

AS 3778.4.1:2022
ISO 1438:2017



STANDARDS
Australia



Measurement of water flow in open channels

Part 4.1: Measurement using flow gauging structures — Thin-plate weirs
(ISO 1438:2017, IDT)



currently in preview, click buy full version

AS 3778.4.1:2022

This Australian Standard ® was prepared by CE-024, Measurement Of Water Flow In Open Channels and Closed Conduits. It was approved on behalf of the Council of Standards Australia on 30 May 2022.

This Standard was published on 10 June 2022.

The following are represented on Committee CE-024:

- Australian Bureau of Meteorology
- Australian Hydrographers Association
- Australian Industry Group
- Department of Planning, Industry and Environment, NSW
- Engineers Australia
- Institute of Instrumentation, Control & Automation Australia
- Irrigation Australia
- Joint Accreditation System of Australia & New Zealand
- National Measurement Institute
- Water NSW

This Standard was issued in draft form for comment as DR AS 3778.4.1:2022.

Keeping Standards up-to-date

Ensure you have the latest versions of our publications and keep up-to-date about Amendments, Rulings, Withdrawals, and new projects by visiting:

www.standards.org.au

ISBN 978 1 76113 819 5

Measurement of water flow in open channels

Part 4.1: Measurement using flow gauging structures — Thin-plate weirs (ISO 1438:2017, IDT)

Origin: technical specification AS 3778.4.1—1991.
Second edition 2022.

COPYRIGHT

© ISO 2022 — All rights reserved
© Standards Australia Limited 2022

All rights are reserved. No part of this work may be reproduced or copied in any form or by any means, electronic or mechanical, including photocopying, without the written permission of the publisher, unless otherwise permitted under the Copyright Act 1968 (Cth).

Preface

This Standard was prepared by the Standards Australia Committee CE-024, Measurement of water flow in open channels and closed conduits, to supersede AS 3778.4.1:1991, *Measurement of water flow in open channels, Part 4: Measurement using flow gauging structures, Method 4.1: Thin-plate weirs*.

The objective of this document is to define the requirements for the use of rectangular and triangular (V-notch) thin-plate weirs for the measurement of flow of clear water in open channels under free flow conditions. It includes the requirements for the use of full-width rectangular thin-plate weirs in submerged (drowned) flow conditions.

This document is identical with, and has been reproduced from, ISO 1438:2017, *Hydrometry — Open channel flow measurement using thin-plate weirs*.

As this document has been reproduced from an International document, a full point substitutes for a comma when referring to a decimal marker.

Australian or Australian/New Zealand Standards that are identical adoptions of international normative references may be used interchangeably. Refer to the online catalogue for information on specific Standards.

The terms “normative” and “informative” are used in Standards to define the application of the appendices or annexes to which they apply. A “normative” appendix or annex is an integral part of a Standard, whereas an “informative” appendix or annex is only for information and guidance.

Contents

Preface	ii
Foreword	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Symbols and abbreviated terms	1
5 Principle	2
6 Installation	2
6.1 General	2
6.2 Selection of site	2
6.3 Installation conditions	2
6.3.1 General	2
6.3.2 Weir	3
6.3.3 Approach channel	3
6.3.4 Downstream channel	4
7 Measurement of head	4
7.1 Head-measuring devices	4
7.2 Stilling or float well	4
7.3 Head-measurement section	5
7.3.1 Upstream head-measurement	5
7.3.2 Downstream head measurement	5
7.4 Head-gauge datum (gauge zero)	5
8 Maintenance	6
9 Rectangular thin-plate weir	6
9.1 Types	6
9.2 Specifications for the standard weir	7
9.3 Specifications for installation	8
9.4 Determination of gauge zero	8
9.5 Discharge formulae — General	10
9.6 Formulae for the basic weir form (all values of b/B)	10
9.6.1 Kindsvater-Carter formula	10
9.6.2 Evaluation of C_d , k_b and k_h	10
9.6.3 Formulae for C_d	12
9.6.4 Practical limitations on h/p , h , b and p	13
9.7 Formulae for full-width weirs ($b/B = 1,0$)	13
9.7.1 Modular flow discharge formula	13
9.7.2 Non-modular flow discharge formula	14
10 Triangular-notch thin-plate weir	15
10.1 Specifications for the standard weir	15
10.2 Specifications for the installation	18
10.3 Specifications for head measurement	18
10.3.1 General	18
10.3.2 Determination of notch angle	18
10.3.3 Determination of gauge zero	18
10.4 Discharge formulae — General	19
10.5 Formula for all notch angles between $\pi/9$ and $5\pi/9$ radians (20° and 100°)	19
10.5.1 Kindsvater-Shen formula	19
10.5.2 Evaluation of C_d and k_h	19
10.5.3 Practical limitations on α , h/p , p/B , h and p	21
10.6 Formula for specific notch angles (fully-contracted weir)	21

10.7	Accuracy of discharge coefficients — Triangular-notch weirs.....	22
11	Uncertainties of flow measurement.....	22
11.1	General.....	22
11.2	Combining measurement uncertainties.....	23
11.3	Uncertainty of discharge coefficient, $u^*(C_d)$, for thin-plate weirs.....	24
11.4	Uncertainty budget.....	25
12	Example.....	25
12.1	General.....	25
12.2	Characteristics — Gauging structure.....	25
12.3	Characteristics — Gauged head instrumentation.....	26
12.4	Discharge coefficient.....	26
12.5	Discharge estimate.....	26
12.6	Uncertainty statement.....	26
Annex A	(informative) Flow measurement with small weir tanks.....	29
Annex B	(normative) Guide to the design and installation of a flow straightener.....	31
Annex C	(informative) Introduction to measurement uncertainty.....	33
Annex D	(informative) Sample measurement performance for use in hydrometric worked examples.....	41
Annex E	(informative) Specimen tables.....	44
Bibliography	59

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 on 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 the following URL: 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 1438:2008), which has been technically revised. It also incorporates the Technical Corrigendum ISO 1438:2008/Cor 1:2008.

The major changes from ISO 1438:2008 are as follows:

- a) the modular flow discharge formula for weirs with weir plate height of $1 \text{ m} \leq p \leq 2,5 \text{ m}$ has been supplemented in [9.7.1](#);
- b) the C_d formula for rectangular weir with $b/B = 1,0$, [Formula \(5\)](#), has been corrected to the same formula as the full-width weir, [Formula \(15\)](#);
- c) subclause numbers of [9.6](#) have been re-numbered.

NOTES

Currently in preview, click buy full version

Australian Standard®

Measurement of water flow in open channels

Part 4.1: Measurement using flow gauging structures — Thin-plate weirs (ISO 1438:2017, IDT)

1 Scope

This document defines the requirements for the use of rectangular and triangular (V-notch) thin-plate weirs for the measurement of flow of clear water in open channels under free flow conditions. It includes the requirements for the use of full-width rectangular thin-plate weirs in submerged (drowned) flow conditions.

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 terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

4 Symbols and abbreviated terms

Symbol	Unit	Description
A	m^2	Area of approach channel
B	m	Width of approach channel
b	m	Measured width of the notch
b_{\max}	m	Width of notch at maximum head (V-notch)
C		Discharge coefficient (gauged head)
C_d		Coefficient of discharge
f		Drowned flow reduction factor
C_v		Coefficient of velocity
Δb	m	Random uncertainty in the width measurement
g	m/s^2	Acceleration due to gravity
H	m	Total head above crest level
h	m	Upstream gauged head above crest level (upstream head is inferred if no subscript is used)
J		Numerical constant
l	m	Distance of the head measurement section upstream of the weir
n		Number of measurements in a set
p	m	Height of the crest relative to the floor
Q	m^3/s	Volumetric rate of flow