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Specification for

Laboratory pH meters

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Cooperating organizations

The Laboratory Apparatus Standards Committee, under whose direction this British Standard was prepared, consists of representatives from the following Government departments and scientific and industrial organizations:

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Contents

Foreword

This British Standard, first published in 1959, has been revised under the direction of the Laboratory Apparatus Standards Committee.

The first edition specified requirements for meters of the now obsolete manually operated null or potentiometric type. This revision covers all types of laboratory pH meters in current production including the moving coil type previously specified in BS 3422 (now withdrawn), the automatic (servo-driven) potentiometric type and the more recently developed digital display type.

In this revision, the requirements are based on the electrical performance of pH meters. Although the compliance tests, given in the appendices, have been designed with typical usage for glass and reference electrodes in mind, simulated conditions are used to make the tests independent of electrode performance. These tests are conducted by applying d.c. potential differences from a potentiometer using a high value resistor to simulate a glass electrode.

The committee undertook an examination of a range of pH meters in current production which showed that the new requirements of this British Standard are practicable. The principal cost-restricted limitations of pH meters are deflection meter linearity and scaling, input current, and dial scaling and linearity of temperature compensator potentiometers. Possible inaccuracies arising from these features can be minimized by attention to the way the pH measurements are carried out. Suitable procedures are described in BS 1647. Errors due to input current can be considerable for very high electrical resistance glass electrodes, or for electrodes with resistances in the normal range (100 MΩ to 350 MΩ) at room temperatures when used at low temperatures. Errors arising from input current are of similar origin to those described as "grid current" errors when valve electrometer tubes were employed in pH meters up to a decade ago. Unlike grid current errors, however, the input current error may be of either sign, as present day solid-state input stages may cause current to flow in either direction through the glass electrode/reference electrode pair. Furthermore, the current depends on the voltage, applied to the input stage. Input current tests are described in Appendix C.

It is not widely appreciated that the conversion of the measured potential to the indicated pH value carried out by the temperature compensator of a pH meter is an incomplete one even if isopotential control is used. Although the compensator operates according to the slope factor, corrections for smaller effects of a physicochemical origin are not fully made. Moreover, the quality of the components available and inadequacies in the scaling of the slope factor adjustment dial frequently limit the accuracy of the pH measurement. If the dial cannot be set accurately and reproducibly to a particular temperature (e.g. 25 °C) then there may even be inaccuracy in the measurement of pH values when both sample and standard buffer are temperature controlled to within ± 0.1 °C.

Because of the many designs of pH meters in current production, it has not been found possible to specify all design details, but suppliers are required to provide information on some of these in their instruction manuals.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 8, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope

This British Standard specifies requirements for pH meters for laboratory use.

2 References

The titles of the standards publications referred to in this standard are listed on the inside back cover.

3 Definitions

For the purposes of this British Standard the following definitions apply.

3.1
pH value

this was originally intended to represent the negative common logarithm of hydrogen ion activity in aqueous solution but this notional definition is now replaced by an operational one (as given in BS 1647) in terms of the electrochemical cell used for its measurement

3.2
laboratory pH meter

a high impedance input instrument designed for general laboratory use in conjunction with hydrogen ion responsive glass and reference electrodes (q.v.) by means of which either the pH of a solution, or the potential difference between the electrodes immersed in a solution, can be measured

3.3
hydrogen ion responsive electrode

an electrode, consisting of a bulb, or other suitable form, made of special glass, attached to a stem of high resistance glass complete with internal reference electrode and internal filling solution

3.4
reference electrode

an external electrode system which incorporates a means of forming a liquid junction such as a ceramic plug or frit. Usually this reference electrode system is either calomel (mercury (I) chloride) or silver/ silver chloride in contact with a concentrated solution of potassium chloride

3.5
range

the interval in pH or millivolts over which the instrument is usable

3.6
moving index instrument

an indicating instrument in which the index is a pointer moving over a fixed scale

3.7
scale division

the interval between two consecutive (minor) scale marks on an instrument with a scale or chart

3.8
scale interval

the value of the measured quantity corresponding to a scale division

3.9
scale spacing

the linear or curvilinear length, measured along the scale base, between the axes of two consecutive minor scale marks of a scale or chart

3.10
digital pH meter

a pH meter in which the value of the measured quantity is displayed as a group of digits

3.11
representation unit

the minimum increment between two successive output states of a digital pH meter

3.12
set buffer adjustment

a control for adjusting the pH meter to indicate the value of the pH of the standardizing solution

3.13
slope factor

the temperature dependent proportionality factor between potential and pH

3.14
slope/temperature factor adjustment

a manual control by which readings on the pH scale can be corrected for variations of temperature of the pH cell

3.15
slope factor adjustment

a manual control used in conjunction with two-point standardization procedures to correct for non-Nernstian but linear response of the electrode system

3.16
isopotential control

a control which determines the point on the pH scale where the correcting effect of the temperature compensation device is zero. This additional temperature compensating device permits a partial correction to be made for those cell potential difference changes which occur only as a result of:

a) temperature differences between the test solution and the standard buffer solution;

b) temperature differences between the glass electrode and the reference electrode.

3.17
zero point

the value of the pH of a solution, which, for a given glass electrode in combination with a stated outer reference electrode system, gives zero potential difference from the system

3.18
error (of indication)

the difference ($v_i - v_c$) between the value indicated by the pH meter (v_i) and the true value of the measured quantity (v_c), taken as equivalent to the d.c. potential difference applied from a potentiometer

3.19
calibration

the operation of determining the errors (of indication) of a pH meter

3.20
intrinsic error

the error of indication of a pH meter under reference conditions

3.21
input current

the current flowing through the glass electrode and reference electrode cell under specified conditions of input voltage

3.22
(overall) instrument error

the whole error of indication of a pH meter under specified conditions of use

3.23
influence quantity

any quantity, generally external to the pH meter, which may affect the performance of the pH meter

3.24
common mode imput voltage

a voltage applied to both input terminals together

3.25
common mode rejection ratio (CMRR)

ratio input voltage range to maximum change in input offset voltage over this range

4 Presentation of the measured quantity

The value of the measured quantity may be presented by:

a) a moving index instrument;

b) a digital instrument;

c) a recording instrument;

d) a computer-readable output e.g. RS 232.

The principal form of presentation is usually a) or b) with c) and/or d) as optional accessories. The manufacturer shall state in the literature provided with the pH meter which is the principal method of presentation adopted and which optional methods are available together with a description of these, e.g. parallel b.c.d., isolated potentiometric recorder output, etc. (see clause **15**).

5 Scale

5.1 The scale of the instrument shall be graduated both in pH and in millivolts.

5.2 The principal scale of the instrument shall cover the pH range 0 to 14.

5.3 For an instrument with scales or charts, the scale spacing (in millimetres) and the scale interval on both pH and millivolt scales and on any expanded scale shall be stated in the literature provided with the pH meter.

5.4 The instrument shall be described in terms of its most sensitive pH scale interval or representation unit. For example, a pH meter with 0.01 pH scale interval shall be designated a 0.01 pH meter and a digital pH meter with 0.001 representation unit shall be designated a 0.001 pH meter.

5.5 For moving index instruments, the scales should be divided and marked to comply with the recommendations of BS 3693-2. The index (knife edge) and (minor) scale mark thickness shall be about $1/10$ of the scale division in order to facilitate interpolation by eye into fifths.

5.6 For a digital instrument, the representation unit on both pH and millivolt scales and on any expanded scale, and the height in millimetres of the numerical display shall be stated in promotional and accompanying literature.

5.7 In a multi-range instrument, the range in use shall be clearly indicated on the front panel.

5.8 The manufacturer shall state in accompanying literature whether a positive millivolt scale refers to positive polarity of the glass electrode input or of the reference electrode input.

6 Errors of indication

6.1 When determined by the methods given in Appendix A, the intrinsic error of indication arising from graduation and non-linearity at any point shall not exceed, on any range, 20 % of the scale interval for instruments with scales, or one representation unit for digital instruments.

6.2 When determined by the method given in Appendix B, the (overall) instrument error shall not exceed 50 % of the scale interval at any point on any range or two representation units on that range.

6.3 On multi-range instruments, unless the manufacturer states in the literature provided with the pH meter (see clause **15**) that the electrode system should be separately standardized on each pH scale, the error of indication arising from scale incompatibility shall not exceed 20 % of the principal scale interval or one representation unit when switching between the principal scale and an expanded scale, or 50 % of the expanded scale interval or two representation units when switching between expanded scales of the same scale interval but different range.

7 Input current

7.1 The input current at zero voltage shall not cause an error of indication of more than one scale interval or five representation units on the most sensitive scale of the instrument when a glass electrode with 1 GΩ resistance is used. Compliance with this requirement shall be ascertained by testing according to the procedure detailed in **C.1** in which a resistor is used to simulate the glass electrode.

NOTE 1 The test given in **C.1** employs a 10 GΩ screened resistor to obtain detectable effects, and is equivalent to the requirement specified above for a glass electrode with 1 GΩ resistance.

NOTE 2 For a moving index pH meter with 0.05 scale interval the use of a 10 GΩ resistor corresponds to an input current of 3 pA.

NOTE 3 A glass electrode with 1 GΩ resistance at 25 °C would have a resistance of about 10 GΩ at 0 °C and this would result in an error of indication due to input of ten scale intervals if the electrode were calibrated at 25 °C and used at 0 °C. However, an electrode with a resistance lower than 1 GΩ at 25 °C would normally be selected for use at lower temperatures.

7.2 The change in input current over the pH range 0 to 14 shall not lead to an indication error greater than 20 % of the scale interval or one representation unit on the most sensitive scale when a glass electrode with 1 GΩ resistance is used. Compliance with this requirement shall be ascertained by testing according to the procedure detailed in **C.2** in which a resistor is used to simulate the glass electrode.

NOTE 1 The test given in **C.2** employs a 10 GΩ source resistor to obtain detectable effects and is equivalent to the requirement specified in **7.1** for a glass electrode with a 1 GΩ resistance.

NOTE 2 For a moving index pH meter with 0.05 pH scale interval, the use of a 10 GΩ resistor corresponds to a change in input current per volt of 0.5 pA.

8 Stability

8.1 The instrument temperature change that produces an error of indication, over a change in pH value of 10, of not more than 20 % of a scale interval or one representation unit on the most sensitive scale at the extremes of isopotential setting, when the input is short circuited and a 1 GΩ resistor is connected across the input terminals, shall be as follows:

a) for a 0.001 pH meter not less than ± 1 °C;

b) for a 0.01 pH meter not less than ± 5 °C

c) for a 0.1 pH meter not less than ± 10 °C.

8.2 For instruments designed for use with mains electricity supply, a voltage variation of + 6 % or – 10 % shall produce a variation of no more than 20 % of the scale interval or one representation unit on the most sensitive scale at either end of the pH or millivolt scales when a 1 GΩ resistance is connected across the input terminals.

8.3 For battery-powered instruments, the manufacturer shall provide a means of determining when an error of indication of 20 % of the scale interval or one representation unit on the most sensitive scale will result from a drop in battery voltage.

8.4 The uncertainty of measurement due to circuit noise measured over any period of 15 min shall not exceed 20 % of the scale interval for moving index instruments or one representation unit for digital instruments on the most sensitive scale, when a 1 GΩ resistance is connected across the input terminals and the set buffer control is adjusted to give an on-scale reading.

8.5 The manufacturer shall state, in the literature provided with the pH meter, the recommended values and ranges of influence quantities listed in BS 4889, other than those already specified in **8.1** to **8.4** of this standard.

9 Glass electrode input

The glass electrode input socket shall be so designed as to make good electrical contact with one of the screened plugs mentioned in BS 2586. The manufacturer shall state, in the literature provided with the pH meter, which type of socket has been fitted.

10 Reference electrode input

10.1 The reference electrode socket shall be designed to make good electrical contact with the reference electrode plug which should preferably have the 3 mm diameter shaft commonly in use. However a 2 mm or 4 mm diameter plug is permitted, provided the manufacturer states, in the literature provided with the pH meter, which has been adopted.

NOTE For some instruments, particularly hand-held, so-called "stick" pH meters, which are designed for combination or dual electrodes only (see BS 2586), no separate reference electrode socket may be provided and the combination electrode may be plugged directly into the instrument.

10.2 The instrument shall tolerate the reference electrode input being earthed, floating or at ± 2 V from earth and reference electrode resistances up to 100 kΩ. Under all these conditions, additional errors of indication shall be less than 20 % of the scale interval or one representation unit on the most sensitive scale.

NOTE Compliance with these requirements can be tested by connecting a 2 V battery between instrument and earth and then reversing the connection and by using a 100 kΩ resistor in series with the reference electrode.

10.3 Some instruments have dual high impedance input so that the reference electrode input is electrically similar to the pH glass electrode input. For such instruments the value of CMRR (see **3.25**) shall be greater than 80 dB (corresponding to a rejection ratio of 1 in 10 000).

NOTE 1 Compliance with this requirement can be tested as follows. The maximum common mode input voltage, V_c, (see **3.24**), is applied and the output reading is noted. An input voltage, V_i, is applied to the instrument using a simulator and adjusted to a value such that the resulting output reading equals the value previously noted. Then CMRR (in dB) = $-20 \lg (V_c/V_i)$.

NOTE 2 With dual high impedance input instruments, the manufacturer's recommendations with regard to earthing should be observed.

11 Temperature compensating devices

11.1 The instrument shall be provided with a manually operated or automatic device by means of which readings on the pH scale can be corrected for changes in the solution temperature from 25 °C (slope factor compensation). The range of any such device shall be stated in the literature provided with the pH meter.

NOTE 1 Slope factor values are given in BS 1647 a revision of which is in course of preparation.

NOTE 2 The automatic temperature compensating device may be a separate platinum (or other metal) resistance thermometer or a thermistor incorporated in the electrode stem. Alternatively, a change in electrical resistance of the glass electrode itself can be used as a means of correcting for changes in solution temperature.

11.2 A manually operated temperature compensating device shall be designed and scaled to comply with the recommendations of BS 3693-2. There shall be a scale mark at 25 °C and the scale interval of the device in degrees Celsius shall be 200 times the numerical value of the scale interval in pH on the most sensitive scale of the instrument. When tested in accordance with the procedure detailed in **D.2**, a manual temperature compensator shall not lead to an error of indication of more than 40 % of the scale interval or two representation units at 25 °C (or at the reference temperature stated by the manufacturer), or more than two scale intervals or ten representation units at any other temperature.

NOTE An error of 1 °C in setting a manual slope factor compensating device at 25 °C will lead to an error of 0.010 in the pH of a test solution which is 3 pH units removed from the standardizing buffer value when both test and standardizing solutions are at 25 °C. If the test and standardizing solutions differ in temperature, the error is a function of the difference between the isopotential pH and that of the test buffer. Thus if the difference in pH value is 3, an error of 0.01 in pH can be produced by a difference in temperature of 1 °C. It should, therefore, be possible to set the manual temperature compensator more accurately than 1 °C if measurements are to be made to 0.01 in pH. For a 0.01 pH meter, the compensator will have to be scaled every 2 °C in order to meet the requirements of **11.2**, which should permit interpolation to 0.4 °C. The tolerance in linearity of the variable resistors used for compensators is, however, usually not better than ± 1 %, which corresponds to ± 1 °C in a compensator having 0 °C to 100 °C range.
With some microprocessor-based instruments, the user is required to key in the value of the temperature of the solution. If a scaled temperature compensating device is not provided, the procedure detailed in **D.2** cannot be applied.

11.3 When tested in accordance with the procedure detailed in **D.2**, an automatic temperature compensating device throughout a temperature range, which shall be stated by the manufacturer in the literature provided with the pH meter, shall not lead to an indication error, for the specified pH change of 7, of more than 40 % of the scale interval or two representation units on the most sensitive scale.

11.4 The instrument may incorporate an additional device to compensate for the change with temperature of potentials which are independent of the pH value of the test solution (isopotential control). When tested in accordance with the procedure detailed in **D.1**, temperature compensation by such means shall not lead to an indication error of more than 20 % of the scale interval or one representation unit on the most sensitive scale over a temperature range of 10 °C. The manufacturer shall state in the literature provided with the pH meter for which combinations of glass and reference electrodes the isopotential control has been designed, and indicate to the user what action should be taken if the use of this temperature compensation facility is not required.

NOTE When isopotential control is not provided, the isopotential value is usually pH 7. In microprocessor-based instruments, the user may be required to key in the isopotential value and the procedure detailed in **D.1** cannot be applied.

12 Set buffer adjustment

The range of the set buffer control shall be such as to permit the use of glass electrodes with zero point values specified by the manufacturer of the pH meter.

NOTE In microprocessor-based instruments, the set buffer control is not provided and the user is required to key in the pH values of the reference standard solution(s) used, or, in some cases, the instrument itself provides the values from the microprocessor memory. The former option should always be available and the user's choice of reference standard solutions should not be restricted.

13 Slope factor adjustment

Slope factor adjustment control (if fitted) shall be scaled in percentage of the theoretical slope factor. It shall be possible to set this control to the value (100 %) corresponding to the theoretical slope factor without incurring an error of indication of more than 20 % of the scale interval or one representation unit on the principal pH scale of the instrument.

14 Electrical safety and earthing

The instrument shall comply with the requirements of BS 4743 for electrical safety and earthing, and with those of BS 4410 for colour coding of the mains supply lead (for mains instruments).

NOTE For laboratory pH meters for use in explosive atmospheres see CP 1003.

15 Summary of information to be given in the literature provided with the pH meter

The following information shall be supplied with a pH meter.

a) The principal form of presentation of the measured quantity (see clause **4**) and which optional methods are available, together with a description of these, e.g. a computer readable output isolated potentiometric recorder output etc.

b) For an instrument with scales or charts, the scale spacing in millimetres for pH scales, millivolt scales and expanded scales.

c) For an instrument with scales or charts, the scale interval for pH scales, millivolt scales and expanded scales.

d) For a digital instrument, the representation unit on both pH and millivolt scales and on any expanded scale and the height of the numerical display in millimetres.

e) Whether a positive millivolt scale refers to positive polarity of the glass electrode input or positive polarity of the reference electrode input.

f) Whether the electrode system should be standardized on each pH scale on multi-range instruments.

g) The recommended values and ranges of the influence quantities listed in BS 4889 including:

1) the instrument temperature change which permits compliance with **8.1**;

2) the mains supply voltage variation which permits compliance with **8.2**;

3) the means provided for indicating compliance with **8.3**.

h) Which of the screened plug sockets mentioned in BS 2586 is fitted.

i) Which of the plug sockets described in **10.1** is fitted.

j) The temperature range that permits compliance with **11.3**.

k) The combinations of glass and reference electrodes for which the isopotential control has been designed and an indication to the user of what action should be taken if the use of this temperature compensation facility is not required.

l) The zero point values of the glass electrodes suitable for use with the set buffer control.

Appendix A Method of test for errors of indication

A.1 General. The compliance tests described in this appendix are performed with the apparatus ready for use after warm-up time and within the ranges of influence quantities (temperature, humidity, etc.) specified by the manufacturer in the literature provided with the pH meter.

A.2 Millivolt scales. The calibration of the pH meter scale is carried out using a potentiometer with a scale interval in millivolts equal to $^1/_5$ of the numerical value of the scale interval of the pH scale under test.

NOTE With a 500 mV scale with scale interval of 10 mV, a potentiometer with settings of 2 mV is required.

The potential difference is applied directly across the input terminals of the instrument. In all tests, measurements are made with both increasing and decreasing incremental applied potential differences to test for hysteresis.

NOTE Millivolt calibrators are available and may be used in place of the potentiometer used in this test.

Before checking the millivolt scale, set the temperature compensator in accordance with the manufacturer's directions.

NOTE This is only necessary on certain pH meters where the temperature compensator remains in circuit on switching to the millivolt scales. Such instruments should not be used as millivoltmeters without ascertaining that the temperature compensating device can be accurately set to the value stated by the manufacturer.

Test the principal millivolt scale at 100 mV intervals and expanded scales at 25 mV or 50 mV intervals.

If the set buffer control is effective on the millivolt scale, use the control to set the zero initially. Check both positive and negative regions of the millivolt scale by reversing the input connections, with a double check of the scale zero.

A.3 pH scales. Before checking the pH scales, set the temperature compensator to 25 °C or to the calibration temperature stated by the manufacturer. Set the isopotential control (if fitted) to 7.0 or, where fixed isopotential values only are provided, to a value close to 7. With the input terminals shorted, adjust the set buffer control so that the indicator reads this isopotential value or 7.0 on instruments without isopotential control.

Vary the manual temperature compensator between its extreme settings, readjusting the set buffer control if necessary, until these variations produce no discernible change in indicator reading. Calibrate the principal scale at seven points between 0 and 14 by applying potential differences appropriate to 25 °C from the potentiometer as shown in Table 1.

The values given in Table 1 are applicable to meters with 0.001 pH scale intervals and may be rounded off appropriately for less accurate instruments.

For checking expanded pH scales, calculate the appropriate values for the applied potential differences from the slope factor value:

k = 59.159 mV at 25 °C

For meters graduated for temperatures other than 25 °C, calculate the applied potential differences from the table of slope factor values in BS 1647[1)].

Appendix B Method for determination of overall instrument error

Determine the (overall) instrumental error using the procedure described in Appendix A but applying the potential differences from the potentiometer through a 1 GΩ (± 10 %) screened resistor to the glass electrode input.

NOTE Under these conditions the test approximates closely to the normal usage of a pH meter.

Appendix C Method of test for input current

C.1 Input current at zero voltage. Adjust the set buffer control with the input terminals shorted so that the indicator reads pH 7.000. Connect a screened 10 GΩ (± 10 %) resistor across the glass and reference electrode inputs. Observe the change in reading.

NOTE The change in reading should not exceed ten scale intervals or fifty representation units which is equivalent to the requirement of **7.1**.

C.2 Input current change per volt. Apply a potential difference of 0.5 V between the glass and reference electrode inputs.

NOTE This can be done with a potentiometer but high accuracy is not required and a suitable source is the voltage drop across one of three 100 kΩ resistors connected in series across a 1.5 V dry

[1)] A revision of BS 1647 is in course of preparation.

Adjust the set buffer control so that the meter indicates a value (e.g. v_1) on the scale. Connect a 10 GΩ (± 10 %) screened resistor in series with the voltage source and observe the reading (e.g. v_2). Note the difference ($v_1 - v_2$). Reverse the polarity of the input voltage, repeat the procedure, and note the difference ($v_1 - v_3$). Note the difference between the greater of these two changes in reading, i.e. either ($v_1 - v_2$) or ($v_1 - v_3$), and that observed in the test described in **C.1**. It should not exceed two scale intervals or ten representation units which is equivalent to the requirement of **7.2**.

Appendix D Methods of test for isopotential and temperature compensation

The isopotential, manual and automatic temperature compensation devices are checked by the following procedures.

D.1 With the input terminals shorted and the manual temperature compensator set to 25 °C, adjust the set buffer control so that the indicator reads the isopotential value selected. Change the manual temperature compensator setting from 0 °C to 50 °C and observe the change in indication.

NOTE The indication should not change by more than one scale interval or five representation units. This is equivalent in measured pH to 20 % of the scale interval or one representation unit over 10 °C as specified in **11.4**.

D.2 Readjust the set buffer control so that no discernible error is observed when the test described in **D.1** is carried out. For instruments without isopotential control, adjust the set buffer control with input shorted so that no discernible change in indicator reading is observed on rotating the manual temperature compensator between its extreme settings.

NOTE The indicated value is then the pH reading at which the temperature compensator is inoperative.

If testing an instrument with a manual temperature control, set this control to one of the temperatures listed in Table 2. For an instrument with an automatic temperature control, immerse the temperature sensing device for 30 min in a bath controlled to within ± 0.1 °C of the selected temperature.

Using the potentiometer specified in Appendix A, apply the appropriate voltage given in Table 2 and observe any difference in reading from the set (or adjusted) position.

Reverse the polarity of the applied voltage and again observe any difference in reading from the set (or adjusted) position.

Repeat this procedure at the other temperatures listed in Table 2.

Observe the change in reading from the set (or adjusted) isopotential value. This is the indication error as specified in **11.2** and **11.3**.

Table 1 — Potential differences for calibrating pH scales

ΔpH scale reading	1	2	3	4	5	6	7	8	9	10
± applied potential difference (mV)	59.16	118.32	177.48	236.64	295.80	354.95	414.11	473.27	532.43	591.59

Table 2 — Voltages for calibrating isopotential control and temperature compensator

Temperature setting or bath temperature (°C)	0	40	60	80	100
± applied voltage (mV)	379.38	434.93	462.71	490.49	518.27

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Publications referred to

BS 1647, *pH scale.*
BS 2586, *Glass electrodes for measurement of pH.*
BS 3422, *Laboratory deflection pH meters (withdrawn).*
BS 3693, *Recommendations for the design of scales and indexes.*
BS 3693-2, *Indicating instruments to be read to 0.33 – 1.25 per cent resolution.*
BS 4410, *Connection of flexible cables and cords to appliances.*
BS 4743, *Safety requirements of electronic measuring apparatus.*
BS 4889, *Method for specifying the performance of electronic measuring equipment.*
CP 1003, *Electrical apparatus and associated equipment for use in explosive atmospheres of gas or vapour other than mining applications.*

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