

Australian Standard<sup>®</sup>

**Measurement of water flow in open  
channels**

**Part 5.3: Liquid flow in open channels  
and partly filled pipes—Guidelines for  
the application of Doppler-based flow  
measurements**

**STANDARDS**  
Australia



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 5 April 2007.

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The following are represented on Committee CE-024:

- Australian Industry Group
  - Australian National Committee on Irrigation and Drainage
  - Department of Environment and Water Resources
  - Institute of Instrumentation, Control and Automation Australia
  - Irrigation Association of Australia
  - National Measurement Institute
  - Plumbing Products Industry Group
  - University of New South Wales
  - University of South Australia
  - Water Services Association of Australia
- 

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## PREFACE

This Standard was prepared by the Standards Australia Committee CE-024, Measurement of Water Flow in Open Channels and Closed Conduits.

The objective of this Standard is to specify methods for measuring discharge in large rivers and estuaries by the moving-boat technique.

This Standard is identical to and reproduced from ISO/TS 15769:2000, *Hydrometric determinations—Liquid flow in open channels and partly filled pipes—Guidelines for the application of Doppler-based flow measurements*.

As this Standard is reproduced from an international standard, the following applies:

- (a) its number appears on the cover and title page while the international standard number appears only on the cover
- (b) In the source text 'ISO/TS 15769' should read 'AS 3776.5.3'
- (c) A full point substitutes for a comma when referring to a decimal mark

The term 'informative' has been used in this Standard to define the application of the annex to which it applies. An 'informative' annex is only for information and guidance.

## CONTENTS

	<i>Page</i>	
<b>1</b>	<b>Scope .....</b>	<b>1</b>
<b>2</b>	<b>Normative references .....</b>	<b>1</b>
<b>3</b>	<b>Terms and definitions .....</b>	<b>1</b>
<b>4</b>	<b>Principle .....</b>	<b>1</b>
<b>5</b>	<b>Factors affecting operation and accuracy .....</b>	<b>3</b>
<b>5.1</b>	<b>General .....</b>	<b>3</b>
<b>5.2</b>	<b>Characteristics of the instrument .....</b>	<b>3</b>
<b>5.3</b>	<b>Channel and water characteristics .....</b>	<b>6</b>
<b>6</b>	<b>General expectations of performance .....</b>	<b>10</b>
<b>7</b>	<b>Considerations when selecting equipment .....</b>	<b>10</b>
<b>8</b>	<b>Evaluation and verification .....</b>	<b>10</b>
<b>Annex A (informative)</b>	<b>Other practical considerations .....</b>	<b>11</b>
<b>Annex B (informative)</b>	<b>Sample questionnaire — Doppler-based flowmeter .....</b>	<b>16</b>

## INTRODUCTION

Flow measurement using Doppler-based flowmeters fall into the category of velocity-area methods and, as with all variants of this approach, flow estimation is a two-stage process. Measurements are made to derive estimates of:

- a) mean channel velocity, using the principle of Doppler shift,
- b) depth, from which cross-sectional area is computed with a knowledge of the relationship between depth and area (i.e. the profile of the cross-section).

Most difficulties governing this method relate to the estimation of mean channel velocity and the degree to which computed velocities can be assumed to be representative of the true mean velocity through the measurement section. The accuracy with which the calculated velocities represent the mean velocity is influenced by various factors which are considered in clause 4. This guide focuses on the process of velocity estimation and the conditions and practices which may help to deliver optimum results. However, it should be recognised that the accuracy of overall flow determination also depends on the accuracy of depth measurement. The influence of meter location and sensitivity of cross-sectional area to depth variation will have a bearing on performance.

## STANDARDS AUSTRALIA

## Australian Standard

**Measurement of water flow in open channels  
Part 5.3: Liquid flow in open channels and partly filled pipes—Guidelines  
for the application of Doppler-based flow measurements****1 Scope**

This Technical Specification gives guidelines for the selection and use of Doppler-based flowmeters for the measurement of liquid flow in small open channels and partly filled pipes. It is applicable to whole-channel flow measurements using a single meter at a fixed point in the cross-section.

It is not applicable to flow measurements made using Doppler-based current meters for point velocity measurement nor using mobile profiling systems.

A limitation of this technique is that measurement is made of the velocity of particles or other reflectors being transported by the liquid rather than that of the liquid itself.

NOTE Though the title refers to liquid flow in general, the main use of flowmeters which use the Doppler principle is for water or water-based liquid and particular reference is often made in the text to water.

**2 Normative references**

The following normative documents contain provisions which, through reference in this text, constitute provisions of this Technical Specification. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this Technical Specification are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 772, *Hydrometric determinations — Vocabulary and symbols*.

ISO/TR 8363, *Measurement of liquid flow in open channels — General guidelines for selection of method*.

**3 Terms and definitions**

For the purposes of this Technical Specification, the terms and definitions given in ISO 772 apply.

**4 Principle**

This method of velocity measurement is based on a phenomenon first identified by Christian Doppler in 1843. The principle of “Doppler shift” describes the difference or shift which occurs in the frequency of emitted sound waves as they are reflected back from a moving body.

The sensors of Doppler systems normally contain a transmitting and a receiving device (see Figure 1). A sound wave of high frequency ( $f_s$ ) is transmitted into the flow of water and intercepted and reflected back at a different frequency by tiny particles or air bubbles (reflectors). A typical reflector “ $n$ ” produces a frequency shift  $f_{D,n}$ . The “shift” between transmitted and reflected frequencies is proportional to the movement of particles relative to the position of the sound source (i.e. the sensor).