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Australian Standard®

Measurement of water flow in open channels

Part 3: Velocity-area methods Method 3.4: Collection and processing of data for determination of errors in measurement

This Australian Standard was prepared by Committee CE/24, Measurement of Water Flow in Open Channels and Closed Conduits. It was approved on behalf of the Council of Standards Australia on 9 April 1990 and published on 10 December 1990.

The following interests are represented on Committee CE/24:

Association of Consulting Engineers of Australia

Australian Water and Wastewater Association

Board of Works, Melbourne

Department of Water Resources, NSW

Engineering and Water Supply Department of South Australia

Forestry Commission, NSW

Institute of Instrumentation and Control

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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 1088—1985, *Liquid flow measurement in open channels—Velocity-area methods—Collection and processing of data for determination of errors in measurement.*

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 (this Standard)
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 (this Standard)
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 structure methods
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)

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
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:

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

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

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

(d) The references to other publications should be replaced by references to Australian Standards as follows.

Reference to International Standard		*Australian Standard*	
ISO		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
5168	Measurement of fluid flow—Estimation of uncertainty of a flow-rate measurement	3778.2.4	Part 2.4: General estimation of uncertainty of a flow-rate measurement
748	Liquid flow measurement in open channels—Velocity-area methods	3778.3	Part 3: Velocity-area methods
		3778.3.1	Method 3.1: Measurement by current-meters and floats

Measurement of water flow in open channels

Part 3: Velocity-area methods
Method 3.4: Collection and processing of data for determination of errors in measurement

1 Scope and field of application

This International Standard specifies a standard basis for the collection and processing of data for the determination of individual components of the total error in the measurement of liquid flow in open channels by velocity-area methods.

For determining the discharge in open channels by the velocity-area method, components of the flow need to be measured. The total uncertainty in discharge is a combination of the uncertainties in these components. This International Standard specifies a standard basis for collecting and processing the data required to compute the component uncertainties for determining the total uncertainty in discharge. This International Standard may be used when carrying out an investigation of component uncertainties from data taken from a large sample of rivers in a basin or in a country or for international investigations.

2 References

ISO 748, *Liquid flow measurement in open channels – Velocity-area methods.*

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

ISO 4363, *Liquid flow measurement in open channels – Methods for measurement of suspended sediment.*

ISO 4364, *Liquid flow measurement in open channels – Bed material sampling.*

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

ISO/TR 7178, *Liquid flow measurement in open channels – Velocity-area methods – Investigation of total error.*

3 General

3.1 Principle

The principle of the velocity-area method consists in determining from measurements the distribution of the flow velocity in the cross-section and the cross-sectional area, and using these observations for the computation of the discharge.

The measurements of the flow velocity are made in a number of verticals. In each vertical the mean velocity is determined from measurements at a selected number of points. The discharge per unit width may be found by multiplying the mean velocity by the depth in the vertical considered.

Each vertical is assumed to be representative of a segment of the cross-sectional area. The selection of the number and location of the verticals determines the width of these segments. Assuming that the discharge has remained constant during the measurements, summation of the discharge in the various segments gives the total discharge through the section.

3.2 Occurrence of error

When measuring width, depth and flow velocity, errors occur. The application of certain computational methods also introduces errors depending on the assumptions made.

A distinction shall be made between random and systematic errors, resulting from the instruments used, the measuring procedures and the processing of data. Random errors are also influenced by the nature of turbulent flow. The magnitude of random errors can be influenced favourably by the proper selection of instruments and methods. Systematic errors may be constant or variable and they cannot be eliminated by repeating the measurements or by increasing the duration of a measurement. There are, in addition, mistakes due to misreading an instrument or to instrument malfunction.