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Measurement of liquid flow in open channels —

Part 4: Weirs and flumes —

Part 4B: Triangular profile weirs

[ISO title: Liquid flow measurement in open channels by weirs
and flumes — Triangular profile weirs]

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Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Industrial-process Measurement and Control Standards Committee (PCL/-) to Technical Committee PCL/3, upon which the following bodies were represented:

- Department of the Environment for Northern Ireland
- Institute of Measurement and Control
- Institution of Civil Engineers
- Institution of Water Engineers and Scientists
- Scottish Development Department
- Water Authority Association
- Welsh Office

The following bodies were also represented in the drafting of the standard, through subcommittees and panels:

- Anglian Water Authority
- British Effluent and Water Association

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National foreword

This Part of BS 3680 has been prepared under the direction of the Industrial-process Measurement and Control Standards Committee. It is identical with ISO 4360:1984 “*Liquid flow measurement in open channels by weir and flumes — Triangular profile weirs*”, published by the International Organization for Standardization (ISO). This standard supersedes BS 3680-4B:1969 which is withdrawn.

Terminology and conventions. The text of the International Standard has been approved as suitable for publication as a British Standard without deviation. Some terminology and certain conventions are not identical with those used in British Standards; attention is drawn especially to the following.

Wherever the words “International Standard” appear, referring to this standard, they should be read as “British Standard”.

The comma has been used as a decimal marker. In British Standards it is current practice to use a full point on the baseline as the decimal marker.

Cross-references

International Standard	Corresponding British Standard
	BS 3680 <i>Methods of measurement of liquid flow in open channels</i>
ISO 748:1979	Part 3A:1980 <i>Velocity-area methods</i> (Identical)
ISO 5168:1978	BS 5844:1980 <i>Methods of measurement of fluid flow: estimation of uncertainty of a flow-rate measurement</i> (Identical)

The Technical Committee has reviewed the provisions of ISO 772:1978, to which reference is made in the text, and has decided that they are acceptable for use in conjunction with this standard.

A related British Standard to ISO 772 is BS 3680-1:1983 “*Glossary of terms*”.

At present there is no corresponding British Standard for ISO 4373:1979 which is quoted for information purposes only.

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 16, 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 and field of application

This International Standard specifies methods for the measurement of the flow of water in open channels under steady flow conditions using triangular profile weirs. The flow conditions considered are steady flows which are uniquely dependent on the upstream head and drowned flows which depend on downstream as well as upstream levels.

2 References

- ISO 748, *Liquid flow measurement in open channels — Velocity-area methods*.
 ISO 772, *Liquid flow measurement in open channels — Vocabulary and symbols*.
 ISO 4373, *Measurement of liquid flow in open channels — Water level measuring devices*.
 ISO 5168, *Measurement of fluid flow — Estimation of uncertainty of a flow-rate measurement*.

3 Definitions and symbols

For the purpose of this International Standard, the definitions given in ISO 772 apply. The symbols used in this International Standard are given in the Annex.

4 Units of measurement

The units of measurement used in this International Standard are seconds and metres.

5 Installation

Conditions regarding preliminary survey, selection of site, installation, the approach channel, maintenance, measurement of head, and stilling or float wells which are generally necessary for flow measurement are given in the following sub-clauses. The particular requirements for the triangular profile weir are given separately in clause 8.

5.1 Selection of site

5.1.1 A preliminary survey shall be made of the physical and hydraulic features of the proposed site, to check that it conforms (or may be made to conform) to the requirements necessary for measurement by a weir.

Particular attention should be paid to the following features in selecting the site:

- a) availability of an adequate length of channel of regular cross-section;
- b) the existing velocity distribution;
- c) the avoidance of a steep channel, if possible;
- d) the effects of any increased upstream water level due to the measuring structure;
- e) conditions downstream including such influences as tides, confluences with other streams, sluice gates, mill dams and other controlling features which might cause submerged flow;
- f) the impermeability of the ground on which the structure is to be founded, and the necessity for piling, grouting or other sealing-in river installations;
- g) the necessity for flood banks to confine the maximum discharge to the channel;
- h) the stability of the banks, and the necessity for trimming and/or revetment in natural channels;
- j) the clearance of rocks or boulders from the bed of the approach channel;
- k) the effect of wind; wind can have a considerable effect on the flow in a river or over a weir, especially when these are wide and the head is small and when the prevailing wind is in a transverse direction.

If the site does not possess the characteristics necessary for satisfactory measurement, the site shall be rejected unless suitable improvements are practicable.

If an inspection of the stream shows that the existing velocity distribution is regular, then it may be assumed that the velocity distribution will remain satisfactory after the construction of a weir.

If the existing velocity distribution is irregular and no other site for a gauge is feasible, due consideration shall be given to checking the distribution after the installation of the weir and to improving it if necessary.

Several methods are available for obtaining a more precise indication of irregular velocity distribution: velocity rods, floats or concentrations of dye can be used in small channels, the latter being useful in checking conditions at the bottom of the channel. A complete and quantitative assessment of velocity distribution may be made by means of a current-meter. Complete information about the use of current-meters is given in ISO 748.

5.2 Installation conditions

5.2.1 General

The complete measuring installation consists of an approach channel, a measuring structure and a downstream channel. The conditions of each of these three components affect the overall accuracy of the measurements.

Installation requirements include such features as weir finish, cross-sectional shape of channel, channel roughness, influence of control devices upstream or downstream of the gauging structure.

The distribution and direction of velocity, determined by the features outlined in **5.1.1**, have an important influence on the performance of the weir.

Once an installation has been constructed, the user shall prevent any change which could affect the discharge characteristics.

5.2.2 Approach channel

On all installations the flow in the approach channel shall be smooth, free from disturbance and shall have a velocity distribution as normal as possible over the cross-sectional area. This can usually be verified by inspection or measurement. In the case of natural streams or rivers this can only be attained by having a long straight approach channel free from projections either at the side or on the bottom. Unless otherwise specified in the appropriate clauses, the following general requirements shall be complied with.

The altered flow-conditions due to the construction of the weir might have the effect of building up shoals of debris upstream of the structure, which in time might affect the flow conditions. The likely consequential changes in the water level shall be taken into account in the design of gauging stations.

In an artificial channel the cross-section shall be uniform and the channel shall be straight for a length equal to at least five times its breadth.

In a natural stream or river the cross-section shall be reasonably uniform and the channel shall be straight for such a length as to ensure regular velocity distribution.

If the entry of the approach channel is through a bend or if the flow is discharged into the channel through a conduit of smaller cross-section, or at an angle, then a longer length of straight approach channel may be required to achieve a regular velocity distribution.

There shall be no baffle nearer to the points of measurement than five times the maximum head to be measured.

Under certain conditions, a standing wave may occur upstream of the gauging device, for example if the approach channel is steep. Provided this wave is at a distance of not less than 30 times the maximum head upstream, flow measurement will be feasible, subject to confirmation that a regular velocity distribution exists at the gauging station.

5.2.3 Measuring structure

The structure shall be rigid and watertight and capable of withstanding flood flow conditions without distortion or fracture. It shall be at right angles to the direction of flow and shall conform to the dimensions given in the relevant clauses.

5.2.4 Downstream of the structure

The channel downstream of the structure is of no importance as such if the weir has been so designed that the flow is modular under all operating conditions. A downstream gauge shall be provided to measure tailwater levels to determine when submerged flow occurs.

In the event of the possibility of scouring downstream, which phenomenon may also lead to the instability of the structure, particular measures to prevent this happening may be necessary.

A crest tapping and separate stilling well shall be fitted if the weir is designed to operate in a drowned condition or if there is a possibility that the weir may drown in the future.

The latter circumstance may arise if the altered flow conditions due to the construction of the weir have the effect of building up shoals of debris immediately downstream of the structure or if river works are carried out downstream at a later date.

6 Maintenance

Maintenance of the measuring structure and the approach channel is important to secure accurate continuous measurements.

It is essential that the approach channel to weirs should be kept clean and free from silt and vegetation as far as practicable for at least the distance specified in 5.2.2. The float well and the entry from the approach channel shall also be kept clean and free from deposits.

The weir structure shall be kept clean and free from clinging debris and care shall be taken in the process of cleaning to avoid damage to the weir crest.

7 Measurement of head

7.1 General

The head upstream of the measuring structure may be measured by a hook-gauge, point-gauge or staff-gauge where spot measurements are required, or by a recording-gauge where a continuous record is required, and in many cases it is preferable to measure heads in a separate stilling-well to reduce the effects of water surface irregularities.

The discharges given by the working equation are volumetric figures, and the liquid density does not affect the volumetric discharge for a given head provided that the operative head is gauged in liquid of identical density. If the gauging is carried out in a separate well, a correction for the difference in density may be necessary if the temperature in the well is significantly different from that of the flowing liquid. However, it is assumed herein that the densities are equal.

7.2 Stilling-well or float-well

Where provided, the stilling-well shall be vertical and have a margin of 0,6 m over the maximum water level estimated to be recorded in the well.

It shall be connected to the river by an inlet pipe or slot, large enough to permit the water in the well to follow the rise and fall of head without significant delay.

The connecting pipe or slot shall, however, be as small as possible, consistent with ease of maintenance, or, alternatively, shall be fitted with a constriction to damp out oscillations due to short amplitude waves.

The well and the connecting pipe or slot shall be watertight. Where provided for the accommodation of the float of a level recorder, the well shall be of adequate diameter and depth to accommodate the float.

The well shall also be deep enough to accommodate any silt which may enter, without the float grounding. The float-well arrangement may include an intermediate chamber between the stilling-well and the approach channel of similar proportions to the stilling-well to enable silt and other solids to settle out. For ease of maintenance the pipework may be valved.

For a detailed description of the stilling-well, see ISO 4373.

7.3 Zero setting

A means of checking the zero setting of the head-measuring devices shall be provided, consisting of a datum related to the level of the weir.

A zero check based on the level of the water when the flow ceases is liable to serious errors from surface tension effects and shall not be used.

As the size of the weir and the head on it reduces, small errors in construction and in the zero setting and reading of the head-measuring device become of greater importance.