AS 3778.3.7—1990
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Australian Standard®

Measurement of water flow in open channels

Part 3: Velocity-area methods Method 3.7: Measurement by ultrasonic (acoustic) method

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
Monash University
Public Works Department, NSW
Snowy Mountains Engineering Corporation
University of New South Wales
University of Queensland
Water Authority of Western Australia
Water Board, Sydney
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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 6416—1985, *Liquid flow measurement in open channels—Measurement of discharge by the ultrasonic (acoustic) method*.

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 (this Standard)
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 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:

(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.

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

1100/2 Liquid flow measurement in open channels—Part 2: Determination of the stage-discharge relation

5168 Measurement of fluid flow—Estimation of uncertainty of a flow-rate measurement

748 Liquid flow measurement in open channels—Velocity-area methods

3778.2.3 Part 2.3: General—Determination of the stage-discharge relation

3778.2.4 Part 2.4: General—Estimation of uncertainty of a flow-rate measurement

3778.3.1 Part 3: Velocity-area methods—Method 3.1: Measurement by current-meters and floats

Measurement of water flow in open channels

Part 3: Velocity-area methods
Method 3.7: Measurement by ultrasonic (acoustic) method

1 Scope and field of application

This International Standard describes the establishment and operation of an ultrasonic (acoustic) gauging station on a river or open channel for the measurement of discharge. For the operation and performance of instrumentation, reference should be made to ISO 6418.

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 1100/2, *Liquid flow measurement in open channels— Part 2: Determination of the stage discharge relation*.

ISO 4373, *Measurement of liquid flow in open channels — Water level measuring devices*.

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

ISO 6418, *Liquid flow measurement in open channels— Ultrasonic (acoustic) velocity meters*.

3 Definitions

For the purpose of this International Standard, the definitions given in ISO 772 apply.

4 Units of measurement

The units of measurement used in this International Standard are those of the International System of Units (SI).

5 Principles of the measurement method

5.1 The principle of the ultrasonic (acoustic) method is measurement of the velocity of flow at a certain elevation, or elevations, in the channel by transmitting acoustic pulses in both directions through the water from transducers located in the banks on both sides of the river. The transducers may be designed to transmit and receive pulses; they are not located directly opposite each other but are staggered so that there is a time difference between pulses travelling downstream and those travelling upstream. The angle between the transmission path and the direction of flow should normally be between 30 and 60° (see figures 2 and 3).

5.2 The difference between the time of travel of the acoustic pulses crossing the river in an upstream direction and those travelling downstream is directly related to the average velocity of the water at the elevation of the transducers. This velocity can then be related to the average velocity of flow of the whole cross-section and, if desirable, by incorporating an area factor in the electronic processor, the system can give an output of discharge.

6 Site selection

6.1 The site selected should be such that it is feasible to measure the whole range and all types of flow which may be encountered or of which measurement is required. The following factors should be considered:

a) a reliable source of electrical energy should be available;

b) there should be good all-weather access to the site;

c) the measuring reach should be straight and uniform; abrupt bends and irregularities in the channel should be avoided if possible but these may be acceptable provided that condition d) is satisfied or where changes can be effectively monitored by a crossed acoustic path. Sections in which appreciable cross-currents or large eddies form should be avoided;

d) at cross-sections taken in the reach between the upstream and downstream transducer mountings, the velocity distribution should be similar;

e) if the bed profile should change significantly with stage, regular bed surveys should be carried out at different stages of flow to determine the change in area in order to compute the discharge;

f) the section should be free of weed growth since this will attenuate the acoustic signal;