging tapes” or “dip tapes” and are used for gauging the oil-water interface and the level of liquids in tanks.

### **23.1 Nominal length**

These measures have nominal lengths between 5 m and 50 m; they are of the composite type.

### **23.2 Reference conditions**

The tension is approximately equal to the weight of the sinker in air. The mass of the sinker shall be indicated to within  $\pm 10$  g, on both measure and sinker.

### **23.3 Construction**

23.3.1 The sinker shall have a sufficient mass to stretch out the tape properly and shall be made of a material not liable to cause sparking on impact.

23.3.2 The sinker shall be permanently attached to the tape. This attachment or joint shall be such that it does not introduce any uncertainty of measurement.

23.3.3 The other end of the measure may be provided with a winding device.

### **23.4 Scale**

The scale shall be regular, with a scale interval of 1 mm. The sinker incorporates electronic sensing to determine the interface and this constitutes the principal scale mark at the zero end of the scale. The scale continues along the entire length of the tape.

### **23.5 Sensing element**

The sensing element of the measure shall provide a clear and reliable indication of the air/oil and oil/water phase transition.

### **23.6 Power supply**

23.6.1 If the measure is powered by a replaceable or rechargeable battery, the battery compartment shall form an integral part of the measure.

23.6.2 The manufacturer shall give precise rules for the replacement or recharging of the power source.

### **23.7 Accuracy classes**

The blades shall conform to accuracy class I or II, as specified in 4.2 and 4.3.

However, with the electronic sensor fitted, the instrument shall conform to the accuracy classes and maximum permissible errors specified in OIML R 85, 3.4.

**24 Flexible steel surveyor's tapes designed for measuring lengths greater than their nominal length by repeated use of the same tape**

**24.1 Nominal length**

These measures have nominal lengths of 5 m, 10 m, 20 m, 50 m, 100 m, or 200 m; they are of the end or line type.

**24.2 Reference conditions**

The specified tension shall be approximately 50 N or greater, and shall be indicated on the measure.

**24.3 Construction**

These measures are provided with handles or rings at both ends. If the handles are included in the nominal length of the measure, they shall be so constructed that their attachment to the tape introduces no uncertainty of measurement.

**24.4 Accuracy classes**

These measures shall conform to accuracy class I or II.

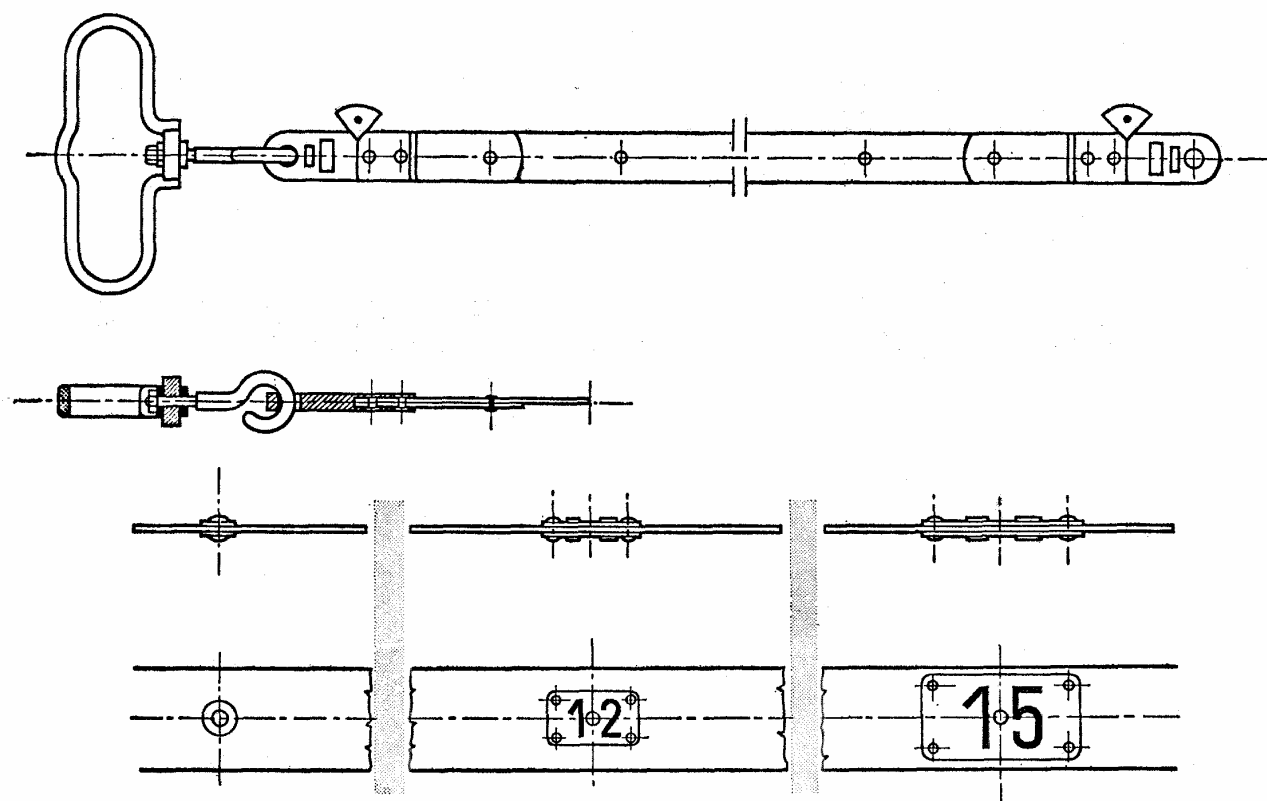


Figure 9 – Flexible steel surveyor's tape

## **25 Flexible tape measures made of fibreglass and plastics or other suitable non-metallic materials**

### **25.1 Nominal length**

These measures have nominal lengths between 5 m and 100 m; they are of the end, line, or composite type.

### **25.2 Construction**

25.2.1 The ends of end measures and the zero end of composite measures shall be provided with wear-resistant bands or tips which are firmly attached to the tape.

25.2.2 For measures in class I, the free end may be provided with a ring, which is not included in the nominal length.

For measures in classes II and III, the free end may be provided with a ring which may be included in the nominal length; in this case, the beginning of the scale shall be clearly indicated.

25.2.3 The means of fastening a supplementary device to the end of a measure shall be permitted to obscure the scale marks at the beginning of the measure only under the following conditions:

- if the nominal length is between 5 m and 10 m, not more than the first 15 mm may be obscured;
- if the nominal length is greater than 10 m, not more than the first 30 mm may be obscured.

25.2.4 These measures may include a belt clip or carrying strap, which must neither obscure the dimensions marked on the side of the case nor interfere with internal measurements (i.e. they must not prevent the end of the case from touching the object being measured).

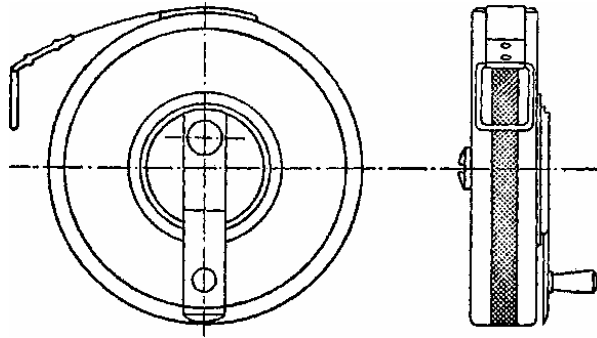
25.2.5 The specified tension shall be approximately 10 N to 20 N, and shall be indicated on the measure.

### **25.3 Scale**

These measures may have a scale on each of the two faces.

### **25.4 Accuracy classes**

These measures shall conform to accuracy classes I, II or III.



Winding device case

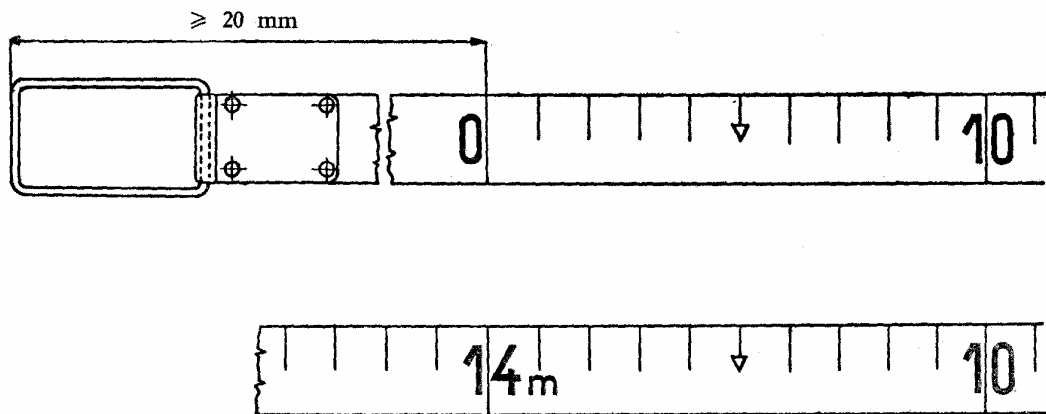


Figure 10 – Flexible tape measure

## SECTION VI – TEST REQUIREMENTS

### 26 Test requirements for material measures of length

The following requirements apply to material measures of length.

#### 26.1 External examination

##### 26.1.1 Object of examination

To verify visually that the measure meets the requirements of this Recommendation with respect to the design, construction and markings.

#### 26.2 Accuracy tests

##### 26.2.1 Object of the test

To verify by testing that the following parameters of the measure meet the accuracy requirements of this Recommendation.

##### 26.2.2 Scale accuracy and large scale linearity

- a) The error in the nominal length of the measure shall not exceed the mpe given in 4.2.1.
- b) The error in the distance between two non-consecutive marks at four randomly-chosen points along the length of the measure plus the nominal length shall not exceed the mpe given in 4.2.1. The four points may also be chosen visually, seeking for errors that might be apparent by sight.

##### 26.2.3 Scale interval accuracy

The error in the length of the scale interval at four randomly-chosen points along the length of the measure and at the nominal length shall not exceed the mpe given in 4.2.2.

##### 26.2.4 Scale interval linearity

The error in the difference between the lengths of two consecutive scale intervals at four randomly-chosen points along the length of the measure and at the nominal length shall not exceed the mpe given in 4.2.3.

##### 26.2.5 Accuracy of other metrological components, such as hooks, rings, dimensioned tape case, detachable sinker

The presence of the additional component shall not cause the error in the length of the blade to exceed the mpe given in 4.2.1 or the error in the length of the component, as a separate entity, shall not exceed the mpe.

### 27 Test requirements for material measures fitted with ancillary electronic devices

#### 27.1 General requirements

This section defines the test requirements which are intended to verify that measures with ancillary electronic devices perform and function as intended in a specified environment and under specified conditions. Each test indicates, where appropriate, the reference conditions for determining the intrinsic error.

These performance tests are additional to the accuracy tests described in 25.2 and apply to complete measures or to the ancillary electronic device alone.

The requirements assume that when the effect of one influence quantity is being evaluated, all other influence quantities are maintained at the reference conditions.

## **27.2 Accuracy tests for indicating devices**

These tests apply to indicating devices only.

### **27.2.1 Agreement with blade reading**

Throughout the length of the blade, including zero, the length indicated on the display shall meet the requirement in 11.6.

### **27.2.2 Hysteresis**

For changes in blade extension of one scale interval, the length indicated on the display shall meet the requirement in 11.6.

## **27.3 Accuracy tests for flexible steel tape measures with tensioning weight or sinker equipped with electronic sensing**

When fitted with electronic sensors, these instruments shall be tested according to the requirements of OIML R 85 Parts 1 and 2.

## **27.4 Environmental classification (see OIML D 11)**

For each performance test, the severity of the test conditions is indicated. The levels correspond to the climatic and electromagnetic environmental conditions to which material measures of length fitted with electronic devices are usually exposed.

## **27.5 Influence and disturbance tests for ancillary electronic devices fitted to material measures of length**

Influence and disturbance tests for ancillary electronic devices fitted to material measures of length are given in Table 5 and may be carried out in any order.

Table 5 – Test for ancillary electronic devices for material measures of length

| Test  | Nature of influence quantity | Severity level for the class  | Applicable standards  |
|---|------------------------------|---|---|
| 27.5.1 Static temperatures (Dry heat, Cold)   | Influence factor             | According to national (or regional) legislation:<br>Dry heat<br>Severity level 1: 30 °C<br>Severity level 2: 40 °C<br>Severity level 3: 55 °C<br>Severity level 4: 70 °C<br>Cold<br>Severity level 1: +5 °C<br>Severity level 2: –10 °C<br>Severity level 3: –25 °C<br>Severity level 4: –40 °C | IEC 60068-1 [1, 2]<br>IEC 60068-3-1 [3, 4]<br>IEC 60068-2-2 [5, 6, 7]<br>IEC 60068-2-1 [8, 9, 10] |
| 27.5.2 Damp heat, cyclic (condensing)   | Influence factor             | According to national (or regional) legislation:<br>Severity level 1: 40 °C<br>Severity level 2: 55 °C  | IEC 60068-3-4 [11]<br>IEC 60068-2-30 [12]   |
| 27.5.3 Mechanical shock (drop test)   | Disturbance                  | Modified to 0.75 m drop   | IEC 60068-2-31 [13, 14]   |
| 27.5.4 Immunity against radiated, radio-frequency   |                              |   |   |
| 27.5.4.1 Electromagnetic fields of general origin and those specifically caused by digital radio telephones | Disturbance                  | 2 (E1) <sup>1</sup><br>3 (E2) <sup>2</sup>  | IEC 61000-4-3 [15]  |
| 27.5.4.2 Radiated, radio-frequency, electromagnetic fields specifically caused by digital radio telephones  | Disturbance                  | 3 (E1)<br>4 (E2)  | IEC 61000-4-3 [15]  |
| 27.5.5 Electrostatic discharge  | Disturbance                  | 3   | IEC 61000-4-1 [16]<br>IEC 61000-4-2 [17]  |
| 27.5.6 Voltage of power source  | Disturbance                  | N/A   | OIML D11 [18]   |

<sup>1</sup> Electromagnetic disturbances corresponding to those likely to be found in residential, commercial and light industrial buildings.

<sup>2</sup> Electromagnetic disturbances corresponding to those likely to be found in industrial buildings.

## Annex A

### Bibliography

- |      |  |   |
|------|--|---|
| [1]  | IEC Publication 60068-1<br>– Ed. 6.0 (1988-06)                         | Environmental testing. Part 1: General and guidance   |
| [2]  | IEC Publication 60068-1-am1<br>– Ed. 6.0 (1992-06), Amendment 1        | Environmental testing. Part 1: General and guidance.  |
| [3]  | IEC Publication 60068-3-1<br>– Ed. 1.0 (1974-01)                       | Environmental testing - Part 3: Background information -<br>Section One: Cold and dry heat tests  |
| [4]  | IEC Publication 60068-3-1-1A<br>– Ed. 1.0 (1978-01)                    | Environmental testing - Part 3: Background information -<br>First supplement  |
| [5]  | IEC Publication 60068-2-2<br>– Ed. 4.0 (1974-01).                      | Environmental testing - Part 2: Tests. Tests B: Dry heat  |
| [6]  | IEC Publication 60068-2-2-am1<br>– Ed. 4.0 (1993-02)                   | Environmental testing - Part 2: Tests. Tests B: Dry heat  |
| [7]  | IEC Publication 60068-2-2-am2<br>– Ed. 4.0 (1994-05)                   | Environmental testing - Part 2: Tests. Tests B: Dry heat  |
| [8]  | IEC Publication 60068-2-1<br>– Ed. 5.0 (1990-05)                       | Environmental testing - Part 2: Tests. Tests A: Cold  |
| [9]  | IEC Publication 60068-2-1-am1<br>– Ed. 5.0 (1993-02) , Amendment 1     | Environmental testing - Part 2: Tests. Tests A: Cold  |
| [10] | IEC Publication 60068-2-1-am2<br>– Ed. 5.0 (1994-06), Amendment 2      | Environmental testing - Part 2: Tests. Tests A: Cold  |
| [11] | IEC Publication 60068-3-4<br>– Ed. 1.0 (2001-08)                       | Environmental testing - Part 3-4: Supporting<br>documentation and guidance - Damp heat tests  |
| [12] | IEC Publication 60068-2-30<br>– Ed. 3.0 (2005-08)                      | Environmental testing - Part 2-30: Tests - Test Db: Damp<br>heat, cyclic (12 h + 12 h cycle)  |
| [13] | IEC 60068-2-31<br>– Ed. 1.0 (1969-01)                                  | Environmental testing. Part 2: Tests. Test Ec: Drop and<br>topple, primarily for equipment-type specimens   |
| [14] | IEC 60068-2-31-am1<br>– Ed. 1.0 (1982-01), Amendment 1                 | Environmental testing. Part 2: Tests. Test Ec: Drop and<br>topple, primarily for equipment-type specimens   |
| [15] | IEC Publication 61000-4-3<br>– Ed. 3.0 (2006-02)                       | Electromagnetic compatibility (EMC) - Part 4-3: Testing<br>and measurement techniques - Radiated, radio-frequency,<br>electromagnetic field immunity test |
| [16] | IEC Publication 61000-4-1<br>– Ed. 2.0 (2000-04)                       | Electromagnetic compatibility (EMC) - Part 4-1: Testing<br>and measurement techniques - Overview of IEC 61000-4<br>series                                 |
| [17] | IEC Publication 61000-4-2<br>Consol. Ed. 1.2 (incl. am1+am2) (2001-04) | Electromagnetic compatibility (EMC)- Part 4-2: Testing<br>and measurement techniques - Electrostatic discharge<br>immunity test                           |
| [18] | OIML International Document<br>D 11 (2004)                             | General requirements for electronic measuring<br>instruments  |
| [19] | OIML International Recommendation<br>R 85 (1998)                       | Automatic level gauges for measuring the level of liquid<br>in fixed storage tanks  |