AS 3778.4.11—1991
ISO 4371:1984
(Reconfirmed 2009)

AS 3778.4.11—1991

Australian Standard®

Measurement of water flow in open channels

Method 4.11: Measurement using flow gauging structures—End-depth method for estimation of flow in non-rectangular channels with a free overfall (approximate method)

This Australian Standard® was prepared by Committee CE-024, Measurement of Water Flow in Open Channels and Closed Conduits. It was approved on behalf of the Council of Standards Australia on 12 July 1991.
This Standard was published on 23 September 1991.

The following are represented on Committee CE-024:

- Association of Consulting Engineers, Australia
- Australian Water and Wastewater Association
- Board of Works, Melbourne
- Department of Water Resources, N.S.W.
- Engineering and Water Supply Department of South Australia
- Forestry Commission, N.S.W.
- Institute of Instrumentation and Control
- Monash University
- Snowy Mountains Engineering Corporation
- University of New South Wales
- University of Queensland
- Water Authority of Western Australia
- Water Board, Sydney—Illawarra—Blue Mountains
- Water Resources Commission, Queensland

Standards Australia wishes to acknowledge the participation of the expert individuals that contributed to the development of this Standard through their representation on the Committee.

Keeping Standards up-to-date

Australian Standards® are living documents that reflect progress in science, technology and systems. To maintain their currency, all Standards are periodically reviewed, and new editions are published. Between editions, amendments may be issued.

Standards may also be withdrawn. It is important that readers assure themselves they are using a current Standard, which should include any amendments that may have been published since the Standard was published.

Detailed information about Australian Standards, drafts, amendments and new projects can be found by visiting www.standards.org.au

Standards Australia welcomes suggestions for improvements, and encourages readers to notify us immediately of any apparent inaccuracies or ambiguities. Contact us via email at mail@standards.org.au, or write to Standards Australia, GPO Box 476, Sydney, NSW 2001.

AS 3778.4.11—1991
(Reconfirmed 2009)

Australian Standard®

Measurement of water flow in open channels

Method 4.11: Measurement using flow gauging structures—End-depth method for estimation of flow in non-rectangular channels with a free overfall (approximate method)

First published as AS 3778.4.11—1991.
Reconfirmed 2009.

Published by Standards Australia GPO Box 476, Sydney, NSW 2001, Australia

ISBN 0 7262 7068 7

PREFACE

This Standard was prepared by the Standards Australia Committee on Measurement of Water Flow in Open Channels and Closed Conduits. It is identical with and has been reproduced from ISO 4371:1984, *Measurement of liquid flow in open channels by weirs and flumes—End-depth method for estimation of flow in non-rectangular channels with a free overfall (approximate method).*

Under arrangements made between Standards Australia and the International Standards Bodies, ISO and IEC, as well as certain other Standards organizations, users of this Australian Standard are advised of the following:

(a) Copyright is vested in Standards Australia.

(b) The number of this Standard is not reproduced on each page; its identity is shown only on the cover and title pages.

(c) There may be occasional dual language sections, but English is always one of the languages reproduced.

(d) Where any cross-references to page numbers appear within the text, these relate to page numbering in the International Standard and are to be disregarded.

This Standard is one of a series which deals with methods of measurement of water flow in open channels. The series when complete will consist of the following parts:

Part 1: *Vocabulary and symbols*
Part 2.1: *General—Guidelines for the selection of methods of measurement*
Part 2.2: *General—Establishment and operation of a gauging station*
Part 2.3: *General—Determination of the stage-discharge relation*
Part 2.4: *General—Estimation of uncertainty of a flow-rate measurement*
Part 2.5: *General—Guidelines for the selection of flow gauging structures*
Part 3: *Velocity-area methods*
Method 3.1: *Measurement by current-meters and floats*
Method 3.2: *Measurement by moving-boat method*
Method 3.3: *Measurement by slope-area method*
Method 3.4: *Collection and processing of data for determination of errors in measurement*
Method 3.5: *Investigation of total error*
Method 3.6: *Measurement of flow in tidal channels*
Method 3.7: *Measurement by ultrasonic (acoustic) method*
Method 3.8: *Electromagnetic method using a full-channel-width coil*
Part 4: *Measurement using flow gauging structures*
Method 4.1: *Thin-plate weirs*
Method 4.2: *Rectangular broad-crested weirs*
Method 4.3: *Round-nose horizontal broad-crested weirs*
Method 4.4: *V-shaped broad-crested weirs*
Method 4.5: *Triangular profile weirs*
Method 4.6: *Flat-V weirs*
Method 4.7: *Rectangular, trapezoidal and U-shaped flumes*
Method 4.8: *Trapezoidal profile weirs*
Method 4.9: *Parshall and Saniiri flumes*
Method 4.10: *End-depth method for estimation of flow in rectangular channels with a free overfall*
Method 4.11: *End-depth method for estimation of flow in non-rectangular channels with a free overfall (approximate method)* (this Standard)
Part 5: *Dilution methods*
Method 5.1: *Constant-rate injection method for the measurement of steady flow*
Method 5.2: *Integration method for the measurement of steady flow*
Part 6.1: *Measuring devices, instruments and equipment—Rotating element current-meters*
Part 6.2: *Measuring devices, instruments and equipment—Direct depth sounding and suspension equipment*
Part 6.3: *Measuring devices, instruments and equipment—Calibration of rotating element current-meters in straight open tanks*
Part 6.4: *Measuring devices, instruments and equipment—Echo sounders for water depth measurements*
Part 6.5: *Measuring devices, instruments and equipment—Water level measuring devices*
Part 6.6: *Measuring devices, instruments and equipment—Cableway system for stream gauging*
Part 6.7: *Measuring devices, instruments and equipment—Ultrasonic (acoustic) velocity meters*
Part 6.8: *Measuring devices, instruments and equipment—Position fixing equipment for hydrometric boats*

For the purposes of this Australian Standard, the ISO text should be modified as follows:

(i) Wherever the words 'International Standard' appear, referring to this Standard, they should be read as 'Australian Standard'.

(ii) Wherever the word 'fluid' appears, it should be read as 'water'.

(iii) Substitute a full point (.) for a comma (,) as a decimal marker.

(iv) The references to other publications should be replaced by references to Australian Standards as follows:

Reference to International Standard ISO		*Australian Standard* AS	
		3778	Measurement of water flow in open channels
772	Liquid flow measurement in open channels—Vocabulary and symbols	3778.1	Part 1: Vocabulary and symbols
1438	Water flow measurement in open channels using weirs and venturi flumes	3778.4.1	Part 4: Measurement using flow gauging structures
1438-1	Part 1: Thin-plate weirs		Method 4.1: Thin-plate weirs
3846	Liquid flow measurement in open channels by weirs and flumes—Rectangular broad-crested weirs	3778.4.2	Part 4: Measurement using flow gauging structures Method 4.2: Rectangular broad-crested weirs
3847	Liquid flow measurement in open channels by weirs and flumes—End-depth method for estimation of flow in rectangular channels with a free overfall	3778.4.10	Part 4: Measurement using flow gauging structures Method 4.10: End-depth method for estimation of flow in rectangular channels with a free overfall

Measurement of water flow in open channels

Part 4: Measurement using flow gauging structures

Method 4.11: End-depth method for estimation of flow in non-rectangular channels with a free overfall (approximate method)

0 Introduction

Free overfall occurs in many hydraulic structures when the bottom of a horizontal channel (or gently sloping channel) is abruptly discontinued. Such an overfall forms a control section and offers an approximate means for the estimation of flow. The flow at the brink is curvilinear and, therefore, the depth at the drop is not equal to the critical depth as computed by the principle based on assumption of parallel flow. However, the ratio between the end depth and the critical depth (as in the case of the assumption of parallel flow) has an almost constant value. Therefore, from the depth measured at the drop, the discharge can be estimated.

1 Scope and field of application

This International Standard specifies a method for the estimation of subcritical flow of clear water in smooth, essentially horizontal, straight open channels with a vertical drop and discharging freely. Gentle positive slopes not greater than 1 in 2 000 are admissible. This International Standard covers channels with the following types of cross-section, the nappe being unconfined:

a) trapezoidal;

b) triangular;

c) parabolic;

d) circular.

Using the measured depth at the end, the flow can be estimated.

2 References

ISO 772, *Liquid flow measurement in open channels — Vocabulary and symbols.*

ISO 1438/1, *Water flow measurement in open channels using weirs and venturi flumes — Part 1: Thin-plate weirs.*

ISO 3846, *Liquid flow measurements in open channels by weirs and flumes — Free overfall weirs of finite crest width (rectangular broad-crested weirs).*

ISO 3847, *Liquid flow measurement in open channels by weirs and flumes — End-depth method for estimation of flow in rectangular channels with a free overfall.*

3 Definitions

For the purpose of this International Standard, in addition to the definitions given in ISO 772, the following definition shall apply:

unconfined nappe: The jet formed by the flow where the guide walls of the structure end at the crest (or edge) and permit free lateral expansion of flow and where the nappe is sufficiently ventilated to ensure atmospheric pressure below the nappe.

4 Units of measurement

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

5 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 by the end depth method.

Particular attention should be paid to the following features in selecting the site and ensuring the necessary flow conditions:

a) an adequate straight length (at least 20 h_e where h_e is the end depth corresponding to the maximum discharge anticipated) of channel of regular cross-section should be available upstream of the drop;