Draft

Australian Standard

Public Comment is invited for:

DR AS 4747.3:2024, Metering systems for non-urban water supply, Part 3: Technical requirements for open channel metering systems

During their development process, Australian Standards are available in draft form during the public consultation period to allow any interests concerned with the application of the proposed Standard to review the draft and submit their comments.

This draft is liable to alteration. It is not to be regarded as an Australian Standard until finally issued as such by Standards Australia.

Upon successful conclusion of the Public Comment period it is proposed to publish this Standard as AS 4747.3:202X.

STANDARDS Australia

Preface

This Standard was prepared by the Standards Australia Committee CE-024, Measurement Of Water Flow In Open Channels and Closed Conduits, to supersede AS 4747.3—2013, *Meters for non-urban water supply, Part 3: Technical requirements for open channel meters*.

The objective of this document is to set out the technical requirements for non-urban metering systems in open channel applications.

This document forms part of the AS 4747 series covering the metering of non-urban water supply. A list of all parts in this series can be found in the Standards Australia online catalogue.

The major changes in this edition are as follows:

(a) The relevant terms and definitions from AS 4747.1 have been incorporated into this document. AS 4747.1 has been withdrawn.

(b) An Introduction section has been included to explain the relationship between this document and regulatory documents such as the Metrological Assurance Framework (MAF). AS 4747.8 has been withdrawn and the material previously contained in that document relating to in-service compliance is now covered by the MAF.

(c) Pseudo-regulatory requirements and validation/verification requirements have been removed.

(d) The content in this document has been consolidated so that it is easier to navigate. The document structure has been aligned with AS 4747.2: 202X which deals with closed conduit metering systems.

(e) The technical requirements have been clarified.

(f) There is additional flexibility in the design requirements by conformance with other Australian and International Standards.

(g) The term “metering system” replaces the use of other terms such as “modular metering system” and “self-contained meter”.

(h) The product documentation requirements have been updated, and the purchasing guidelines have been removed.

(i) The appendix related to uncertainty of measurement has been updated, and a new calculation example has been provided.

The terms “normative” and “informative” are used in Standards to define the application of the appendices to which they apply. A “normative” appendix is an integral part of a Standard, whereas an “informative” appendix is for information and guidance only.

NOTE This document applies to areas subject to legislation. Refer to the relevant federal, state and territory authorities for the legal and regulatory requirements that apply in that jurisdiction.

Contents

Introduction

The National Water Initiative (NWI) (2004) was established to increase the productivity and efficiency of Australia's water use. The Commonwealth and all Australian states and territories agreed to the NWI. Clause 88 of the NWI refers to the development of the National Meter Specification, now known as AS 4747. This Australian Standard contributes to the outcomes of the NWI.

The requirements for non-urban water metering systems are described in the following documents:

(a) Parts 2, 3 and 4 of the AS 4747 series. Parts 2 and 3 describe the construction and technical requirements and Part 4 describes the installation and commissioning requirements for meters to conform to this series.

NOTE 1 AS 4747.1, which was a glossary of terms, has been withdrawn and the relevant terms and definitions are now included in Parts 2, 3 and 4.

NOTE 2 AS 4747.5 and AS 4747.6 have been withdrawn and the content combined to form AS 4747.4.

NOTE 3 AS 4747.8 has been withdrawn and replaced by the Metrological Assurance Framework (MAF).

(b) The National Measurement Institute (NMI) documents NMI M 10 and NMI M 11. These describe the requirements and test methods for the pattern approval and verification of non-urban water metering systems.

AS 4747 references the requirements and test procedures specified in the NMI documents. NMI M 10 and NMI M 11 are freely available from an Australian government website.

(c) The Metrological Assurance Framework 2 (MAF2). This describes —

(i) the nationally consistent compliance management approach for non-urban water meters in Australia; and

(ii) the rules and guidelines used to maintain compliance for non-urban water meters, including methods and practices for validation.

NOTE 4 Compliance is usually maintained by State and Territory regulators or irrigation infrastructure operators.

The MAF 2 is freely available from an Australian government website.

Pattern approval and verification are regulatory requirements specified under the *National Measurement Act 1960*. This standard does not require meters to be pattern approved or verified. However, testing and evaluation performed for pattern approval purposes can also be used to demonstrate conformance to AS 4747. Pattern approval certificates for approved meters are available from an Australian government website.

At the time of publication, water meters with a maximum continuous flow rate (Q^3) greater than 16 kL/h are exempt from pattern approval and verification under the *National Measurement Act 1960.*

Verification and validation are separate and distinct requirements described in the above documentation. The requirements for verification are defined under the *National Measurement Act 1960.* The MAF2 describes practices for validation and verification.

NOTES

Australian Standard®

Metering systems for non-urban water supply

Part 3: Technical requirements for open channel metering systems

Section 1 Scope and general

1.1 Scope

This document sets out the technical requirements for non-urban metering systems in open channel and partially filled conduit applications. The document covers metering principally used for non-urban water supply.

NOTE 1 Metering systems are defined in Clause 1.3.

NOTE 2 The installation and commissioning requirements for metering systems are specified in AS 4747.4.

NOTE 3 A partially filled conduit is an open channel condition.

The technical requirements in this document cover all design elements of the metering system including ancillary equipment.

This document excludes the following:

(a) Validation and verification of metering systems.

(b) Telemetry systems.

NOTE 4 Telemetry systems can be subject to regulatory requirements.

1.2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document.

NOTE Documents referenced for informative purposes are listed in the Bibliography.

AS 1565,Copper and copper alloys — Ingots and castings

AS 2345,Dezincification resistance of copper alloys

AS 2738, Copper and copper alloys — Compositions and designations of refinery products, wrought products, ingots and castings

AS 3558.5, Methods of testing plastics and composite materials sanitary plumbing fixtures, Method 5: Determination of degradation by ultraviolet light

AS 4747.4, Meters for non-urban water supply, Part 4: Installation and commissioning of metering systems

AS/NZS 1567,Copper and copper alloys — Wrought rods, bars and sections

AS ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*

AS ISO/ IEC 17065, *Conformity assessment — Requirements for bodies certifying products, processes and services*

ASTM A276,Standard specification for stainless steel bars and shapes

ASTM A480, Standard specification for general requirements for flat-rolled stainless and heat-resisting plate, sheet, and strip

ASTM A743, *Standard specification for castings, iron-chromium, iron-chromium-nickel, corrosion resistant, for general application*

NMI M 11, Meters intended for the metering of water in open channels and partially filled pipes

1.3 Terms and definitions

For the purposes of this document, the terms and definitions in *International Vocabulary of Terms in Legal Metrology* (VIML), ISO/IEC Guide 99 (2007), AS 3778.1, and the following apply.

1.3.1
accuracy (of measurement)
closeness of the agreement between the measured quantity and a reference value

[SOURCE: ISO/IEC Guide 99: 2007, 2.13, modified]

1.3.2
adjustment
alteration of the measurement parameters of an instrument to bring them within the allowable maximum permissible errors (MPEs) for an instrument in use

1.3.3
ancillary equipment
ancillary device
device intended to perform a particular function, directly involved in elaborating, transmitting or displaying measurement results

Note 1 to entry: Ancillary devices can include —

(a) zero setting devices;

(b) repeating indicating devices;

(c) printing devices;

(d) memory devices;

(e) tariff control devices; and

(f) pre-setting devices.

[SOURCE: VIML: 2022, 5.06, modified]

1.3.4
calibration
set of operations which, under specified conditions, establish the relationship between the quantity values indicated by the measuring instrument and the corresponding reference quantity value with associated measurement uncertainties

Note 1 to entry: Note to entry: ISO/IEC Guide 99:2007 (Clause 2.39) provides a more detailed definition of "calibration", but the definition provided above is suitable for the purposes of this document.

1.3.5
can
indicates the possibility of an option

1.3.6
commissioning
process to check that a metering system is installed according to relevant documents and is ready for service

Note 1 to entry: Relevant documents can include product documentation and certifications.

1.3.7
competent person
person who has acquired, through education, training, qualification or experience or a combination of these, the knowledge and skill enabling that person to perform the task required

1.3.8
configuration
configured
parameters specified in relevant product documentation that are entered into the metering system to enable correct operation

1.3.9
error of indication
indication minus a reference quantity value

[SOURCE: VIML: 2022, 0.04]

1.3.10
error (of measurement)
measured quantity value minus a reference quantity value

[SOURCE: ISO/IEC Guide 99:2007, 2.16]

1.3.11
flow disturbance
disturbance
change in upstream or downstream conditions that can cause an asymmetric flow

Note 1 to entry: An asymmetric flow can affect meter performance.

1.3.12
flow rate
Q
quotient of the actual volume of water passing a specified point and the time taken for this volume to pass that specified point

Note 1 to entry: Expressed in megalitres per day (ML/d), litres per second (L/s), cubic metres per hour or kilolitres per hour.

1.3.13
fully charged
pipe completely filled with water

1.3.14
indicating device
display
part of the metering system that displays the measurement results, either continuously or on demand

Note 1 to entry: A printing device that provides an indication at the end of the measurement is not an indicating device.

1.3.15
in-service
metering system that has been commissioned and is used to measure water for a defined purpose

Note 1 to entry: A defined purpose can include trade, water resource management and licensing compliance.

1.3.16
IP rating
coding system to indicate the degrees of protection provided by an enclosure against access to hazardous parts, ingress of solid foreign objects and water, and provide additional information in connection with such protection

1.3.17
maximum permissible error
MPE
extreme value of the measurement error of a metering system

Note 1 to entry: The value of maximum permissible error, as permitted by the AS 4747 series.

[SOURCE: VIML: 2022, 0.05, modified]

1.3.18
maximum permissible uncertainty
MPU
extreme value of expanded uncertainty of a metering system, as permitted by the AS 4747 series

1.3.19
may
indicates the existence of an option

1.3.20
meter
water meter
instrument intended to measure, memorize and display the volume of water passing through the measurement transducer at metering conditions

Note 1 to entry: A water meter includes at least a measurement transducer, a calculator (including adjustment or correction devices if present) and an indicating device. These three devices may be in different housings.

[SOURCE: ISO 4064, 3.1.1]

1.3.21
metering system
device or group of associated devices that is intended to measure the quantity of water that passes a specified point

Note 1 to entry: The previous editions of this Standard included the terms “self-contained meter” and “modular metering systems”. This definition is intended to cover both of these terms.

Note 2 to entry: A metering system can include only a meter and no other associated devices.

Note 3 to entry: The devices comprising a metering system can include meters, sensors, physical structures (such as weirs, flumes and gates) and other electrical or mechanical equipment / interfaces associated with the metering system.

Note 4 to entry: Displays can be onsite or remote, and can be continuous or on-demand.

1.3.22
open channel
longitudinal boundary surface consisting of the bed and banks or sides within which water flows with a free surface

Note 1 to entry: Open channel includes partially filled conduits or pipes.

[SOURCE: ISO 772, 3.19]

1.3.23
pattern approval
decision of legal relevance, based on the review of the type evaluation report, that the type of a measuring instrument complies with the relevant statutory requirements and results in the issuance of the type approval certificate

Note 1 to entry: This is a process whereby an impartial body examines the pattern of an instrument against a set of national or international metrological specifications, which determines whether an instrument can retain its calibration over a range of environmental and operating conditions and ensures that the instrument is not capable of facilitating fraud.

Note 2 to entry: "Type approval" is equivalent to "pattern approval". "Type approval" is more commonly used internationally, whereas the term "pattern approval" is more commonly used in Australia.

[SOURCE: VIML:2022, 2.05]

1.3.24
rated operating condition
operating condition that must be fulfilled during measurement in order that a measuring instrument or measuring system performs as designed

Note 1 to entry: Rated operating conditions generally specify intervals of values for a quantity being measured and for any influence quantity.

[SOURCE: VIML:2022, 0.08]

1.3.25
reference conditions
set of values, or ranges of environmental conditions, prescribed for testing the performance of a meter, or comparing the results of measurements

1.3.26
resolution (of a displaying device)
smallest difference between indications of an indicating device that can be meaningfully distinguished

Note 1 to entry: For a digital device, this is the change in the indication when the least significant digit changes by one step.

[SOURCE: ISO/IEC Guide 99: 2007, 4.15]

1.3.27
sampling rate
frequency at which the metering system makes discrete measurements

1.3.28
shall
indicates that a statement is mandatory

1.3.29
should
indicates a recommendation

1.3.30
true value (of a quantity)
quantity value consistent with the definition of a quantity

Note 1 to entry: See ISO/IEC Guide 99 for a more detailed explanation of true value.

[SOURCE: ISO/IEC Guide 99:2007, 2.11]

1.3.31
uncertainty (of measurement)
non-negative parameter characterizing the dispersion of the quantity values being attributed to a measurand, based on the information used

Note 1 to entry: Measurement uncertainty includes components arising from systematic effects, such as components associated with corrections and the assigned quantity values of measurement standards, as well as the definitional uncertainty. Sometimes estimated systematic effects are not corrected for but, instead, associated measurement uncertainty components are incorporated.

Note 2 to entry: The parameter may be, for example, a standard deviation called standard measurement uncertainty (or a specified multiple of it), or the half-width of an interval, having a stated coverage probability.

Note 3 to entry: Measurement uncertainty comprises, in general, many components. Some of these may be evaluated by Type A evaluation of measurement uncertainty from the statistical distribution of the quantity values from series of measurements and can be characterized by standard deviations. The other components, which may be evaluated by Type B evaluation of measurement uncertainty, can also be characterized by standard deviations, evaluated from probability density functions based on experience or other information.

Note 4 to entry: In general, for a given set of information, it is understood that the measurement uncertainty is associated with a stated quantity value attributed to the measurand. A modification of this value results in a modification of the associated uncertainty.

[SOURCE: ISO/IEC Guide 99:2007, 2.26]

1.3.32
validation
set of activities that includes inspecting the meter to check that it is installed in accordance with relevant Standards and maintained to an acceptable state of repair which provides an acceptable level of confidence that the meter will operate within an acceptable range of error under normal operating conditions

Note 1 to entry: Validation is different to verification. The requirements for verification are defined under the *National Measurement Act 1960*.

1.4 Symbols and abbreviated terms

Megalitres (ML) or kilolitres (kL) are the preferred units of volume; however, cubic metres (m^3) is an acceptable alternative to the latter.

Where megalitres (ML), kilolitres (kL) or cubic metres (m^3) are specified in this document, the alternatives are acceptable.

Megalitres per day (ML/d) or litres per second (L/s) are the preferred units for flow rate.

1.5 Evaluation of product conformity

To claim that a metering system is installed and commissioned to the requirements of this document, the metering system and its installation shall meet the conformity requirements detailed in Appendix A.

Section 2 Materials

2.1 General

Materials shall have the following characteristics:

(a) Metals shall be resistant to internal and external corrosion. See Clause 2.2.

(b) External plastics components shall be tested in accordance with Clause 2.3.

Any other material used in the manufacture of metering systems should conform to the relevant material standards.

Consideration should be given to recyclability of components and the circular economy.

2.2 Resistance to corrosion

2.2.1 General

Metal components that are in contact with the metered water, or buried in the surrounding ground and groundwater, shall be —

(a) of corrosion-resistant material; or

(b) rendered resistant by a coating or other surface treatment.

Non-metallic materials in contact with the metered water should resist chemical or physical degradation by the dissolved compounds and suspended matter commonly found in the metered water.

Any construction materials should not affect or inhibit the accurate operation of the metering system during its operational lifetime.

2.2.2 Corrosion-resistant materials

For the purposes of this document, for most water chemistries, the following materials shall be deemed to be corrosion resistant:

(a) Copper alloys conforming to AS 1565, AS/NZS 1567 or AS 2345.

(b) Austenitic stainless-steel conforming to ASTM A276 (grades to be suitable for the application).

(c) Stainless steel conforming to ASTM A480 or ASTM A743.

(d) Phosphor bronze conforming to AS 2738 alloy C 51800b.

(e) Copper nickel alloy conforming to AS 2738 alloy C 71500 or alloy C 70610.

(f) Aluminium grades 5083-H321, 5052-H34, 6351 T5, 6352 T5, 6353 T5, 6354 T5, 6355 T5, 6063 T6.

NOTE 1 Where there is a history of corrosion, the type and material composition of the metering system should be considered when choosing a metering system.

NOTE 2 Other materials may be considered, based on demonstrated corrosion-resistance data.

NOTE 3 Combinations of materials can breach the resistance to corrosion requirement.

NOTE 4 High solute or aggressive waters can require site-specific design beyond the scope of this document.

2.3 Material durability test — Ultraviolet exposure test

Plastics components of metering systems exposed to sunlight shall be tested in accordance with the ultraviolet exposure test specified in AS 3558.5, using an ultraviolet sunlamp F/28, 220 V to 240 V, 300 ± 50 W, or equivalent.

Components shall be exposed for 8 cycles of 16 h on, 8 h off as well as for 48 h continuous. After this there shall be no observed cracking, crazing or other failures.

Section 3 Principles of measurement

3.1 Methods

This section sets out methods for measuring the flow in open channels and partially filled pipes, which are covered by Australian and International Standards. Metering systems used for flow measurement shall be based on existing standards or developed as proprietary metering systems under this document. Examples of open channel metering methodologies and minimum expected uncertainties (where available) are listed in Table 3.1.

NOTE Where a metering method is not covered by a document listed in Table 3.1, guidance should be sought from the relevant jurisdiction.

3.2 Requirements related to specific technologies

The metering system shall include a recording and registering device.

NOTE 1 AS 3778.2.1 provides a guide to the selection of methods. Table 3.1 provides a list of technologies and expected uncertainties that may be applicable to this document.

NOTE 2 Using a methodology listed in Table 3.1 does not imply that meter systems employing that methodology can meet the Maximum Permissible Error (MPE).

When metering systems are installed and put into service, measurements shall be made to ensure the correct operation of the system.

NOTE 3 Measurements can include length, diameter, depth, height, width, angle, time, or other values required by the modular metering system design parameters.

Such measurements shall be traceable to national primary standards of measurement. Instruments used to make such measurements shall have a calibration certificate issued by a laboratory accredited by an International Laboratory Accreditation Cooperation (ILAC) Mutual Recognition Agreement (MRA) signatory.

NOTE 4 In Australia, the National Association of Testing Authorities (NATA) is an example of an ILAC MRA signatory.

The uncertainty associated with these measurements shall be incorporated in the overall uncertainty of measurement for the metering system.

Table 3.1 — Examples of open channel metering methodologies and minimum uncertainties [a,b]

No.	Methodology description	Australian Standard	Equivalent International Standard	Other standards/ documents	Expected uncertainties[c]
1	Velocity-area methods. Measurement by current-meters and floats	AS 3778.3.1	ISO 748	-	±5
2	Velocity-area methods using ADCPs	National Guideline 8[d]	ISO 24578	-	±5
3	Velocity-area methods — Measurement by ultrasonic method	AS 3778.3.7	ISO 6416	-	±5
4	Ultrasonic (doppler)	AS 3778.5.3	ISO 15769	-	±5[e]
5	Velocity-area method — Electromagnetic method using a full-channel-width coil	AS 3778.3.8	ISO 9213	-	±5
6	Dilution using tracer injection	AS 3778.5.1 and AS 3778.5.2	ISO 9555 Parts 1,3 and 4[f]	-	±5
7	Measurement using flow gauging structures — Thin-plate weirs and sharp crest	AS 3778.4.1	ISO 1438	-	±1
8	Thin-plate weirs, sharp crested, rectangular, and rectangular suppressed	AS 3778.4.1	ISO 1438	-	±3
9	Measurement using flow gauging structures — Rectangular broad-crested weirs	AS 3778.4.2	ISO 3846	-	±3
10	Measurement using flow gauging structures — Round-nose horizontal broad crested weirs	AS 3778.4.3	ISO 4374	-	±5
11	Weirs, triangular profile	AS 3778.4.5	ISO 4360	-	±5
12	Weirs, streamlined triangular profile	No current AS equivalent	ISO 9827	-	±5
13	Measurement using flow gauging structures — Flat-V weirs	AS 3778.4.6	ISO 4377	-	±5
14	Weirs, V-shaped, broad crested	AS 3778.4.4	ISO 8333	-	±5
15	Weirs, trapezoidal profile	No current AS equivalent	ISO 4362	-	±5
16	Measurement using flow gauging structures — Rectangular, trapezoidal and U-shaped flumes	AS 3778.4.7	ISO 4359	-	±5
17	Flumes, Parshall and SANIIRI	No current AS equivalent	ISO 9826	-	±5
18	Compound gauging structures	No current AS equivalent	ISO 14139	-	±5
19	Vertical underflow or Radial gates	No current AS equivalent	ISO 13550	-	±4[g]
20	Meters intended for the metering of water in open channels and partially filled pipes	-	-	NMI M 11-1, NMI M 11-2, NMI M 11-3	±2.5 %[h]

Table 3.1 *(continued)*

No.	Methodology description	Australian Standard	Equivalent International Standard	Other standards/ documents	Expected uncertainties[c]

a This table is generally based on AS 3778.2.2 (ISO 18365).

b Uncertainties are expressed at the 95th percentile confidence level. Methods with minimum uncertainties in excess of ±5% have been excluded.

c The expected uncertainties for metering systems are based on installation in accordance with AS 4747.4 and the documents listed in this table.

d As implied in NI GL 100.08 *National Industry Guidelines for hydrometric monitoring — Part 8: Application of acoustic doppler current profilers to measure discharge in open channels*.

e As specified in Clause 11.3 of AS3778.5.3 (2022), for a correctly sited instrument.

f ISO 9555-2:1992 has been superseded, but is noted as a potential resource for readers.

g As listed in ISO 8368.

h Maximum permissible error (MPE)

3.3 Metering of open channel conditions

Metering systems for open channel conditions can include devices for measuring water height and velocity (see Clause 3.4, velocity area methods).

NOTE 1 The output from these devices, coupled with the geometry of the metering system, is used to calculate the flow rate which, when integrated over time, results in measured volume. The height and velocity measurement devices may be one device, for example, a metering system incorporating a flow disturbance such as a weir or flume.

The metering system shall —

(a) be applicable for the operating conditions;

(b) have a measurement range suitable for the installation. The operating parameters shall be defined;

NOTE 2 The measurement range can include minimum height and maximum velocity.

(c) report parameters that fall outside its specification as soon as practicable after it falls outside specification;

NOTE 3 Reporting may include status information, and the status of alarms. Parameters include fully charged pipe conditions, the duration of the fully charged pipe, and when the metering system is not designed to measure those conditions.

(d) be capable of measuring flow, no-flow and flow direction (where required);

NOTE 4 Flows below detection limits should register as “no flow”.

(e) meet the performance requirements specified in Clause 5; and

(f) be installed according to AS 4747.4.

3.4 Velocity area methods

Velocity area methods multiply the average velocity with the cross-sectional flow area(s) at a singular time point.

The cross-sectional flow area computation relies on pre-configured sectional parameters.

NOTE These methods can be used to develop a rating table or a velocity index. More details, including discussion of limitations, are included in other standards, see Table 3.1.

3.5 Flow computation

Flow computation methods can be undertaken onsite or offsite.

NOTE 1 Offsite methods may include data-logs and databases.

The following principles apply:

(a) Flow computers shall be fit for purpose, taking into account the method to be applied, flow conditions and environmental conditions. See Table 3.1 for uncertainty estimations for various approach methodologies.

(b) Flow computers shall operate according to product specifications.

(c) Flow computers shall be tested for accuracy over the range of input parameters and reference conditions. They shall be tested for the effects of the applicable environmental conditions and flow disturbances. During these tests, measured input parameters may be actual or simulated.

(d) For onsite computations, all parameters that are not measured but are necessary for computation shall be stored in the flow computer at the beginning of the operation.

(e) The MPE shall not be exceeded due to flow computation.

(f) Any extrapolation processes shall be clearly defined. Uncertainty associated with extrapolation shall be incorporated in the overall uncertainty of measurement for the metering system.

NOTE 2 There is currently no validated methodology for ratings determination.

(g) All data and metadata associated with the measurement shall be recorded and traceable.

Section 4 Design

4.1 Output

4.1.1 General

Metering systems shall provide output signals capable of interfacing with data recording and/or data transmission equipment.

NOTE 1 The output will be dependent on jurisdictional requirements.

NOTE 2 The output selection can be determined by many factors, including rate of information exchange, available power, form of communication (whether radio or telecom), and the ability or requirement to connect many metering systems to the same link.

Equipment connected to the metering system shall be calibrated to the same range as the metering system. The range and units shall be clearly identified. Such equipment may be calibrated to a subset of the full range where the usage conditions of the metering system are well understood.

Settings, calibration and stored data shall be protected from non-authorised modification.

4.1.2 Flow rate

Where the metering system records flow rate, it shall be capable of accurately recording the flow rate at the resolution specified in the product documentation.

4.1.3 Volume

The metering system shall be capable of transmitting the flow volume at the required resolution.

4.1.4 Other data output

The data output can include set and operating parameters, such as the following:

(a) *Metering system identification* — For example, product identity code or reference, serial number (of both sensor and signal converter), tag or location identity, site reference and Q_3 rating.

(b) *Metering system construction* — For example, geometry parameters.

(c) *Metering system set-up* — Details including factors required for flow calculation, adjustments specific to the installation, flow rate and volume output settings, and network address if the serial communication is shared among many metering systems.

(d) *Metering system operational status* — For example, flow rate, accumulated volume, errors, alerts, checksum and other operation integrity details, measuring condition status, battery or supply voltage values, other metering information such as water conductivity or sound speed.

Parameters to be transferred at each interrogation shall be identified in the product documentation.

4.2 Electronic data storage

Electronic data storage shall not be lost if battery or power fails.

4.3 Sampling rate

For metering systems with operation principles that depend on instantaneous flow rate measurements (rather than continuous flow rate measurements), both the following apply:

(a) The sampling rate shall be set at an appropriate interval based on the intended use application; and

(b) The sampling rate shall not result in a measurement error greater than ±5 %.

NOTE 1 Stricter jurisdictional requirements can exist for list items (a) and (b).

Adjustable sampling rates shall be set and protected before placing into service.

NOTE 2 Metering systems can be protected by mechanical or electronic means.

4.4 Frost protection

Where provided, frost protection devices shall be designed so that they will yield or break under freezing conditions to minimize damage to any other part of the measurement system.

4.5 Bypass

There shall be no water that bypasses the metering system.

NOTE Water bypass includes leakage.

Section 5 Performance requirements

5.1 General

The following performance requirements apply to metering systems:

(a) Metering systems shall conform to a relevant ISO or Australian Standard, or to NMI M 11.

NOTE 1 Examples of relevant standards include, but are not limited to, those given in Table 3.1.

(b) All components that comprise a metering system shall be calibrated/configured before first use. Where practicable, metering systems should be tested for initial accuracy prior to being placed into service.

(c) If a metering system is tested for initial accuracy (e.g. in a laboratory), then it shall operate within an MPE of ±2.5 %.

NOTE 2 It may not be practicable to test the initial accuracy of some metering systems.

(d) When in-service, all metering systems shall operate —

(i) within a maximum permissible error (MPE) of ±5 %; or

(ii) within a maximum permissible uncertainty (MPU) of ±5 %.

NOTE 3 MPU is a performance requirement of the metering system, whereas the allowable uncertainty nominated in Table 5.1 is a requirement that applies to the determination of a reference volume when testing a metering system.

NOTE 4 Guidance on the evaluation of uncertainty for open channel metering systems can be found in the relevant Australian Standards, e.g. AS 3778.2.4. General guidance for uncertainty calculations can be found in ISO/IEC Guide 98-1. ISO/IEC Guide 98-3, ISO/IEC Guide 98-3 Supplement 1, ISO/IEC Guide 98-4, ISO/IEC Guide 98-6, NMI Monograph 1 and NMI Monograph 2.

NOTE 5 See Appendix B for an example of how to determine the uncertainty of the system.

Maximum permissible errors and allowable uncertainties when testing a metering system are summarised in Table 5.1.

Table 5.1 — Maximum permissible errors and allowable uncertainties

Flowrate range	Purpose	Maximum permissible error (MPE)	Allowable uncertainty of reference volume	Notes
$Q^1 \leq Q \leq Q^4$	NMI M 11 testing (or similar)	±2.5 %	±0.5 % ($\frac{1}{5}$ MPE)	Testing generally performed in a laboratory for certification purposes.
	Initial accuracy	±2.5 %	$\pm 0.833\dot{3}\,\%$ ($\frac{1}{3}$ MPE)	Testing generally performed in a laboratory for initial accuracy testing prior to the metering system being placed into service.
	In-service accuracy	±5 %	$\pm 1.66\dot{6}\,\%$ ($\frac{1}{3}$ MPE)	Testing generally performed in-situ to confirm performance after it has been placed into service. However, testing may also be performed in a laboratory. If the one-third of the MPE cannot be practically met, then a greater uncertainty may be acceptable by the relevant jurisdiction. In-service testing refers to testing of metering systems after they have been installed and placed into service for any period of time.

5.2 Rated operating conditions

The metering system shall operate under open channel and partially filled conduit applications.

Metering systems shall maintain their performance under the following rated operating conditions:

(a) Minimum working water temperature range between 0.1 °C to 30 °C.

(b) Minimum range for ambient air temperature: −5 °C to 55 °C.

(c) Minimum range for ambient relative humidity: 0 % to 93 %.

5.3 Measurement of performance

5.3.1 General

Metering system performance can be evaluated in one of two ways, direct volumetric comparison and indirect volumetric calculation.

NOTE 1 For the purposes of this clause, recognized formulas include those published by Australian Standards and by the International Standardization Organization, and those specified in documentation provided by the manufacturer.

NOTE 2 In most cases, determining if the metering system conforms to this document will be via direct volumetric comparison. If this cannot be achieved, for example, due to the size or design of the meter or the metering system, then indirect volumetric calculation can be used to determine if the metering system conforms to the requirements of this document.

5.3.2 Direct volumetric comparison

Where direct volumetric comparison is used for metering system evaluation, then performance shall be measured via a direct comparison with a reference device. This is undertaken by comparing the volumetric measurement of the metering system under test with the volumetric measurement of the reference device by passing the same volume of water through both.

The difference between the two measurements is defined as the error of indication of the metering system under test and is expressed as a percentage as follows:

$$\frac{\left(V_{\mathrm{i}}-V_{\mathrm{a}}\right)}{V_{\mathrm{a}}}\times 100$$

where

V_{a} = actual volume as determined by the reference equipment

V_{i} = indicated volume of the metering system under test

Other recognized formulae may also be used, including those —

(a) published by Standards Australia;

(b) published by the International Standardization Organization; and

(c) specified in documentation provided by the manufacturer.

The reference device may be a direct volumetric measure, a gravimetric system, a calibrated reference meter or similar volumetric measuring device. The MPE for pre-service and in-service volumetric performance testing are given in Clause 5.1. The allowable uncertainty of the reference volume shall be in accordance with Table 5.1.

NOTE 1 Refer to AS 3778 for information on volumetric methods through open channels.

NOTE 2 The reference device and corresponding methodology used by the test facility for volumetric comparisons will have an associated measurement uncertainty. The evaluation of this uncertainty is part of the facility's accreditation and is beyond the scope of this document.

5.3.3 Indirect volumetric calculation

Indirect volumetric calculations for metering systems shall conform to the relevant Australian or ISO Standard. See Table 3.1 for examples of relevant standards.

Allowable tolerances for all components in the model describing the operation of the metering system (including recalibration periods for sensors/measuring devices) shall be —

(a) indicated to demonstrate conformance; and

(b) used as part of the post-installation and ongoing validation of the metering system.

Flow models and uncertainty budgets for metering systems shall meet the performance requirements specified in Clause 5.1. Uncertainty should be determined in accordance with the ISO/IEC Guide 98-3.

Section 6 Product documentation

Product documentation shall include the following information:

(a) Handling information, including workplace, health and safety, transport and storage advice.

(b) Serial numbers and any other identifiers.

(c) Product certifications and/or approvals (where applicable).

NOTE 1 This may include pattern approval certificates.

(d) The calibration and configuration data that describes the metrological testing.

(e) Installation manuals and instructions that include any limitations, conditions or requirements for installation (refer to AS 4747.4).

NOTE 2 This may include precautions and measures required to avoid flow disturbances.

(f) Metering system performance while operating in various water conditions.

NOTE 3 This can be influenced by sedimentation, suspended solids in the water or conductivity of the water on metering system performance.

(g) An operational instruction manual for all components that includes the following:

NOTE 4 An instruction manual may include hard copy or electronic resources.

(i) A description of the meter system, its components and its rated operating conditions.

(ii) The function, application and technical specifications for all equipment including subassemblies, wiring and schematic diagrams.

(iii) Information and instruction about configurable variables.

(iv) Parameters to be transferred at each interrogation (see Clause 4.1.4).

NOTE 5 Refer to the jurisdictional requirements for parameters relevant to that jurisdiction.

(v) Relevant product ratings for each component.

NOTE 6 This can include ingress protection (IP rating), metrological, mechanical and electrical ratings.

(vi) Maintenance requirements and service schedules, including a suggested list of maintenance processes for validation.

NOTE 7 This should include required spare parts and consumables.

(vii) Description of interfaces and diagnostic tools.

NOTE 8 Interfaces and diagnostic tools may facilitate —

(a) in situ testing of functions and performance to specifications; and

(b) integration of the metering system with external data logging or telemetry devices.

(vii) Commissioning requirements (refer to AS 4747.4).

The instruction manual should also include the following:

(A) A list of contents, including illustrations and drawings.

(B) Dimensional drawings, weights and specifications.

(C) Troubleshooting procedures.

(D) Dismantling and re-assembly procedures (where applicable).

NOTE 9 This should include instructions for revalidation if the metering system metrology is affected.

(E) List of spare parts that are available.

(F) Decommissioning and end-of-life equipment disposal requirements (where applicable).

NOTE 10 End of life is generally when a metering system cannot attain the MPE of ±5 % or cannot be repaired to attain the MPE of ±5 %.

Appendix A
(normative)

Demonstration of conformance

Laboratories that perform the tests outlined in this document shall meet the requirements of AS ISO/IEC 17025.

NOTE 1 Accreditation bodies which are signatories to the International Laboratory Accreditation Cooperation (ILAC) Mutual Recognition Arrangement (MRA) for testing laboratories may be able to offer accreditation against the requirements of AS ISO/IEC 17025. A list of ILAC signatories is available from the ILAC website (www.ilac.org). In Australia and New Zealand, the National Association of Testing Authorities (NATA), Joint Accreditation System of Australia and New Zealand (JAS-ANZ) and International Accreditation New Zealand (IANZ) are signatories to the ILAC MRA.

NOTE 2 In Australia, the signatory to the International Accreditation Forum Multi-Lateral Recognition Arrangement (IAF MLA) accreditation body is JAS-ANZ.

Any changes to the metering system design shall be evaluated in accordance with the requirements of this document. This is summarised in Table A.1. Re-evaluation, and re-testing if necessary, shall be undertaken to confirm product conformity.

NOTE 3 Alternatives to re-testing or re-evaluation could be achieved by demonstrating process control, quality plans and/or documented procedures, as considered adequate by the certification body.

NOTE 4 Design changes may include changes to firmware or software, and changes to the hardware.

Product evaluation and the need for re-testing is the responsibility of the certifying body.

NOTE 5 Statements of conformance to this document on product, packaging or promotional material related to that product should ensure that such conformance is capable of being verified.

Evaluation of conformity shall be performed by a competent person.

NOTE 6 Conformance to this document does not necessarily imply a metering system has gained pattern approval.

NOTE 7 A competent person may be defined by JAS-ANZ or by the relevant jurisdiction.

Table A.1 — Summary of conformance requirements

Characteristics	Clause	Requirement	Method	Frequency
Material properties	2.1	Materials	Review materials part lists and compliance certificates	At any change in materials
	2.2	Resistance to corrosion	See list of standards in Clause 2.2.2	
	2.3	Ultraviolet exposure test	AS 3558.5	
Design	3	Metering methodologies and minimum uncertainties	See examples of standards in Table 3.1	At any change in design
	4.1	Output	Review metering system specifications	
	5	Measurement performance	A relevant ISO or Australian Standard, or NMI M 11	
Product documentation	6	Product documentation	Review documentation	

Appendix B
(informative)

Uncertainty of measurement — Example

B.1 General

This appendix provides introductory information about the uncertainty of measurement, including a worked example.

NOTE 1 Refer to the ISO/IEC Guide 98-3 for more information about uncertainty of measurement.

NOTE 2 The JCGM *Guide to the expression of uncertainty in measurement* is equivalent to ISO/IEC Guide 98-3.

B.2 Nature of errors

All measurements have errors, even after corrections and calibrations have been applied. The errors can be positive or negative and can have variable magnitude. Many errors vary with time, whether hourly, daily, weekly, seasonally, or yearly.

Errors that are constant or apparently constant during testing are typically called systematic errors. These errors can be determined only when measurements are compared with the true quantity value. This is rarely possible, though upper bounds on the errors can be estimated. The objective is to construct an uncertainty interval (sometimes referred to as a range) within which the true value will lie with a stated probability.

The terms "error" and "uncertainty" should not be confused. Error is the difference between the measured value and the "true value" of the thing being measured. Uncertainty is a quantification of the doubt about the measurement result.

B.3 Simple example of an uncertainty calculation

B.3.1 Background

The following example of an uncertainty calculation is a modified excerpt from AS 3778.4.1:2022.

B.3.2 Characteristics — Gauging structure

The example relates to modular flow conditions for a 90° V-notch weir.

The crest height p above the bed of the approach channel is 0.151 m.

The channel is 0.503 m wide.

The angle of the V-notch is estimated to lie between 89.5° and 90.5°.

B.3.3 Characteristics — Gauged head instrumentation

In this example, a pressure transducer is used to determine head. The transducer is located in the approach channel about 1 m upstream of the weir. The signal indicates a head of 0.212 m. At this head:

$$u(h_1) = 0.002 \text{ m}$$

NOTE 1 Refer to AS 3778.4.1: 2022, Annex D, Table D.1 (measurement uncertainty).

The transducer is susceptible to drift. Over time, the nominal datum signal varies in the range 0.000 m to 0.007 m. Datum uncertainty is estimated according to the rectangular distribution:

$$u(E) = \frac{1}{\sqrt{3}}\left(\frac{0.007 - 0.000}{2}\right)$$

$$u(E) = 0.002 \text{ m}$$

NOTE 2 Refer to AS 3778.4.1:2022, Formula C.5.

B.3.4 Discharge coefficient

The value of the gauged head discharge coefficient for the 90° V-notch weir is determined from AS 3778.4.1:2022, Figure 8. The key ratios of h/p and p/B are:

$$\frac{h}{p} = \frac{0.212}{0.151} = 1.40$$

$$\frac{p}{B} = \frac{0.151}{0.503} = 0.30$$

from which C_d = 0.600.

B.3.5 Discharge estimate

The flow rate is calculated from AS 3778.4.1:2022, Formula 19 as follows:

$$Q = C_\text{d}\,\frac{8}{15}\tan\frac{\alpha}{2}\sqrt{2g}\;h_e^{\frac{5}{2}}$$

where

$$h_e = h + k_h = 0.212 + 0.00085$$

$$Q_t = 0.600 \times 0.5333 \times 4.429 \times 1 \times 0.212\ 85^{2.5}$$

$$\therefore Q_t = 0.029\ 6\text{m}^3\ /\ \text{s}$$

Specimen tables for the discharge of water over a V-notch with tan $1/\alpha$ equal to 1, $\frac{1}{2}$ and $\frac{1}{4}$ are given in AS 3778.4.1:2022, Annex E.

B.3.6 Uncertainty statement

B.3.6.1 Formula B.3.6.1

The value for uncertainty of the discharge coefficient is:

$$u^*(C) = 0.50\ \%$$

NOTE Refer to AS 3778.4.1:2022, Table 2.

B.3.6.2 Formula B.3.6.2

Using AS 3778.4.1:2022, Formula C.4, the value of uncertainty of the V-angle may be written as:

$$u[\tan(\frac{\alpha}{2})] = \frac{1}{\sqrt{6}}[\frac{\tan(\frac{90.5}{2}) - \tan(\frac{89.5}{2})}{2}]$$

= 0.0036; or

$$u^{*}[\tan(\frac{\alpha}{2})] = 100 \times \frac{0.0036}{\tan(\frac{90}{2})} = 0.36\ \%$$

B.3.6.3 Formula B.3.6.3

The combined uncertainty of gauged head $u(h)$, calculated in Clause B.3.3, is combined with instrumentation measurement uncertainty and datum measurement uncertainty.

$$u(h) = \sqrt{(0.002)^2} + (0.002)^2 \text{m}$$

$$u(h) + 0.002\ 8\text{m}$$

$$u^{*}(h) = \frac{0.002\ 8}{0.212} \times 100$$

$$u^{*}(h) = 1.32\ \%$$

NOTE See AS 3778.4.1:2022, Clause 12.3.

B.3.6.4 Formula B.3.6.4

The combined uncertainty estimate is determined from AS 3778.4.1:2022, Formula 31.

$$u_c^{*}(Q) = \sqrt{u^{*}(C_{\text{d}})^2 + u * [\tan(\frac{\alpha}{2})]^2 + [2,5u^{*}(h_e)]^2}$$

$$u_c^{*}(Q) = \sqrt{0.50^2 + 0.36^2 + (2.5 \times 1.32)^2}$$

$$u_c^{*}(Q) = 3.35\ \%$$

Therefore, at the 95 % confidence level:

$$u_c^{*}(Q) = 3.35 \times 2 = 6.7\%$$

NOTE This estimate is dominated by the contribution from head measurement uncertainty and assumes sufficient measurement samples.

B.3.7 Conventional statement of discharge

The conventional statement of discharge is therefore:0.029 3 m^3/s with an uncertainty of 6.7 % at the 95 % level of confidence based on a coverage factor of k = 2.

B.3.7.1 Uncertainty budget

The uncertainty budget for the example may be expressed as in Table B.1.

Table B.1 — Uncertainty budget for the example

Symbol	Type/ Evaluation	u, u^* Value	Sensitivity coefficients	Source
$u^*(C_d)$	B/Normal	0.5 %	1.0	Laboratory tests
$u^*[\tan(\alpha/2)]$	B/Triangular	0.36 %	1.0	B.3.6.2
$u(E)$	B/Rectangular	0.002 m	—	B.3.6.3
$u(h_1)$	B/Rectangular	0.002 m	—	B.3.6.3
$u^*(h_1)$	Combined	1.32 %	2.5	B.3.6.3
$u_c^*(Q)$	Combined	3.35 %	—	B.3.6.4

Bibliography

AS 3778.1, *Measurement of water flow in open channels, Part 1: Vocabulary and symbols (ISO 772:2022, IDT)*

AS 3778.2.1, *Measurement of water flow in open channels, Part 2.1: General — Guidelines for the selection of methods*

AS 3778.2.2, *Measurement of water flow in open channels, Part 2.2: General —Selection, establishment and operation of a gauging station (ISO 18365: 2013, IDT)*

AS 3778.2.4, *Measurement of water flow in open channels, Part 2.4: General — Estimation of uncertainty of a flow rate measurement*

AS 3778.3.1, *Measurement of water flow in open channels, Part 3.1: Velocity-area methods — Measurement by current-meters and floats*

AS 3778.3.7, *Measurement of water flow in open channels, Part 3.7: Velocity-area methods — Measurement by ultrasonic method (ISO 6416:2017, IDT)*

AS 3778.3.8, *Measurement of water flow in open channels, Part 3.8: Velocity-area methods — Electromagnetic method using a full-channel-width coil*

AS 3778.4.1, *Measurement of water flow in open channels, Part 4.1: Measurement using flow gauging structures — Thin-plate weirs (ISO 18481:2017, IDT)*

AS 3778.4.2, *Measurement of water flow in open channels, Part 4.2: Measurement using flow gauging structures — Rectangular broad-crested weirs (ISO 3846:2008, IDT)*

AS 3778.4.3, *Measurement of water flow in open channels, Part 4.3: Measurement using flow gauging structures — Round-nose horizontal broad-crested weirs*

AS 3778.4.4, *Measurement of water flow in open channels, Part 4.4: Measurement using flow gauging structures — V-shaped broad-crested weirs*

AS 3778.4.5, *Measurement of water flow in open channels, Part 4.5: Measurement using flow gauging structures — Triangular profile weirs (ISO 4360:2020, IDT)*

AS 3778.4.6, *Measurement of water flow in open channels, Part 4.6: Measurement using flow gauging structures — Flat-V weirs (ISO 4377:2012, IDT)*

AS 3778.4.7, *Measurement of water flow in open channels, Part 4.7: Measurement using flow gauging structures — Rectangular, trapezoidal and U-shaped flumes (ISO 4359:2022, IDT)*

AS 3778.5.1, *Measurement of water flow in open channels, Part 5.1: Tracer dilution methods for the measurement of steady flow — General (ISO 9555-1:1994, IDT)*

AS 3778.5.2, *Measurement of water flow in open channels, Part 5: Dilution methods, Methods 5.2: Integration method for the measurement of steady flow*

AS 3778.5.3, *Measurement of water flow in open channels, Part 5.3: Guidelines for the application of acoustic velocity meters using the Doppler and echo correlation methods (ISO 15769: 2010, IDT)*

ISO 748, *Hydrometry — Measurement of liquid flow in open channels — Velocity area methods using point velocity measurements*

ISO 1438, *Hydrometry — Open channel flow measurement using thin-plate weirs*

ISO 3846, *Hydrometry — Open channel flow measurement using rectangular broad-crested weirs*

ISO 4359, *Flow measurement structures — Rectangular, trapezoidal and U-shaped flumes*

ISO 4360, *Hydrometry — Open channel flow measurement using triangular profile weirs*

ISO 4362, *Hydrometric determinations — Flow measurement in open channels using structures — Trapezoidal broad-crested weirs*

ISO 4374, *Liquid flow measurement in open channels — Round-nose horizontal broad-crested weirs*

ISO 4377, *Hydrometric determinations — Flow measurement in open channels using structures — Flat-V weirs*

ISO 6416, *Hydrometry — Measurement of discharge by the ultrasonic transit time (time of flight) method*

ISO 8333, *Liquid flow measurement in open channels by weirs and flumes — V-shaped broad-crested weirs*

ISO 8368, *Hydrometric determinations — Flow measurements in open channels using structures — Guidelines for selection of structure*

ISO 9213, *Measurement of total discharge in open channels — Electromagnetic method using a full-channel-width coil*

ISO 9555-1,*Measurement of liquid flow in open channels — Tracer dilution methods for the measurement of steady flow — Part 1: General*

ISO 9555-2, *Measurement of liquid flow in open channels — Tracer dilution methods for the measurement of steady flow — Part 2: Radioactive tracers*

ISO 9555-3, *Measurement of liquid flow in open channels — Tracer dilution methods for the measurement of steady flow — Part 3: Chemical tracers*

ISO 9555-4, *Measurement of liquid flow in open channels — Tracer dilution methods for the measurement of steady flow — Part 4: Fluorescent tracers*

ISO 9826, *Measurement of liquid flow in open channels — Parshall and SANIIRI flumes*

ISO 9827, *Measurement of liquid flow in open channels by weirs and flumes — Streamlined triangular profile weirs*

ISO 13550, *Hydrometric determinations — Flow measurements in open channels using structures — Use of vertical underflow gates*

ISO 14139, *Hydrometric determinations — Flow measurements in open channels using structures — Compound gauging structures*

ISO 15769, *Hydrometry — Guidelines for the application of acoustic velocity meters using the Doppler and echo correlation methods*

ISO 24578, *Hydrometry — Acoustic Doppler profiler — Method and application for measurement of flow in open channels from a moving boat*

ISO/IEC Guide 98-1, *Guide to the expression of uncertainty in measurement — Part 1: Introduction*

ISO/IEC Guide 98-3, *Uncertainty of measurement — Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

ISO/IEC Guide 98-3, *Uncertainty of measurement — Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

ISO/IEC Guide 98-4, *Uncertainty of measurement — Part 4: Role of measurement uncertainty in conformity assessment*

ISO/IEC Guide 98-6, *Uncertainty of measurement — Part 6: Developing and using measurement models*

ISO/IEC Guide 99:2007, *International vocabulary of metrology — Basic and general concepts and associated terms (VIM)*

NATIONAL WATER INITIATIVE. accessed from https://www.dcceew.gov.au/water/policy/policy/nwi 1 March 2024.

NI GL 100.08, *National Industry Guidelines for hydrometric monitoring — Part 8: Application of acoustic doppler current profilers to measure discharge in open channels.* Bureau of Meteorology.

NMI. M 10, *Meters intended for the metering of water in full flowing pipes,* National Measurement Institute.

OIML V 1, *Vocabulary*, International vocabulary of terms in legal metrology (VIML), *Paris, 2022*.

Standards Australia

Standards Australia develops Australian Standards® and other documents of public benefit and national interest. These Standards are developed through an open process of consultation and consensus, in which all interested parties are invited to participate. Through a Memorandum of Understanding with the Commonwealth Government, Standards Australia is recognized as Australia's peak non-government national standards body.

For further information visit www.standards.org.au

Australian Standards®

Committees of experts from industry, governments, consumers and other relevant sectors prepare Australian Standards. The requirements or recommendations contained in published Standards are a consensus of the views of representative interests and also take account of comments received from other sources. They reflect the latest scientific and industry experience. Australian Standards are kept under continuous review after publication and are updated regularly to take account of changing technology

International Involvement

Standards Australia is responsible for ensuring the Australian viewpoint is considered in the formulation of International Standards and that the latest international experience is incorporated in national Standards. This role is vital in assisting local industry to compete in international markets. Standards Australia represents Australia at both the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC).

Australian Standards are prepared by a consensus process involving representatives nominated by organizations drawn from major interests associated with the subject. Australian Standards may be derived from existing industry Standards, from established international Standards and practices or may be developed within a Standards Australia committee.

Committee CE-024, Measurement Of Water Flow In Open Channels and Closed Conduits, consisting of the following, is responsible for the issue of this draft:

- Australian Bureau of Meteorology
- Australian Hydrographers Association
- Australian Industry Group
- Department of Planning and Environment (NSW)
- Engineers Australia
- Institute of Instrumentation, Control & Automation Aust
- Irrigation Australia
- National Measurement Institute
- University of South Australia
- Water NSW

For information regarding the development of Standards contact:
Standards Australia Limited
GPO Box 476
Sydney NSW 2001
Phone: 02 9237 6000
Email: mail@standards.org.au
www.standards.org.au

STANDARDS Australia

ISBN to be allocated on publication of the final document