

AS 3778.4.10:2022
ISO 18481:2017



Measurement of water flow in open channels

Part 4.10: Measurement using flow gauging structures — End-depth method for estimation of flow in channels with a free overfall (ISO 18481:2017, IDT)



AS 3778.4.10:2022

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 3778.4.10:2022.

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

Measurement of water flow in open channels

Part 4.10: Measurement using flow gauging structures — End-depth method for estimation of flow in channels with a free overfall (ISO 18481:2017, IDT)

Originated as AS 3778.4.10—1991.
Second edition 2022.

COPYRIGHT

Standards Australia Ltd 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 3778.4.10 — 1991, *Measurement of water flow in open channels, Method 4.10: Measurement using flow gauging structures — End-depth method for estimation of flow in rectangular channels with a free overfall*.

The objective of this document is to specify a method for the estimation of the sub-critical flow of clear water in a smooth, essentially horizontal channel (or a gently sloping channel), abruptly discontinued at bottom by a hydraulic structure, with a vertical drop and discharging freely. Such an overfall forms a control section and offers a means for the estimation of flow using the end depth measurement method.

A wide variety of channel cross-sections with overfall have been studied, but only those which have received general acceptance after adequate research and testing, and therefore do not require *in situ* calibration, are considered. The types of channel cross-sections covered in this document are the following:

- (a) Rectangular with confined and unconfined nappe.
- (b) Trapezoidal.
- (c) Triangular.
- (d) Circular.
- (e) Parabolic.

This document is identical with, and has been reproduced from, ISO 18481:2017, *Hydrometry — Liquid flow measurement using end depth method in channels with a free overfall*.

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	2
5 Principle	2
6 Installation	2
6.1 General	2
6.2 Selection of site	2
7 Measurement of end depth	3
7.1 General	3
7.2 Head measuring devices	3
7.3 Gauge datum	3
8 Maintenance	3
8.1 General	3
8.2 Types	4
8.3 Specifications for the drop structure	5
8.4 Specifications for installation	6
8.5 Determination of gauge zero	6
8.6 Discharge relationship	6
8.7 Coefficient of discharge	6
8.7.1 Confined nappe	6
8.7.2 Unconfined nappe	6
8.8 Practical limitations	6
8.9 Uncertainty of measurement	7
9 Triangular channel drop structure	7
9.1 Specifications for the drop structure	7
9.2 Specifications for installation	7
9.3 Specifications for head measurement	7
9.3.1 General	7
9.3.2 Determination of channel angle	7
9.3.3 Determination of gauge zero	8
9.4 Discharge formula — Unconfined	8
9.5 Practical limitations	8
9.6 Uncertainty of measurement	8
10 Trapezoidal channel drop structure	9
10.1 Specifications for the drop structure	9
10.2 Specifications for head measurement	9
10.2.1 General	9
10.2.2 Determination of gauge zero	9
10.3 Discharge formula — Unconfined	9
10.4 Practical limitations	10
10.5 Uncertainty of measurement	10
11 Circular channel drop structure	11
11.1 Specifications for the drop structure	11
11.2 Specifications for head measurement	11
11.2.1 General	11
11.2.2 Determination of gauge zero	11
11.3 Discharge formula — Unconfined	11

11.4	Practical limitations	13
11.5	Uncertainty of measurement	13
12	Parabolic channel drop structure	14
12.1	Specifications for the drop structure	14
12.2	Specifications for head measurement	14
12.2.1	General	14
12.2.2	Geometry	14
12.2.3	Determination of gauge zero	14
12.3	Discharge formula — Unconfined	15
12.4	Practical limitations	15
13	Uncertainties of flow measurement	15
13.1	General	15
13.2	Sources of error	15
13.3	Kinds of error	16
13.4	Uncertainties in coefficient values	16
13.5	Uncertainties in measurements made by the user	17
13.6	Combination of uncertainties to give total uncertainty on discharge	17
13.7	Example	17
	Bibliography	20

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 first edition of ISO 18481 cancels and replaces ISO 3847:1977 and ISO 4371:1984, which have been merged and technically revised.

NOTES

Australian Standard®

Measurement of water flow in open channels

Part 4.10: Measurement using flow gauging structures — End-depth method for estimation of flow in channels with a free overfall (ISO 18481:2017, IDT)

1 Scope

This document specifies a method for the estimation of the sub-critical flow of clear water in a smooth, essentially horizontal channel (or a gently sloping channel), abruptly discontinued at bottom by a hydraulic structure, with a vertical drop and discharging freely. Such an overfall forms a control section and offers a means for the estimation of flow using the end depth measurement method. A wide variety of channel cross-sections with overfall have been studied, but only those which have received general acceptance after adequate research and testing, and therefore do not require in situ calibration, are considered. This document covers channels with the following types of cross-sections:

- a) rectangular with confined and unconfined nappe;
- b) trapezoidal;
- c) triangular;
- d) circular;
- e) parabolic.

The flow at the brink is curvilinear; therefore, the measured depth at the drop is not equal to the critical depth as computed by the principle based on assumption of parallel flow. However, the end depth and the critical depth (as in the case of the assumption of parallel flow) have unique relation, which is used to estimate the flow through these structures.

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 <https://www.iso.org/obp>