

Methods of measurement of

Liquid flow in open channels —

Part 9: Water level instruments —

Part 9B: Float-operated water level
recorders (mechanical and
electromechanical)

UDC 532.543:532.57:681.128.3

Cooperating organizations

The Industrial-process Measurement and Control Standards Committee, under whose direction this British Standard was prepared, consists of representatives from the following:

- British Gas Corporation
- British Industrial Measuring and Control Apparatus Manufacturers' Association*
- British Steel Corporation
- Control and Automation Manufacturers' Association (BEAMA)
- Department of Industry
- Department of Industry (Computers Systems and Electronics)
- Department of Industry (National Engineering Laboratory)*
- Department of the Environment (Water Engineering Division, including the Water Data Unit)*
- Electrical, Electronic, Telecommunications and Plumbing Union
- Electricity Supply Industry in England and Wales
- Energy Industries Council
- Engineering Equipment Users' Association
- Institute of Measurement and Control
- Institution of Gas Engineers
- Oil Companies Materials Association
- Post Office Engineering Union
- Scientific Instrument Manufacturers' Association*
- Sira Institute

The organizations marked with an asterisk in the above list, together with the following, were directly represented on the Technical Committee entrusted with the preparation of this British Standard:

- Clyde River Purification Board
- Department of the Environment (Hydraulic Research Station)
- Department of the Environment for Northern Ireland
- Institution of Civil Engineers
- Institution of Water Engineers and Scientists
- National Water Council
- Scottish Development Department
- Thames Water Authority (Metropolitan Water Division)
- Welsh Office
- Individual experts

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Foreword

This Part of this British Standard has been prepared under the direction of the Industrial-process Measurement and Control Standards Committee.

This Part complements BS 3680-7 and BS 3680-9A. It deals exclusively with the mechanical and electromagnetic types of instrument. Electronic instruments are dealt with in ISO 4373:1979, published by the International Organization for Standardization (ISO); ISO 4373 is currently being revised to take account of the latest developments in electronic instrumentation, and it is expected that the revised standard will be implemented in a British Standard.

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.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 12, 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 Part of this British Standard specifies the functional requirements of instruments for recording continuously, or as point readings at regular intervals, the levels of water surfaces in open channels and other bodies of water such as lakes or reservoirs.

Appendix A gives examples of types of format for recorded data.

Appendix B gives guidance on the use of stilling wells.

2 References

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

3 Definitions

For the purposes of this British Standard the definitions given in BS 3680-1 apply, together with the following:

3.1

recording head

the part of the recorder that transfers the sensed stage to the recording medium

3.2

recording stylus

the part of the recording head that transfers the observed data, in either analogue or digital form, to the recording medium

3.3

punching head

a particular type of recording head on a digital recorder in which the stage value is punched through a recording tape, usually in a binary code

3.4

timing device

the part of a recorder which provides a time base

3.5

trace reversal

a facility by which the direction of the trace is reversed when the recorded value exceeds the maximum value that can be accommodated by the chart scale

3.6

grammage

the mass per unit area of the recording medium

3.7

bulk density

the ratio of mass per unit area to thickness

3.8

machine direction

the principal direction of alignment of the fibres of a paper recording medium

3.9

cross direction

the direction perpendicular to the principal direction of alignment of the fibres of a paper recording medium

3.10

coefficient of hygroscopic expansion

a coefficient expressed as the percentage change of dimensions of a material per 10 % change in relative humidity

3.11

lag

the difference between the water level on the inside of a stilling well at any instant and the free surface level outside the stilling well

4 Environment

4.1 The water level recorder shall remain operational and be capable of producing valid data under the following environmental conditions:

relative humidity: 10 % to 95 %;

atmospheric pressure: 960 mbar to 1 040 mbar¹⁾;

ambient temperature extremes: – 40 °C to + 50 °C.

NOTE Normal operating temperature conditions lie well within these extremes.

Adjustment, regulation or exchange of components shall be permissible, to accord with local conditions, to enable the water level recorder to comply with the functional requirements of this standard.

4.2 The equipment shall be capable of operating reliably for periods of not less than three years between off-site service overhauls.

NOTE The equipment should be protected from atmospheric environmental conditions by being located in a suitable instrument house. When measuring natural water levels, it may be found necessary to employ stilling wells in order to damp out rapid oscillations of the water surface.

5 Instrument construction

5.1 The instrument casing shall be protected against ingress of moisture and dust. The degree of protection shall be given in the appropriate equipment specification and shall be classified in accordance with BS 5490. The casing shall inhibit the harbouring of insects likely to affect the accurate operation of the equipment.

¹⁾ 1 mbar = 10² N/m² = 10² Pa.

5.2 Materials used in the construction of the equipment shall resist abrasion and corrosion in hostile environments such as marine areas and those containing industrial pollutants. The degree of protection shall be given in the equipment specification, calling up the appropriate environmental tests as laid down in the relevant Parts of BS 2011. The materials used shall also resist attack by insects or other destructive animals or be suitably protected from them. In the case of any element of the equipment whose dimensions are critical to the accuracy of the measurements being taken, overall thermal and hygroscopic expansion shall be within the accuracy requirements laid down in clause 9. All materials shall be chemically stable and not change their physical characteristics during the operational life of the equipment under the conditions within which it is required to operate.

NOTE Details of the environmental working conditions should be requested from the user when an instrument is ordered.

5.3 When the instrument is enclosed in its casing it shall be possible to examine the recording stylus and scale or to check essential operational features. The instrument shall incorporate provision for firm anchorage and a means of levelling where necessary.

5.4 It shall not be possible to open the instrument casing without the use of a special tool.

5.5 The manufacturer shall specify in an operating manual the precautions to be taken to ensure safety in transit.

5.6 The equipment, either as a unit or in parts, shall be capable of being carried by one man.

NOTE It is recommended that the dimensions of the recording head casing do not exceed 1 000 mm × 600 mm × 600 mm.

6 Recording medium and stylus (analogue recorders)

6.1 Recording material

6.1.1 The paper or other medium used for recording data shall remain functional under the full range of environmental change.

6.1.2 The surface of the recording material shall be capable of accepting a trace from the recording stylus with a minimum of frictional resistance, so that its performance complies with the requirements of 9.1.

6.1.3 The medium shall resist the capillary spreading of water-based and solvent-based inks and other marking materials. The properties of the medium shall be such that the requirements for trace thickness specified in 6.3 are not exceeded.

6.1.4 The material of the recording medium shall be cut in such a manner that the direction in which the height is recorded shall be the same as the machine direction of the material.

6.1.5 The coefficient of hygroscopic expansion of the chart material shall not exceed the following values:

machine direction: 0.04 % per 10 % relative humidity;

cross direction: 0.16 % per 10 % relative humidity.

NOTE It is desirable that materials with lower coefficients of hygroscopic expansion be used if available.

6.1.6 When the chart material is paper, its mass per unit area and bulk density shall lie within the ranges 90 g/m² to 120 g/m² and 0.80 g/cm³ to 1.00 g/cm³ respectively.

6.1.7 When the chart material is a plastic, its mass per unit area and bulk density shall lie within the ranges 100 g/m² to 110 g/m² and 1.2 g/cm³ to 1.4 g/cm³ respectively.

NOTE to 6.1.6 and 6.1.7. In the paper industry the term "grammage" is sometimes used instead of "mass per unit area" (see 3.6).

6.1.8 The recording medium or its mounting shall be capable of accepting written site notes by conventional writing instruments and preprinted scales or other identification information as required.

6.2 Chart design

6.2.1 The chart shall be capable of being positively and accurately located on the chart holder of the recorder. The general arrangement of the recorder shall be such as to facilitate chart removal and replacement.

6.2.2 The chart shall be of the rectangular cartesian coordinate type incorporating a height element (stage) on one axis and a corresponding time element on the other.

6.2.3 The chart shall be aligned with the recorder so that the height scale is parallel to the machine direction of the chart material.

6.2.4 The chart graduation shall be compatible with the height and time scales required.

6.2.5 The chart division lines shall be clearly marked. For display of water level, the thickness of indicating lines shall not exceed the following:

indication of metres: 0.4 mm;

indication of 1/2 metres: 0.25 mm;

indication of minor sub-division: 0.15 mm.

For display of time, the thickness of the lines indicating midnight, 0600 h, 1 200 h and 1 800 h shall not exceed 0.4 mm and for all other hours the thickness of the indicating lines shall not exceed 0.15 mm.