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Flow measurement structures — Rectangular, trapezoidal and U-shaped flumes

Structures de mesure du débit — Canaux jaugeurs à col rectangulaire, à col trapézoïdal et à col en U

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 113, *Hydrometry*, Subcommittee SC 2, *Flow measurement structures*.

This third edition cancels and replaces the second edition (ISO 4359:2013), which has been technically revised. It also incorporates the Amendment ISO 4359:2013/Amd.1:2017.

The main changes are as follows:

— 6.1.2 a) and 6.2.3.2 b) have been revised with respect to the flume approach conditions.

— Errors that were introduced in Amendment ISO 4359:2013/Amd.1:2017 have been corrected.

— An acknowledgement has been added that some of the specified tolerances can be difficult to achieve in some installations.

— The spreadsheets have been revised to provide further advice if parameters are outside the applicability range of the curve-fitting formulae for the relative boundary layer thickness (δ^*/L).

— The first edition of this document (ISO 4359:1983) had an additional limitation requiring that the gauged head, h, be not more than 2 m. However, there is no technical justification for this restriction, so it does not appear in the second and third editions of this document.

— In 11.4.7 and 12.4.7, although the relationship of C_s with mH_e/b_e varies very slightly with flume geometry and the value of the boundary layer displacement thickness, this variation was disregarded when applying the coefficient method in the first edition of this document, as a single graphical relationship was provided for trapezoidal flumes. This approximation has been remedied in the second and third editions of this document.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Flow measurement structures — Rectangular, trapezoidal and U-shaped flumes

1 Scope

This document specifies methods for the measurement of flow in rivers and artificial channels under steady or slowly varying flow conditions, using certain types of critical-depth flumes (also known as "standing-wave flumes"). A wide variety of flumes has been developed, but only those critical-depth flumes which have received general acceptance after adequate research and field testing, and which therefore do not require *in situ* calibration, are considered herein.

The flow conditions considered are uniquely dependent on the upstream head, i.e. subcritical flow must exist upstream of the flume, after which the flow accelerates through the contraction and passes through its critical depth (see Figure 1). The water level downstream of the structure is low enough to have no influence upon its performance.

This document is applicable to three commonly used types of flumes, covering a wide range of applications, namely rectangular-throated, trapezoidal-throated and U-throated. The hydraulic theory behind this document was presented in Reference [7].

This document is not applicable to a form of flume referred to in the literature (sometimes called a "Venturi" flume) in which the flow remains subcritical throughout.

NOTE The Venturi form of flume is based on the same principle as a Venturi meter used within a closed conduit system and relies upon gauging the head at two locations and the application of Bernoulli's energy formula.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 772, *Hydrometry — Vocabulary and symbols*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 772 apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

4 Symbols

Symbol	Quantity	Unit of measurement
A	area of cross-section of flow	m^2
B	width of approach channel (width at bed if trapezoidal)	m
b	width of flume throat (width at bed if trapezoidal)	m
C	overall coefficient of discharge (rectangular flumes)	non-dimensional