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**National Measurement**  
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## NMI M 1

# Pattern Approval Specifications for Length Measuring Instruments

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## 1. TERMINOLOGY

### 1.1 Analogue Indicator

An indicator on which the value of the physical quantity measured is indicated by an index and graduated scale, one of which is fixed and the position of the other is a continuous function of the magnitude of the physical quantity being measured.

### 1.2 Digital Indicator

An indicator on which the value of the physical quantity measured is represented by a series of aligned digits which change abruptly such that no indication can be obtained between digits; a digital indicator does not have graduation lines.

### 1.3 Error

**1.3.1 Maximum permissible error** is the maximum permissible departure from true value or performance.

**1.3.2 Reading error** is the quantity equivalent to 2 mm of the scale or 0.2 scale interval of an analogue indicator, whichever is the greater.

**1.3.3 Rounding error** is the quantity equivalent to 1 scale interval on a digital indicator or zero-start ticket printer, or 2 scale intervals on an accumulative printer or indicator.

### 1.4 First Element of an Indicator

In an indicating device comprising several elements the element which carries the scale having the smallest scale interval.

### 1.5 Index

The index of an indicator is that part of an indicator which is directly utilised in making a reading.

### 1.6 Minimum Delivery

The smallest length which can be measured without the possibility of excessive error.

### 1.7 Scale Interval

The value in units of length of the smallest division of an analogue scale, or the difference between two consecutive indicated or printed values in digital indication or printing.

### 1.8 Scale Mark

A line or other mark on an indicating device corresponding to a definite length; the numbers on digital or semi-digital indicators are also considered to be scale marks.

### 1.9 Scale Spacing

The relative displacement of index and scale corresponding to the value of the scale interval measured along the scale base line.

### 1.10 Semi-digital Indicator

An indicator on which the value of the physical quantity measured is represented by a series of aligned digits marked on rotating elements in such a manner that a change of digit on one element is caused by the rotation of the element on its right; the right-hand element is an analogue indicator.

### 1.11 Simple Juxtaposition

Refers to the arrangement of digits of an indicator to permit reading without the need for calculation.

## 2. SCOPE

These rules apply to length measuring instruments, other than simple measures of length, for the measurement of wire, cordage and fabric.

## 3. PERFORMANCE REQUIREMENTS

### 3.1 Maximum Permissible Error

The maximum permissible error shall be  $\pm 0.5\%$  for instruments with analogue indication and  $\pm 0.5\% + 0.5$  scale interval for instruments with digital indication.

### **3.2 Effect of Properties of Material being Measured**

Instruments shall measure within the maximum permissible error without intervention by the operator to correct for properties of the material, such as stretch, surface texture, thickness etc. Use of correction factors is not acceptable.

### **3.3 Effect of Temperature and Power Supply**

#### **3.3.1 Temperature**

Length measuring instruments shall comply with these rules over a temperature range of 0°C to 40°C.

#### **3.3.2 Electric Power Supply**

Electrically operated instruments shall comply with these rules within –15% to +10% of nominal voltage and within  $\pm 2\%$  of nominal frequency.

#### **3.4 Minimum Length**

Minimum length is 100 times the following quantities:

- (a) the reading error on an analogue indicator; or
- (b) the rounding error of a digital indicator or ticket printer; or
- (c) the largest of the above if an analogue indicator and a digital indicator or printer are fitted; and
- (d) any other error not dependent on the quantity delivered.

## **4. CONSTRUCTION REQUIREMENTS**

### **4.1 Suitability**

#### **4.1.1 Suitability for Purpose**

An instrument shall be designed to be suitable for the purpose for which it is intended to be used, and shall be constructed to be suitable for service in normal conditions of use.

#### **4.1.2 Suitability for Verification**

An instrument shall be designed to enable the performance requirements of these rules to be applied.

### **4.2 Operational Safeguards**

#### **4.2.1 Fraudulent Use**

Instruments shall not facilitate fraudulent use.

#### **4.2.2 Breakdown or Accidental Adjustment**

Instruments shall be constructed so that the effect of breakdown or accidental incorrect adjustment is self-evident.

##### **4.2.2.1 Multi-segment Indicators**

When the length is displayed by means of multi-segment indicators, provision shall be made for manual or automatic testing of all segments.

### **4.3 Indication and Printing Requirements**

#### **4.3.1 General**

##### **4.3.1.1 Clarity of Indications**

Indications and printings shall be clear and unambiguous and printings shall be indelible.

On digital indicators means shall be provided for ensuring that the indication at changeover point is stable.

##### **4.3.1.2 Arrangement of Digits**

Indications and printings shall permit reading by simple juxtaposition of the digits.

The digits of a numerical indicator shall be aligned in the direction of reading.

##### **4.3.1.3 Denomination of Indications**

Indications or printings of length shall include the unit of measurement or its symbol.

##### **4.3.1.4 Form of Digits**

- (a) All digits comprising length indications shall be orientated in the normal viewing position.

- (b) The height of digits of indicators shall be not less than  $3 \times L$  millimetres, where  $L$  is the minimum reading distance in metres, without being less than 2 mm on analogue indicators or less than 5 mm on digital indicators (other than ticket printers) (see clause 4.3.2.3) and semi-digital indicators.

#### 4.3.1.5 Scale Interval

The value of length scale intervals shall be in the form 1, 2 or  $5 \times 10^n$  metres, where  $n$  is a positive or negative whole number, or zero.

#### 4.3.2 Modes of Indication

An element of an indicating device may be analogue or digital, but when elements other than the first have part only of their scale visible through apertures, those elements shall have a digital movement (the first element being either analogue or digital).

##### 4.3.2.1 Analogue Indicators

- (a) Reading index

The index of an indicator shall be symmetrical about the scale marks with which it is associated.

The index shall reach but not obscure the shortest scale marks and the end of the index shall be not wider than such marks.

If the index and the scale marks are in the same plane, the distance between the end of the index and the ends of the marks, measured along the scale marks, shall be not more than 1.5 mm.

- (b) Arrangement of indicating elements

When the scale of an element is completely visible, the value of one revolution of that element shall be in the form  $10^n$  units of length, except that this rule does not apply to the element which corresponds to the maximum capacity of the indicator.

On an indicator with several elements, the value of each revolution of the moving part of those elements on which the scale is completely visible shall be equal to the value of the scale interval on the following element.

- (c) Changeover point for indicating elements

On an indicating device comprising several elements the advancement of a digit on an element with digital movement, other than the first, shall stop when the preceding element indicates zero. This advancement shall be accomplished while the preceding element moves not more than 0.1 scale interval.

- (d) Rotation of index

When an analogue indicator is in the form of a fixed circular scale and a rotating index, the direction of rotation of this index shall be clockwise for increasing length.

- (e) Analogue first element

The analogue first element of an indicator shall not be graduated between numbered scale marks.

- (f) Reading aperture

When an analogue indicator is viewed through an aperture, the width of the aperture, measured in the direction of travel of the indicator, shall be such as to allow the numbers of at least two numbered scale marks to be visible at all times.

- (g) Form of scale marks

The scale marks on an indicating device shall be straight lines of uniform thickness, uniformly spaced.

Width of scale marks shall not exceed 0.25 scale spacing.

- (h) Scale spacing

The minimum scale spacing shall be 2 mm.

- (i) Parallax

The distance between the dial and the index shall not exceed the width of the scale spacing, without exceeding 2 mm.

##### 4.3.2.2 Electronic Digital Indication

In the event of power failure, the indications of quantity measured on an electronic digital indicator up to the time of power failure shall be able to be recalled for a total time of at least 5 minutes over a period of at least 30 minutes after failure.

#### 4.3.2.3 *Printed Data*

Digits representing the length shall be not less than 2.5 mm high.

The unit of measurement or its symbol shall be not less than 2 mm high.

The decimal marker shall be printed by the printer and shall not be preprinted on the ticket.

### 4.4 **Zero-resetting Devices**

#### 4.4.1 Provision

All instruments shall be fitted with a device for resetting the indications to zero, either manually or automatically.

#### 4.4.2 Indication

The resetting device shall not alter the indications except to cause them to disappear and be replaced by zeros.

#### 4.4.3 Safeguard

When a zero-resetting operation is commenced, it shall not be possible for a new measured quantity to be indicated or printed until the resetting operation has been completed.

#### 4.4.4 Resetting Accuracy

##### 4.4.4.1 *Analogue Indicators*

On analogue indicators the indication after resetting shall be within 0.2 scale interval of zero.

##### 4.4.4.2 *Digital Indicators*

On digital indicators, the indication after resetting shall be zero.

#### 4.4.5 Simultaneous Resetting of all Modes of Indication

The zero-resetting device shall be constructed so that resetting of either the quantity indicator or the printer shall cause the resetting of the other modes of indication.

### 4.5 **Totalising Indicator**

#### 4.5.1 General

Instruments may be fitted with a totalising indicator for totalising quantities indicated successively by the resettable indicator.

#### 4.5.2 Size of Numbers

If it is possible to see the totalising indicator and resettable indicator at the same time, the height of the digits on the totalising indicator shall be not greater than half the height of the Digits on the resettable indicator.

### 4.6 **Presetting Devices**

When it is possible to see the digits in the presetting device and those of the length indicator simultaneously, the height of the digits on the presetting indicator shall be less than the height of the length-indicator digits.

### 4.7 **Sealing**

#### 4.7.1 Sealing Requirements

Provision shall be made for sealing any calibration device and any component the dismantling or adjustment of which would affect the accuracy of measurement.

Provision shall also be made for sealing any external data-output sockets to prevent connection of unauthorised equipment, and for sealing any external equipment plugs to data-output sockets to prevent unauthorised substitution of equipment.

Where an instrument comprises more than one separate assembly, the interconnecting cables shall be arranged so as to prevent replacement of any assembly without breaking a seal, or the serial number of each assembly shall be, sealed on to the indicator assembly.

#### 4.7.2 Stamping Plugs

Stamping plugs, or seals required to prevent adjustment of parts which affect the accuracy of an instrument, shall consist of a lead plug securely set below the surface of an undercut hole, with a circular face of not less than 12 mm diameter or with a rectangular face of dimensions not less than 8.5 mm × 25 mm. Typical examples of a circular plug are illustrated in Figure 1.

Other methods of sealing may be used on an instrument which is too fragile or otherwise unsuitable for a cup-type stamping plug.

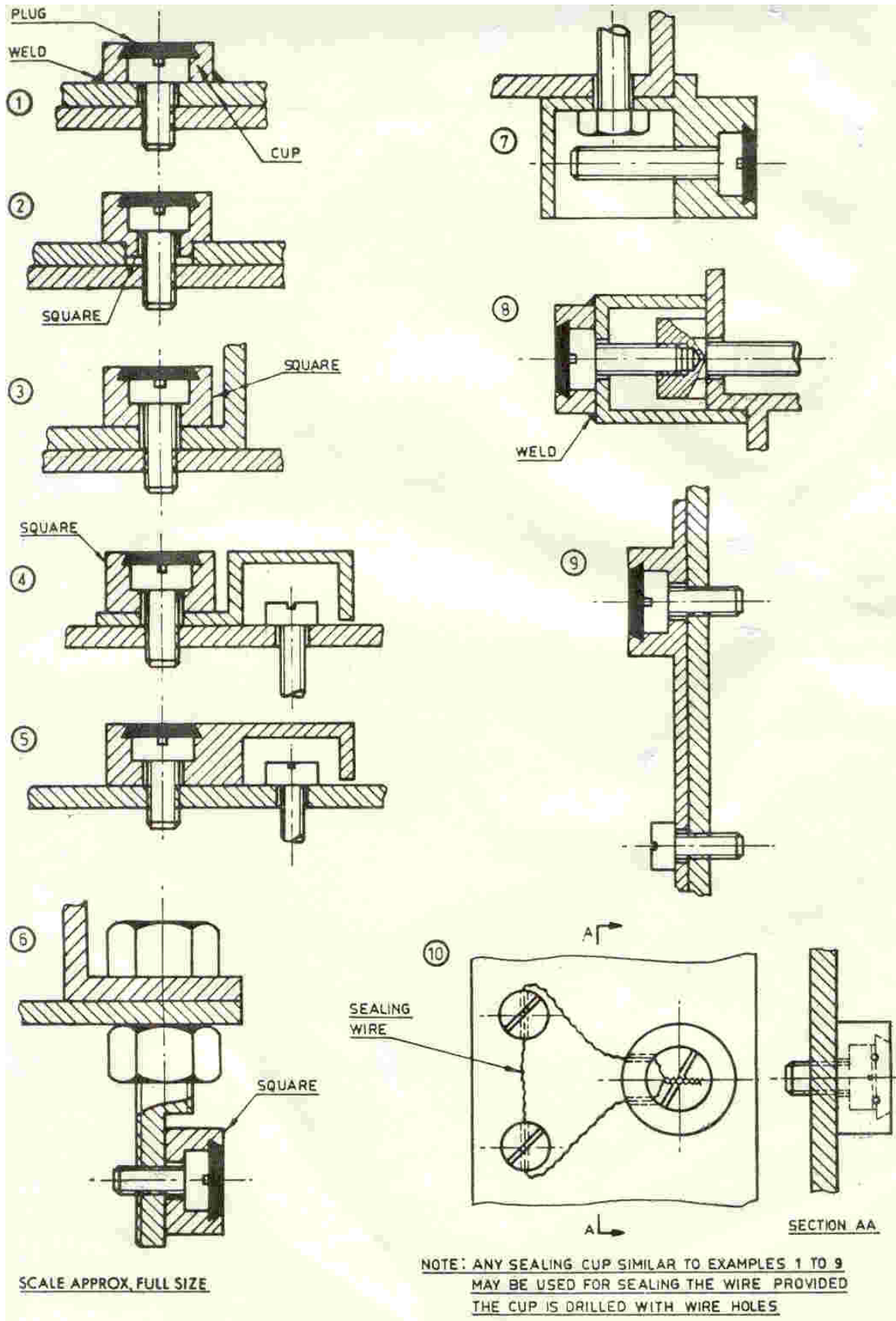


Figure 1. Typical methods of sealing

#### 4.7.3 Location of Stamping Plugs

A stamping plug shall be accessible for stamping by means of a 50 mm long stamping tool and be located so that

- the part on which it is situated cannot be removed from the instrument without damaging the mark;
- the mark can be easily affixed without affecting the metrological properties of the instrument;
- the mark will be visible without moving the instrument when it is in use.

### 4.8 Markings and Notices

#### 4.8.1 Markings

All instruments shall be clearly and permanently marked on one or more permanently attached nameplates, with the following information:

- manufacturer's name or mark
- serial number
- year of manufacture
- NMI approval number
- scale interval
- maximum speed of material
- minimum speed of material
- minimum delivery

#### 4.8.2 Notice

The instrument shall bear a notice describing the limiting properties of the materials for which it is suitable. For example, wire or cordage measuring instruments shall be marked with the maximum and minimum diameter of material, and fabric measuring instruments shall be marked with a permissible range of thickness or mass per square metre and a maximum permissible stretch (expressed as a percentage of elongation related to uniform force in newtons per metre width).

#### 4.8.3 Style of Markings and Notices

All markings and notices shall be clear and permanent and capital letters and numbers shall be not less than 2 mm high.

Numbers and symbols of units shall be presented in accordance with *AS 1000. The International System of Units (SI) and its Application*.