

CONFIRMED
MARCH 1998

Measurement of liquid flow in open channels —

Part 4: Weirs and flumes —

Part 4I: V-shaped broad crested weirs

[ISO title: Liquid flow measurement in open channels by weirs
and flumes — V-shaped broad crested weirs]

UDC 532.543:532.57:681.12

NO COPYING WITHOUT BSI PERMISSION EXCEPT AS PERMITTED BY COPYRIGHT LAW

BSI
Documents

AVA

Document Sharing Hub

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
- Department of the Environment — Welsh Office
- Institute of Measurement and Control
- Institution of Civil Engineers
- Institution of Water Engineers and Scientists
- Scottish Development Department
- Water Authorities Association

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

- Anglian Water Authority
- British Effluent and Water Association

This British Standard, having been prepared under the direction of the Industrial-process Measurement and Control Standards Committee, was published under the authority of the Board of BSI and comes into effect on 30 September 1986

© BSI 12-1999

The following BSI references relate to the work on this standard:
Committee reference PCL/3
Draft for comment 84/21095 DC

ISBN 0 580 15312 6

Amendments issued since publication

Amd. No.	Date of issue	Comments

Contents

	Page
Committees responsible	Inside front cover
National foreword	ii
1 Scope and field of application	1
2 References	1
3 Definitions	1
4 Units of measurement	1
5 Installation	1
6 General requirements for maintenance	4
7 Measurement of head	4
8 V-shaped broad-crested weirs	6
9 Discharge equations	7
10 Errors in flow measurement	9
Annex A Scaling effects	13
Annex B "More than full" flow	14
Annex C Submerged flow	15
Figure 1 — V-shaped broad-crested weir	3
Figure 2 — Longitudinal section of three types of construction	3
Figure 3 — Determination of head-gauge datum	5
Figure 4 — Dimensions of weir and flow	6
Figure 5 — Discharge coefficient as a function of h_1/L	7
Figure 6 — Flow-pattern above crest for free flow with $h_1/L = 0,353$	8
Figure 7 — Dimensions for "more than full" flow	14
Figure 8 — Modular limit for V-shaped broad-crested weirs	15
Figure 9 — Submerged flow reduction factor for V-shaped broad-crested weirs	16
Publications referred to	Inside back cover

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 8333:1985 “*Liquid flow measurement in open channels by weirs and flumes — V-shaped broad-crested weirs*”, published by the International Organization for Standardization (ISO).

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
ISO 5168:1978	BS 5844:1981 <i>Methods of measurement of fluid flow: estimation of uncertainty of a flowrate 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*”.

A related British Standards to ISO 4374, which is quoted for information purposes only is BS 3680-4F:1981.

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 a method for the measurement of subcritical flow in small rivers and artificial channels using V-shaped broad-crested weirs.

The advantages of this type of weir are described in clause 8.

NOTE A comparison of the different types of weirs and flumes will form the subject of a future International Standard.

2 References

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 4374, *Liquid flow measurement in open channels — Round-nose horizontal crest weirs*.

ISO 5168, *Measurement of fluid flow — Estimation of uncertainty of a flow-rate measurement*.

3 Definitions

For the purposes of this International Standard, the definitions given in ISO 772 apply.

4 Units of measurement

The units of measurement used in this International Standard are SI units.

5 Installation

5.1 Selection of site

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 using the weir.

Particular attention shall be paid to the following features in selecting the site of the weir:

- a) the availability of an adequate length of channel of regular cross-section;
- b) the existing velocity distribution;
- c) the avoidance of channels having gradients greater than 1 in 250;
- d) the consequential effects of any increased upstream water level due to the measuring structure;
- e) the consequential conditions downstream, including such influences as tides, confluences with other streams, sluice gates, mill dams and other controlling features which might cause drowning;

- 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 effects of wind (wind can have a considerable effect on the flow in a river or over a weir, especially if 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 required for satisfactory measurements, it shall be rejected unless suitable improvements are practicable.

If a survey of a stream shows that the existing velocity distribution is regular, then it is assumed that the velocity distribution will remain satisfactory after the weir has been built.

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 weir has been installed and to improving it, if necessary.

Several methods are available for obtaining more precise indications 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.

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 parameters of each of these three components affect the overall accuracy of the measurements.

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

The distribution and direction of velocity have an important influence on the performance of a weir, these factors being determined by the features mentioned above.

Once an installation has been designed, the user shall eschew any changes which could affect the discharge characteristics.

5.2.2 Approach channel

For 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 into the flow. Unless otherwise specified in the appropriate clauses, the approach channel shall comply with the general requirements outlined below.

The altered flow conditions due to the construction of the weir may have the effect of building up shoals of debris upstream of the structure, which in time may affect the flow conditions. The likely consequential changes in the water level should 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 10 times its width.

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 to 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 is required to achieve a regular velocity distribution.

Baffles shall not be installed closer to the points of measurement than 10 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 is feasible, subject to confirmation that a regular velocity distribution exists at the gauging station.

If a standing wave occurs within this distance, the approach conditions and/or gauging device shall be modified.

5.2.3 Measuring structure

The structure shall be rigid, watertight and capable of withstanding flow conditions without distortion or fracture. It shall be at right angles to the direction of flow and shall have the dimensions specified in the relevant clauses (see also Figure 1).

The V-shaped broad-crested weir may be constructed with either a fixed crest or a movable one with vertical slots (see Figure 2).

5.2.4 Movable measuring structure

The movable V-shaped broad-crested weir can be constructed with one vertical slot in which the supporting plate of the weir crest can be raised or lowered according to the desired crest level. A vertical guide wall founded at the channel bottom and parallel to the supporting plate acts as a watertight barrier for the movable weir.

If regular flushing of sediment is expected to be necessary, the weir can be constructed with two slots. The movable weir can be operated in the downstream slot while a bottom gate is placed in the upstream slot. During measurement of flow, the gate is closed at the bottom. To flush sediment that has settled upstream of the weir, the gate can be opened by connecting it to the movable weir and raising the weir and gate together.

