

## Comparison of current Australian Standard with updated ISO standard

Current Australian Standard	AS 3778.3.4-1990	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
Updated ISO Standard	ISO 1088-2007	Hydrometry – Velocity-area methods using current meters - Collection and processing of data for determination of uncertainties in flow measurement

### High-level comment on differences

The updated ISO Standard is substantively the same as the current Australian Standard, but there are numerous examples of minor updates and changes which update references, improve clarity/readability.

There are several more significant changes to requirements.

- The document has some differing formulae.
- Extra ANNEXES have been added.

Mark Hopper  
16/03/2021

### Reviewer recommendation

I recommend that the technical committee

- accept the updated ISO in full to replace current AS.

<i>options</i>
<ul style="list-style-type: none"> <li>• <i>accept the updated ISO in full to replace current AS (simplest option!)</i></li> </ul>
<ul style="list-style-type: none"> <li>• <i>reject the updated ISO and withdraw the current AS (in cases where the update is not appropriate for Australian practice)</i></li> </ul>
<ul style="list-style-type: none"> <li>• <i>reject the updated ISO and re-confirm the current AS without change (an alternative option in cases where the update is not appropriate for Australian practice)</i></li> </ul>
<ul style="list-style-type: none"> <li>• <i>further work required to adapt the ISO for an updated AS (non-preferred option, exceptional cases only)</i></li> </ul>

## Detailed summary of differences

The table below outlines in more detail a summary of the differences between the current Australian Standard under review and the relevant updated ISO standard and includes reviewer comment where relevant.

*Column 1: Identifies the number and name of the section in the current Australian Standard*

*Column 2: Classification of the change for that section. Classified as either:*

- **No change (green shading)** – The updated ISO is the same as the current Australian Standard.
- **Minor change (blue shading)** – Changes that have minimal impact on the outcome, including
  - minor format, style or heading changes
  - minor additions, removals or changes to a few words or clauses
  - addition or exclusion of more detailed explanation
  - very minor changes to steps or processes.
- **Significant change (orange shading)** – Changes that have a moderate to major impact on the outcome, such as
  - Changes to requirements
  - Significant changes to calculations, steps or processes.

*Column 3: More detail to describe the change, and comment from the reviewer (enough detail for the consideration of AHA and WaMSTeC members in their review).*

*Text colour is used in this column as follows:*

- *Black text* – More detailed explanation of the changes and reviewer comment. **Specific reviewer comment on the changes highlighted in yellow.**
- *Blue text* – reference to information included in the updated ISO that is not in the current Australian Standard
- *Red text* – reference to information included in the current Australian Standard that is not in the updated ISO.

Section (AS section number)	Classification of change AS to ISO	More detail and comment on changes in the updated ISO
	Significant change	ISO has added an Introduction AS does not have an Introduction
1. Scope and Field of application	Significant change	<p>ISO section called Scope only. ISO contains specific reference to current meters and not applicable to ADVP. AS makes no such references as is a 1990 edition.</p> <p><b>Reviewer comment:</b> Adopt the ISO standard.</p>
2. References	Minor change	<p>ISO – Normative References. AS contains references with the specific edition. The AS also contains 2 additional references.</p> <ol style="list-style-type: none"> <li>1. ISO 5168 Measurement of fluid flow – Estimation of uncertainty of a flow rate measurement</li> <li>2. ISO 7178 Liquid flow measurement in open channels – Velocity-area methods – Investigation of total error</li> </ol> <p><b>Reviewer comment:</b> The additional AS references are not required</p>
	Significant change	<p>ISO Section 3 – Symbols and Abbreviated terms</p> <p><b>Reviewer comment:</b> This change is recommended as it provides an additional method to calculate discharge using the Slope/Area method. Adopt new ISO section.</p>

Section (AS section number)	Classification of change AS to ISO	More detail and comment on changes in the updated ISO
3. General  3.1 Principle	Minor change	ISO Section 4 – Types of errors and procedure for estimating the uncertainties in flow measurement 4.1 Principle <ul style="list-style-type: none"> <li>• ISO has been reworded</li> </ul>
3.2 Occurrence of error	Significant change	<ul style="list-style-type: none"> <li>• AS has only 2 paragraphs which relate to random and systemic errors</li> <li>• ISO (4.2) contains seven lengthy paragraphs which references ISO/IEC Guide 98 where random and systematic categorizations are not used.</li> </ul> Major additions to ISO <ul style="list-style-type: none"> <li>• Includes standard deviations and probability distributions</li> </ul> <b>Reviewer comment:</b> The ISO change is recommended as it provides an quantitative measure of uncertainty. Adopt new ISO section.
3.3 Sources of error	Minor change	<ul style="list-style-type: none"> <li>• ISO 4.3 same title</li> <li>• ISO has been slightly reworded.</li> </ul> <b>Reviewer comment:</b> The ISO change is recommended as it provides additional detail.
3.4 Determination of the individual components of the error  3.4.1 Errors in width	Minor change	<ul style="list-style-type: none"> <li>• ISO 4.4 Same title except error replaced with uncertainty.</li> <li>• ISO 4.4.1 Uncertainties in width</li> <li>• ISO same content except error replaced with uncertainty.</li> </ul> <b>Reviewer comment:</b> The ISO change is recommended.

Section (AS section number)	Classification of change AS to ISO	More detail and comment on changes in the updated ISO
3.4.2 Errors in depth	Minor change	<ul style="list-style-type: none"> <li>ISO 4.4.2 - has been reworded.</li> </ul>
3.4.3 Errors in determination of the mean velocity	Minor change	<ul style="list-style-type: none"> <li>ISO 4.4.2 - has been reworded</li> <li>ISO have changed the type of errors as headings</li> <li>ISO has an extra sentence</li> </ul> <p><b>Reviewer comment:</b> The ISO change is recommended.</p>
3.4.4 Symbols	Significant change	<ul style="list-style-type: none"> <li>ISO does not exist in ISO.</li> </ul> <p><b>Reviewer comment:</b> Section not required. ISO recommended</p>
3.5 Description of uncertainty	Significant change	<ul style="list-style-type: none"> <li>ISO does not exist in ISO.</li> </ul> <p><b>Reviewer comment:</b> Section not required. ISO recommended</p>
3.6 Total uncertainty in discharge	Significant change	<ul style="list-style-type: none"> <li>ISO 4.5 has same heading</li> <li>ISO has completely new text and formulae</li> <li>ISO has additional text.</li> </ul> <p><b>Reviewer comment:</b> The ISO change is recommended as it provides additional detail.</p>
3.7 Evaluation of the error in the individual components	Significant change	<ul style="list-style-type: none"> <li>ISO does not exist in ISO.</li> </ul> <p><b>Reviewer comment:</b> Section not required. ISO recommended</p>
4 Data on the local point velocity	Minor change	<ul style="list-style-type: none"> <li>ISO 5 has main section title – Collection and processing of data for the investigation of component uncertainties – type A evaluation of uncertainty.</li> <li>ISO 5.1 same title as AS (4).</li> <li>ISO - has been slightly reworded</li> </ul>

Section (AS section number)	Classification of change AS to ISO	More detail and comment on changes in the updated ISO
<p>5 Data on the average velocity</p> <p>5.1 Location of the vertical</p> <p>5.2 Distribution of measuring points</p> <p>5.3 Period of measurement of local point velocities</p> <p>5.4 Number of measurements</p> <p>5.5 Presentation of Data</p>	<p>Minor change</p>	<ul style="list-style-type: none"> <li>• ISO 5.2 same title as AS (5).</li> <li>• ISO 5.2.1 has heading General but same content as initial paragraph AS.</li>   <li>• ISO 5.2.2 same heading as AS 5.1.</li> <li>• ISO has same content as AS 5.1.</li>   <li>• ISO 5.2.3 same heading as AS 5.2.</li> <li>• ISO has same content as AS 5.2.</li>   <li>• ISO 5.2.4 same heading as AS 5.3.</li> <li>• ISO has same content as AS 5.3.</li>   <li>• ISO 5.2.5 same heading as AS 5.4.</li> <li>• ISO has same content as AS 5.4.</li>   <li>• ISO 5.2.6 same heading as AS 5.5.</li> <li>• ISO has same content as AS 5.5.</li> </ul>

Section (AS section number)	Classification of change AS to ISO	More detail and comment on changes in the updated ISO
6 Data on the velocity area method  6.1 Measurement at 0.6 times the depth  6.2 Velocity-distribution method  6.3 Presentation of Data  6.4 General Data	Minor change	<ul style="list-style-type: none"> <li>• ISO 5.3 same title as AS (6).</li> <li>• ISO 5.3.1 has heading General but same content as initial paragraph AS.</li> <li>• ISO 5.3.2 same heading as AS 6.1.</li> <li>• ISO has same content as AS 6.1.</li> <li>• ISO 5.3.3 same heading as AS 6.2.</li> <li>• ISO has same content as AS 6.2.</li> <li>• ISO 5.3.4 same heading as AS 6.3.</li> <li>• ISO has same content as AS 6.3.</li> <li>• ISO 5.3.5 same heading as AS 6.4.</li> <li>• ISO has same content as AS 6.4.</li> </ul> <p><b>Reviewer comment:</b> ISO is the same except for section numbering.</p>
7 Integration method	Minor change	<ul style="list-style-type: none"> <li>• ISO 5.4 same heading as AS 7.</li> <li>• ISO has same content as AS 7.</li> </ul>
8 Calibration Curves	Minor change	<ul style="list-style-type: none"> <li>• ISO 5.5 same heading as AS 8.</li> <li>• ISO has same content as AS 8.</li> </ul>
9 Distance Measurement	Minor change	<ul style="list-style-type: none"> <li>• ISO 5.6 same heading as AS 9.</li> <li>• ISO has same content as AS 9.</li> </ul>

Section (AS section number)	Classification of change AS to ISO	More detail and comment on changes in the updated ISO
10 Depth Measurements 10.1 No heading just content 10.2 No heading just content 10.3 No heading just content 10.4 No heading just content 10.5 No heading just content 10.6 No heading just content	Minor change	<ul style="list-style-type: none"> <li>• ISO 5.7 same heading as AS 10</li> <li>• ISO has same content as AS 10.</li> <li>• ISO has the same content under (a) format</li> <li>• ISO has the same content under (b) format</li> <li>• ISO has the same content under (c) format</li> <li>• ISO has the same content under (d) format</li> <li>• ISO has the same content under (e) format</li> <li>• ISO has the same content under (f) format</li> </ul> <p><b>Reviewer comment:</b> The ISO is the same except for section numbering.</p>
11 Data Processing 11.1 General 11.2 Error-type I 11.2.1 Finite measuring time and distribution of results 11.2.2 Correction for non-steady conditions	Significant change	<ul style="list-style-type: none"> <li>• ISO 6 same heading as AS 11.</li> <li>• ISO 6.1 has same content as AS 11.1.</li> <li>• ISO 6.2 same heading as AS 11.2.</li> <li>• ISO 6.2.1 has same heading and content as AS 11.2.1</li> <li>• ISO 6.2.2 has same heading AS 11.2.2</li> <li>• ISO 6.2.2 contains slightly different formulas and extra formulas</li> </ul> <p><b>Reviewer comment:</b> Adopt ISO content for 6.2.2</p>
11.2.3 Standard Deviation of velocity fluctuations 11.2.4 Autocorrelation function 11.2.5 Effect of measuring time on standard deviation	Significant change	<ul style="list-style-type: none"> <li>• ISO 6.2.3 has same heading as AS 11.2.3</li> <li>• ISO has explanation variables in formulae and slightly more content</li> <li>• ISO 6.2.4 has same heading as AS 11.2.4</li> <li>• ISO 6.2.4 is similar in content to AS 11.2.4</li> <li>• ISO 6.2.5 has same heading as AS 11.2.5</li> <li>• ISO 6.2.5 has different content than AS 11.2.5</li> </ul> <p><b>Reviewer comment:</b> Adopt ISO content for 6.2.3</p>

Section (AS section number)	Classification of change AS to ISO	More detail and comment on changes in the updated ISO
11.2.6 Effect of measuring time on standard deviation (2) 11.2.7 Compilation of results	Significant change	<ul style="list-style-type: none"> <li>• ISO 6.2.6 has same heading as AS 11.2.6</li> <li>• ISO 6.2.6 has different content than AS 11.2.6</li> <li>• ISO 6.2.7 has same heading as AS 11.2.7</li> <li>• ISO 6.2.7 has different content than AS 11.2.7               <ul style="list-style-type: none"> <li>○ ISO includes a Table near section where AS has Table not associated with text</li> <li>○ A paragraph in AS not included in ISO</li> </ul> </li> </ul> <p><b>Reviewer comment:</b> Adopt ISO content for 6.2.6 and 6.2.7</p>
11.3 Error -type II 11.3.1 Approx. of mean velocity in the vertical 11.3.2 Determination of the standard mean velocity in the vertical	Minor change	<ul style="list-style-type: none"> <li>• ISO 6.3 has same heading as AS 11.3</li> <li>• ISO 6.3.1 General has same content as AS11.3.1</li> <li>• ISO 6.3.2 has same heading as AS 11.3.2</li> <li>• ISO contains minor changes to content</li> </ul>
11.3.3 Computation methods 11.3.4 Sampling error due to velocity fluctuations and computation rule	Significant change	<ul style="list-style-type: none"> <li>• ISO 6.3.3 has same heading as AS 11.3.3</li> <li>• ISO 6.3.3 has similar content to AS11.3.3</li> <li>• ISO 6.3.4 has same heading as AS 11.3.4</li> <li>• ISO 6.3.4 content differs to AS 11.3.4</li> </ul> <p><b>Reviewer comment:</b> Adopt ISO content for 6.3.4</p>
11.3.5 Sampling error due to computation rule	Significant change	<ul style="list-style-type: none"> <li>• ISO 6.3.5 has same heading as AS 11.3.5</li> <li>• ISO 6.3.5 content differs to AS 11.3.5</li> </ul> <p><b>Reviewer comment:</b> Adopt ISO content for 6.3.5</p>

Section (AS section number)	Classification of change AS to ISO	More detail and comment on changes in the updated ISO
11.4 Error-type III 11.4.1 Restricted number of verticals 11.4.2 True discharge 11.4.3 Omission of verticals 11.4.4 Mean and standard deviations of error 11.4.5 Criteria applied in choosing the verticals	Minor change	<ul style="list-style-type: none"> <li>• ISO 6.4 Same heading</li> <li>• ISO 6.4.1 General has same content as AS 11.4.1</li> <li>• ISO 6.4.2 has same heading and content as AS 11.4.2</li> <li>• ISO 6.4.3 has same heading and slight change in content AS 11.4.3</li> <li>• ISO 6.4.4 has same heading and slight change in content AS 11.4.4</li> <li>• ISO 6.4.5 has same heading and slight change in content AS 11.4.5</li> </ul>
12 List of Symbols	Significant change	<ul style="list-style-type: none"> <li>• Not listed in ISO</li> </ul> <p><b>Reviewer comment:</b> The AS 12 not essential.</p>
Graphs	Minor change	<ul style="list-style-type: none"> <li>• ISO similar Graphs to AS.</li> </ul>
ANNEX A Local Point velocity measurements – Report form	Significant change	ISO: ANNEX A (informative) Characteristics of rivers from which data were collected <ul style="list-style-type: none"> <li>• Contains list of international stream measurements</li> </ul> <p><b>Reviewer comment:</b> Adopt ISO annex</p>

Section (AS section number)	Classification of change AS to ISO	More detail and comment on changes in the updated ISO
ANNEX B Average velocity measurements – Report form	Significant change	ANNEX B (normative) Effect of increasing measuring time on uncertainty. <b>Reviewer comment:</b> Adopt ISO annex.
ANNEX C Velocity-area method – Report form	Minor change - Numbering	ANNEX C (normative) Local Point velocity measurements – Report form. <ul style="list-style-type: none"> <li>• Same content as AS Annex A</li> </ul> <b>Reviewer comment:</b> Adopt ISO annex.
	Minor change - Numbering	ANNEX D (normative) Average velocity measurements – Report form. <ul style="list-style-type: none"> <li>• Same content as AS Annex B</li> </ul> <b>Reviewer comment:</b> Adopt ISO annex.
	Minor change - Numbering	ANNEX E (normative) Velocity-area method – Report form. <ul style="list-style-type: none"> <li>• Same content as AS Annex C</li> </ul> <b>Reviewer comment:</b> Adopt ISO annex.
	Significant change	ANNEX F (informative) Examination of Error Types I, ii, iii <b>Reviewer comment:</b> Adopt ISO annex.

Section (AS section number)	Classification of change AS to ISO	More detail and comment on changes in the updated ISO
	Significant change	ANNEX G (informative) Uncertainties in velocity-area measurement components <ul style="list-style-type: none"> <li>• <b>Reviewer comment:</b> Adopt ISO annex.</li> </ul>
	Significant change	ANNEX H (informative) Calculation of the uncertainty in a current-meter gauging <ul style="list-style-type: none"> <li>• <b>Reviewer comment:</b> Adopt ISO annex.</li> </ul>
	Significant change	Bibliography
		○
ANNEX B (informative) Bibliography	Significant change	<ul style="list-style-type: none"> <li>• ISO ANNEX B “Approximate value of Strickler coefficients <math>k_{St}</math> for natural streams”               <ul style="list-style-type: none"> <li>○ Adopt ISO</li> </ul> </li> </ul> <b>Reviewer comment:</b> Should be included.
	Significant change	<ul style="list-style-type: none"> <li>• ISO ANNEX C “US Soil Conservation Service method of estimating Manning’s <math>n</math>”               <ul style="list-style-type: none"> <li>○ Adopt ISO</li> </ul> </li> </ul> <b>Reviewer comment:</b> Should be included.
	Significant change	<ul style="list-style-type: none"> <li>• ISO ANNEX D “Conveyance estimation system”               <ul style="list-style-type: none"> <li>○ Adopt ISO</li> </ul> </li> </ul> <b>Reviewer comment:</b> Should be included.

Section (AS section number)	Classification of change AS to ISO	More detail and comment on changes in the updated ISO
	Significant change	<ul style="list-style-type: none"><li>• Bibliography<ul style="list-style-type: none"><li>○ Adopt ISO</li></ul></li></ul> <p><b>Reviewer comment:</b> Should be included.</p>