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Australian Standard®

Measurement of water flow in open channels

Part 6.4: Measuring devices, instruments and equipment—Echo sounders for water depth measurements

[ISO title: Echo sounders for water depth measurements]

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Association of Consulting Engineers of Australia

Australian Water and Wastewater Association

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

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Water Authority of Western Australia

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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 4366:1979, *Echo sounders for water depth measurements.*

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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)*

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: *Measuring devices*
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* (this Standard)
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 and other Publication	*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

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CONTENTS

Measurement of water flow in open channels—

Part 6.4:
Measuring devices, instruments and equipment—
Echo sounders for water depth measurements

1 Scope and field of application

This International Standard provides information concerning the principle of operation, performance and selection criteria for echo sounders used in depth measurements for open channel flow (and related) measurements. The use of standard terminology is promoted. Information on the characteristics of sound in water is provided in annex.

2 Reference

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

3 Definitions

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

tracking window: An opening of limited size which follows and automatically centres itself at the depth indicated by the last received echo. If the next echo falls within the window, the signal is accepted as correct; if it does not, the signal is rejected. The purpose of a tracking window is to screen out erroneous readings caused by reflecting materials in the water (fish, debris, etc.)

4 Units of measurement

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

5 General

The state-of-the-ant in echo sounders is well advanced, and sounders have been put into widespread use for many different applications. Consequently, a variety of specialized sounders have evolved to best meet the specific requirements of the application.

6 Principle

The echo sounder is an electroacoustic instrument which indicates the depth of water (actually measuring the distance from the face of its transducer to the stream bed) by measuring the time differential between the transmission of a burst of acoustic energy and the reception of the echo from the stream bed or the bottom. Depth is determined from the equation:

$$d = \frac{t}{2}c$$

where

d is the distance from the transducer to the stream bed

t is the travel time of the acoustic energy;

c is the velocity of sound in water.

6.1 General

The echo sounder consists of two elements : the electronic assembly which usually includes the readout or recording device and the acoustic assembly or the transducer.

The electronic circuitry generates high frequency electrical energy and provides regulated bursts of this energy to the transducer. When a burst of energy is released, time is measured until the return signal is received. The above equation is solved and the depth is displayed or recorded.

The transducer is an electroacoustic assembly which acts as a two-way energy conversion device. During transmission it converts pulses of electrical energy into pulses of sonic energy which travel through the water to the bottom. During reception, it receives the echos of sonic energy reflected from the bed and converts them into electrical energy to operate the electronic circuits.

6.2 Non-recording echo sounders

The most common type of non-recording echo sounder has a display in which a timing motor rotates a light behind a circular scale. When the light is directly behind the zero depth point, it is briefly illuminated; and, concurrently, the acoustic pulse is released. When the echo is received, the light is again briefly illuminated, indicating the depth.