

Measurement of liquid flow in open channels —

Part 7: Specification of equipment for the measurement of water level

ICS 17.120.20

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Committees responsible for this British Standard

The preparation of this British Standard was entrusted by Technical Committee CPI/113, Hydrometry, to Subcommittee CPI/113/5, Flow measuring instruments and equipment, upon which the following bodies were represented:

British Hydrological Society
Chartered Institution of Water and Environmental Management
Environment Agency
GAMBICA

This British Standard, having been prepared under the direction of the Sector Committee for Materials and Chemicals, was published under the authority of the Standards Committee and comes into effect on 15 September 2000

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First published October 1971
Second edition September 2000

The following BSI references relate to the work on this standard:
Committee reference CPI/113/5
Draft for comment 99/402485 DC

ISBN 0 580 33064 8

Amendments issued since publication

Amd. No.	Date	Comments

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Foreword

This part of BS 3680 has been prepared by Technical Committee CPI/113/5. It forms a revision of BS 3680-7:1971, incorporating appropriate contents of BS 3680-9A:1971 and BS 3680-9B:1981, which have been combined in this part of BS 3680 to reflect the current level of technological development in equipment for the measurement of water level. This revision of BS 3680-7 supersedes BS 3680-7:1971, BS 3680-9A:1971 and BS 3680-9B:1981, which are withdrawn.

This standard is one of a series of parts of BS 3680 on measurement of liquid flow in open channels. The other parts are as follows:

- *Part 1: Glossary of terms;*
- *Part 2: Dilution methods;*
- *Part 3: Stream flow measurement;*
- *Part 4: Weirs and flumes;*
- *Part 5: Slope area method of estimation;*
- *Part 6: Guide to measurement of flow in tidal channels;*
- *Part 8: Measuring instruments and equipment;*
- *Part 9: Water level instruments;*
- *Part 10: Sediment transport;*
- *Part 11: Free surface flow in closed conduits.*

Annex A is informative.

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, page i and ii, pages 1 to 14, an inside back cover and a back cover.

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Introduction

Determining the location of a water surface (stage) is a critical starting point for much of hydrometry. It is needed to define a threshold (flood level, tide level), depth (for navigation) or flow (in a stream, of a discharge, of a compensation flow), usually through a calibration process or derived formula, or to infer volume (of a reservoir). It is important to know that the method or equipment selected will be able to produce the level of accuracy and the resolution appropriate to the application, without over-specifying performance. The reading of stage may be required as a single instantaneous measurement, as a short series of instantaneous measurements or as a continuous or practically continuous record of the fluctuations of stage.

1 Scope

This British Standard specifies the functional requirements of instrumentation for measuring the level of water surface (stage) primarily for the purpose of determining flow rates.

This British Standard is supplemented by an annex providing guidance on the types of water level measurement devices currently available (see annex A).

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of this British Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. For undated references, the latest edition of the publication referred to applies.

BS 3680-1, *Measurement of liquid flow in open channels — Glossary of terms*.

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*.

IEC 60079-10, *Electrical apparatus for explosive gas atmospheres — Part 10: Classification of hazardous areas*.

3 Terms and definitions

For the purposes of this part of BS 3680, the terms and definitions given in BS 3680-1 apply.

4 Instrument specification

4.1 Performance classifications

The parameters of performance of a water level measuring device shall be described by the classification categories uncertainty, temperature range and relative humidity so that the overall performance of the equipment may be summarized in three digits.

4.2 Uncertainty of water level measurement

4.2.1 General

Water level measuring devices shall be classified in accordance with the performance classes given in Table 1 in order to take into account the resolution to be achieved and the limits of uncertainty required over specified ranges.

NOTE It should be made clear whether these levels of attainment can only be achieved by the use of special works, for example installation within stilling wells. It is also important to remember that in the measurement of stage, uncertainty expressed as a percentage of range gives rise to worst case uncertainty in the determination of stage at low values of stage. This is highly significant for the measurement of low flows and should be taken into account in the design of equipment for this purpose.

4.2.2 Maximum rate of change

As water levels may rise and fall rapidly in some applications, in order to provide guidance on suitability, the manufacturer shall state on the equipment specification sheet and in the instruction manual:

- the maximum rate of change which the instrument can follow without damage;
- the maximum rate of change which the instrument can tolerate without suffering a change in calibration;
- the response time of the instrument.

Table 1 — Uncertainty classes of water level measuring devices

Class	Resolution	Range	Uncertainty
Uncertainty class 1	1 mm	1.0 m	$\leq \pm 0.1\%$ of range
	2 mm	5.0 m	
	10 mm	20 m	
Uncertainty class 2	2 mm	1.0 m	$\leq \pm 0.3\%$ of range
	5 mm	5.0 m	
	20 mm	20 m	
Uncertainty class 3	10 mm	1.0 m	$\leq \pm 1\%$ of range
	50 mm	5.0 m	
	200 mm	20 m	
NOTE In each case the uncertainty is specified with respect to the range of environmental conditions defined in 4.3.			

4.3 Environment

4.3.1 General

Water level measuring devices shall operate within the ranges of temperature in 4.3.2 and the ranges of relative humidity in 4.3.3.

4.3.2 Temperature

Water level measuring devices shall operate within the following temperature classes:

- temperature class 1: $-25\text{ }^{\circ}\text{C}$ to $+55\text{ }^{\circ}\text{C}$;
- temperature class 2: $-10\text{ }^{\circ}\text{C}$ to $+50\text{ }^{\circ}\text{C}$;
- temperature class 3: $0\text{ }^{\circ}\text{C}$ to $+50\text{ }^{\circ}\text{C}$.

4.3.3 Relative humidity

Water level measuring devices shall operate within the following relative humidity classes:

- relative humidity class 1: 5 % to 95 % including condensation;
- relative humidity class 2: 10 % to 90 % including condensation;
- relative humidity class 3: 20 % to 80 % excluding condensation.

4.4 Timing

4.4.1 General

Where timing, either analogue or digital, is part of the instrument specification, the timing method used shall be clearly stated on the instrument and in the instruction manual.

NOTE It is recognized that digital timing is inherently more accurate than analogue timing.

4.4.2 Digital

The uncertainty of digital timing devices used in water level measuring devices shall be within $\pm 5\text{ s}$ a day measured over a period of 30 days within the range of environmental conditions defined in 4.3.

4.4.3 Analogue

The uncertainty of analogue timing devices used in water level measuring devices shall be within $\pm 30\text{ s}$ a day measured over a period of 30 days within the range of environmental conditions defined in 4.3.

5 Recording

5.1 Chart recorders

NOTE Chart recorders have been superseded to a large extent by data logging devices. However, they are still used as back-up units or to provide rapid visual assessment of flow changes on site.

Where a chart recorder is to be used as the primary source of data the resolution and uncertainty parameters shall take account of changes in the dimensions of the recording medium due to atmospheric variables.

5.2 Data loggers

A data logger shall be able to store at least the equivalent of 4 digits per reading. Where a data logger includes the interface electronics, the resolution and uncertainty shall relate to the stored value.