

Comparison of current Australian Standard with updated ISO standard

Current Australian Standard	AS 3778.3.3-2001	Measurement of water flow in open channels. Part 3.3: Velocity-area methods-Measurement by slope-area method
Updated ISO Standard	ISO 1070-2018	Hydrometry – Slope-area method

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 been reorganised to first present two section computations followed by multiple reach computations;
- A third governing formula (Darcy-Weisbach) has been added;
- Three ANNEXES have been added related to coefficients.

Several sentences/paragraphs (refer detailed analysis comments below) have been deleted from the ISO but should still be included in the AS to provide a clearer explanation of the specific topic. However, these could be incorporated into the AS in a future review.

Mark Hopper
21/01/2021

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"> • <i>accept the updated ISO in full to replace current AS (simplest option!)</i>
<ul style="list-style-type: none"> • <i>reject the updated ISO and withdraw the current AS (in cases where the update is not appropriate for Australian practice)</i>
<ul style="list-style-type: none"> • <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>
<ul style="list-style-type: none"> • <i>further work required to adapt the ISO for an updated AS (non-preferred option, exceptional cases only)</i>

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	Minor change	<p>ISO update is shorter and more concise. AS contains 2 additional paragraphs which have been deleted from ISO.</p> <ol style="list-style-type: none"> 1. Relates to the conditions for accuracy in using the method. 2. Slope Area method used for the extreme high-end rating development. <p>Reviewer comment: Although deleting the first paragraph can be acceptable, the paragraph does provide an overview of the conditions for accuracy in using this method. Deleting the second paragraph is not critical to the context of the Standard.</p>
2. Normative references	Minor change	<p>ISO references (2) are listed as the general name of the ISO. AS contains references with the specific edition. The AS also contains 2 additional references.</p> <ol style="list-style-type: none"> 1. ISO 1100-2-1982 Determination of the stage discharge relation 2. ISO 5168-1978 Estimation of uncertainty of a flow rate measurement <p>Reviewer comment: The additional AS references are not required</p>
3. Definitions	Minor change	<ul style="list-style-type: none"> • Heading changed to "Terms and definitions" • ISO has incorporated links to web pages

Section (AS section number)	Classification of change AS to ISO	More detail and comment on changes in the updated ISO
4 Principle of the method of measurement	Significant change	<ul style="list-style-type: none"> • ISO reworded content but context the same (1st paragraph) • AS uses term “mean hydraulic depth” while ISO uses “hydraulic radius” <p>Major additions to ISO</p> <ul style="list-style-type: none"> • Includes (introduces) the formulas for slope/area • Adds a third formula for calculation: Darcy-Weisbach <p>Reviewer comment: This change is recommended as it provides an additional method to calculate discharge using the Slope/Area method. Adopt new ISO section.</p>
5 Selection and Demarcation of site 5.1 Initial Survey of site	Minor change	<ul style="list-style-type: none"> • ISO is the same as AS for all AS content • ISO contains additional content when determining site <p>Reviewer comment: The ISO change is recommended as it provides additional detail.</p>
5.2 Selection of site	Significant change	<ul style="list-style-type: none"> • AS is formatted into sub sections (5.2.1 to 5.2.9) whereas ISO is separated into paragraphs. • ISO has not included AS 5.2.1. • AS 5.2.2. ISO has reworded and included extra sentence/words. Essentially similar. • AS 5.2.3. ISO has identical paragraph • AS 5.2.4. ISO has completely new definition of reach requirement. Adopt ISO. • AS 5.2.5. ISO has additional content. Adopt ISO • AS 5.2.6. ISO has reworded. • AS 5.2.7. ISO has identical paragraph. • AS 5.2.8. ISO has identical sentence plus additional content incorporating an explanation. • AS 5.2.9. ISO has not included. <p>Reviewer comment: The ISO change is recommended as it provides additional detail.</p>

Section (AS section number)	Classification of change AS to ISO	More detail and comment on changes in the updated ISO
5.3 Demarcation of site	Minor change	<ul style="list-style-type: none"> ISO has been reworded.
6 Devices for measurement of slope 6.1 Reference gauge	Minor change	<ul style="list-style-type: none"> ISO have changed the order of the sub sections AS 6.1 and ISO 6.4 have same heading. ISO has completely reworded the sub section
6.2 Water Level Recorder	Significant change	<ul style="list-style-type: none"> ISO 6.3 with new name change – Pressure transmitters. Completely different sub section with greater details.
6.3 Crest stage gauge	Significant change	<ul style="list-style-type: none"> AS 6.3 and ISO 6.2 have same heading. ISO has completely reworded the sub section and included additional content. <p>Reviewer comment: The ISO change is recommended as it provides additional detail.</p>
6.4 High Water Marks	Significant change	<ul style="list-style-type: none"> AS 6.4 and ISO 6.1 have same heading. ISO has completely reworded the sub section and included additional content. <p>Reviewer comment: The ISO change is recommended as it provides additional detail.</p>
7 Procedure for installing gauges and making observations 7.1 Installation	Significant change	<ul style="list-style-type: none"> ISO has removed this section completely. AS 7.1 content has been included elsewhere in the ISO
7.2 Procedure for observation of gauges	Significant change	<ul style="list-style-type: none"> ISO has removed this section completely. AS 7.2 relates primarily to how to read a gauge which should not belong in this Standard.

Section (AS section number)	Classification of change AS to ISO	More detail and comment on changes in the updated ISO
7.3 Other Observations	Significant change	<ul style="list-style-type: none"> ISO has removed this section completely. AS 7.3 relates primarily to the metadata to be noted when reading a gauge which should not belong in this Standard.
	Significant change	<ul style="list-style-type: none"> ISO 7 Determination of Slope ISO 7 is completely different to AS 8 however, some content within ISO 7 is similar in context to AS 8 <p>Reviewer comment: The removal of this AS section from the ISO is recommended as it relates to reading a gauge.</p>
8 Computation of surface slope 8.1 Computation of surface slope from gauges	Significant change	<ul style="list-style-type: none"> Some content within ISO 7 is similar in context to AS 8
8.2 Computation of surface slope from high water marks	Significant change	<ul style="list-style-type: none"> Some content within ISO 7 is similar in context to AS 8
9 Cross sections of the stream 9.1 Number of cross sections	Significant change	<ul style="list-style-type: none"> ISO 8 has slight change of name – Cross sections of a stream ISO 8.1 has slight change of name – Number and location of cross sections ISO 8.1 in its 1st paragraph is reworded content of AS 9.1 ISO 8.1 includes a 2nd paragraph containing extra content relating to the location of the cross sections
9.2 Measurement of cross sectional profiles	Minor change	<ul style="list-style-type: none"> ISO 8.2 has the same title. ISO 8.2 has been reworded and shortened. <p>Reviewer comment: The ISO change is recommended.</p>
10 Computation of discharge for non-uniform and composite cross sections	Significant change	<ul style="list-style-type: none"> ISO 9 has been completely reorganized and this is mixed within AS 10. AS 10 contains general Q formula. $Q=KS^{1/2}$ ISO 9.3 is titled – Non-uniform cross sections (2 cross section formulation). ISO 9.3.1 General contains the reworded content of AS 10

Section (AS section number)	Classification of change AS to ISO	More detail and comment on changes in the updated ISO
10.1 Computation of conveyance 10.1.1 Non-uniform section	Minor change but major reorganisation	<ul style="list-style-type: none"> • ISO 9.3.2 titled “Computation of conveyance” is a reworded version of AS 10.1.1.
10.1.2 Composite section	Minor change but major reorganisation	<ul style="list-style-type: none"> • AS 10.1.2 and ISO 9.4 “Composite cross sections” are similar headings. ISO has completely reworded the sub section and included additional content.
10.2 Computation of the hydraulic radius	Minor change but major reorganisation	<ul style="list-style-type: none"> • ISO 9.2 “Uniform cross sections” • ISO 9.2.3 “Determination of hydraulic radius” • ISO 9.2.3 has been reworded.
10.3 Value of Manning’s coefficient	Significant change	<ul style="list-style-type: none"> • ISO 9.2.4 “Determination of the mean velocity in the reach” • ISO 9.2.4.3 “Manning and Chezy coefficients” <ul style="list-style-type: none"> ○ Title and content include Chezy as well. ○ Reworded content ○ Extra content and additional Annex (C)
	Significant change	<ul style="list-style-type: none"> • ISO 9.2.4.4 “Using the Darcy-Weisbach (Colebrook-White) formula” <ul style="list-style-type: none"> ○ New sub section to cover additional formula.
10.4 Evaluation of the friction slope	Minor change but major reorganisation	<ul style="list-style-type: none"> • ISO 9.3 “Non-uniform cross section (2 cross section formulation)” • ISO 9.3.3 “Evaluation of the friction slope” <ul style="list-style-type: none"> ○ Slightly reworded content.
10.5 Computation of discharge using three or more cross sections	Minor change	<ul style="list-style-type: none"> • ISO 9.5 “Computation of discharge using three or more cross sections” <ul style="list-style-type: none"> ○ Reworded content. ○ Additional Figure

Section (AS section number)	Classification of change AS to ISO	More detail and comment on changes in the updated ISO
10.6 State of Flow	Minor change	<ul style="list-style-type: none"> • ISO 9.6 “State of Flow” <ul style="list-style-type: none"> ○ Slightly reworded content. ○ Content has been shortened. • AS 10.6 has an additional paragraph which provides an explanation for changes in flow states. <p>Reviewer comment: The AS paragraph should remain.</p>
11 Computation of discharge for uniform cross section	Minor change but major reorganisation	<ul style="list-style-type: none"> • ISO 9.2 “Uniform cross sections” • ISO 9.2.1 “General” <ul style="list-style-type: none"> ○ Slightly reworded content.
11.1 Determination of the mean cross sectional area and the mean wetted perimeter of the reach	Minor change	<ul style="list-style-type: none"> • ISO 9.2 “Uniform cross sections” • ISO 9.2.2 “Determination of the mean cross sectional area and the mean wetted perimeter of the reach” <ul style="list-style-type: none"> ○ Slightly reworded content. ○ Content has been shortened. <p>Reviewer comment: The AS <i>Note</i> should remain.</p>
11.2 Determination of the mean velocity in the reach 11.2.1 Using Manning’s equation	No change	<ul style="list-style-type: none"> • ISO 9.2.4 “Determination of the mean velocity in the reach” • ISO 9.2.4.1 “Using Manning’s formula” <ul style="list-style-type: none"> ○ Same content.

Section (AS section number)	Classification of change AS to ISO	More detail and comment on changes in the updated ISO
11.2.2 Using Chezy's equation	Minor change	<ul style="list-style-type: none"> • ISO 9.2.4.2 "Using Chezy's equation" <ul style="list-style-type: none"> ○ Slightly reworded content. ○ Content has been shortened. • AS 11.2.2 has an additional paragraph which provides an explanation for determining Chezy's C. <p>Reviewer comment: The AS paragraph should remain.</p>
11.3 Correction of discharge	Minor change	<ul style="list-style-type: none"> • Not included in ISO <p>Reviewer comment: Does not need to be included.</p>
	Significant change	<ul style="list-style-type: none"> • ISO 10 "Alternative methods to estimate conveyance" • ISO 10.1 "General" • ISO 10.2 "Divided channel method" • ISO 10.3 "Conveyance estimation system" <p>Reviewer comment: Should be included.</p>
12 Uncertainties in flow measurement 12.1 Errors	Significant change	<ul style="list-style-type: none"> • ISO 11 "Uncertainties in flow measurement" • ISO 11.1 "Definition of Uncertainty" <ul style="list-style-type: none"> ○ Completely different content as AS 12.1. <p>• Reviewer comment: ISO definition should be adopted.</p>

Section (AS section number)	Classification of change AS to ISO	More detail and comment on changes in the updated ISO
<p>12.2 Methods of calculation</p> <p>12.2.1 Sources of Uncertainties for a uniform reach</p>	Significant change	<ul style="list-style-type: none"> • ISO 11.2 “Sources of Uncertainties for a uniform reach” • ISO 11.2.1 “General considerations” <ul style="list-style-type: none"> ○ Reworded AS 12.2.1. ○ AS contains additional detail on Chezy whereas ISO has a brief sentence covering Chezy and Darcy-Weisbach. ○ AS includes additional content relating to overall uncertainty • Reviewer comment: ISO content should be adopted. Inclusion of AS Chezy and other material should be considered.
<p>12.2.2 Determination of individual components of uncertainty in the discharge calculation</p> <p>12.2.2.1 Uncertainty in the calculation of the mean cross sectional area</p>	Minor change	<ul style="list-style-type: none"> • ISO 11.2 “Sources of Uncertainties for a uniform reach” • ISO 11.2.2 “Uncertainty of the mean cross sectional area” <ul style="list-style-type: none"> ○ Slight change in name ○ Slightly reworded AS 12.2.2.1.
<p>12.2.2.2 Uncertainty in the calculation of the mean wetted perimeter</p>	Minor change	<ul style="list-style-type: none"> • ISO 11.2 “Sources of Uncertainties for a uniform reach” • ISO 11.2.3 “Uncertainty in the calculation of the mean wetted perimeter” <ul style="list-style-type: none"> ○ Slightly reworded AS 12.2.2.2.
<p>12.2.2.3 Relationship between the uncertainties in the cross sectional area and in the mean wetted perimeter</p>	Minor change	<ul style="list-style-type: none"> • ISO 11.2 “Sources of Uncertainties for a uniform reach” • ISO 11.2.3 “Uncertainty in the calculation of the mean wetted perimeter” <ul style="list-style-type: none"> ○ This ISO also contains the contents of AS 12.2.2.3.
<p>12.2.2.4 Uncertainties in determination of the friction slope</p>	No change	<ul style="list-style-type: none"> • ISO 11.2 “Sources of Uncertainties for a uniform reach” • ISO 11.2.4 “Uncertainties in determination of the friction slope”.

Section (AS section number)	Classification of change AS to ISO	More detail and comment on changes in the updated ISO
12.2.2.4 Uncertainty due to choice of the rugosity coefficient	Minor change	<ul style="list-style-type: none"> • ISO 11.2 “Sources of Uncertainties for a uniform reach” • ISO 11.2.5 “Uncertainty due to the choice of the rugosity coefficient” <ul style="list-style-type: none"> ○ Slight change in content and context ○ AS includes rating extrapolation which has been deleted from the ISO <p>Reviewer comment: ISO content should be adopted. Inclusion of AS factor should be considered.</p>
12.2.3 Overall uncertainty in the measurement of discharge	Significant change	<ul style="list-style-type: none"> • ISO 11.2 “Sources of Uncertainties for a uniform reach” • ISO 11.2.6 “Overall uncertainty in the measurement of discharge” <ul style="list-style-type: none"> ○ ISO content shorter with no detailed explanations ○ AS includes additional aspects related to Chezy and other material. <p>Reviewer comment: ISO content should be adopted. Inclusion of additional AS material should be considered.</p>
ANNEX A (informative) Approximate values of coefficients n and C for open channels	No change	<ul style="list-style-type: none"> • ISO <ul style="list-style-type: none"> ○ Slight reworded and extra content ○ Removed AS reference to Si units <p>Reviewer comment: ISO content should be adopted.</p>
ANNEX B (informative) Bibliography	Significant change	<ul style="list-style-type: none"> • ISO ANNEX B “Approximate value of Strickler coefficients k_{St} for natural streams” <ul style="list-style-type: none"> ○ Adopt ISO <p>Reviewer comment: Should be included.</p>
	Significant change	<ul style="list-style-type: none"> • ISO ANNEX C “US Soil Conservation Service method of estimating Manning’s n” <ul style="list-style-type: none"> ○ Adopt ISO <p>Reviewer comment: Should be included.</p>

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"> • ISO ANNEX D “Conveyance estimation system” <ul style="list-style-type: none"> ○ Adopt ISO <p>Reviewer comment: Should be included.</p>
	Significant change	<ul style="list-style-type: none"> • Bibliography <ul style="list-style-type: none"> ○ Adopt ISO <p>Reviewer comment: Should be included.</p>