


Comparison of current Australian Standard with updated ISO standard

Current Australian Standard	AS 3778.4.2	Measurement of water flow in open channels Part 4: Measurement using gauging structures Method 4.2: Rectangular broad-crested weirs
Updated ISO Standard	ISO 3846	Hydrometry – Open channel flow measurement using rectangular broad-crested weirs

High-level comment on differences

The updated ISO Standard is much the same as the current Australian Standard in many sections, with only minor updates and changes which improve clarity/readability.

There are however, several substantial differences between the documents which are summarised as follows:

- The updated ISO standard includes provision for the option of measuring the downstream head to determine flow in drowned conditions.
 - The updated ISO includes standards for downstream head measurement location (8.2.2)
 - Drowned flow discharge equation (9.4)
 - Limitations for operation in the drowned flow range (9.5)
 - Uncertainty in drowned flow measurement (10.4.3)
- The updated ISO standard provides considerable additional information on Uncertainties in flow measurement and aligns the Standard with the *Guide to the expression of uncertainty in measurement (GUM)* and *ISO/TS 25377*. The changes include the following:
 - AS3778.4.2 expresses measurement uncertainty of the discharge coefficient at the 95% confidence interval (equivalent to two standard deviations). The updated ISO expresses the discharge coefficient as standard uncertainty in accordance with *GUM* as one standard deviation.
 - Inclusion of a new Annex (Annex C – Introduction to measurement uncertainty)
 - Inclusion of a new Annex (Annex D – Sample measurement performance for use in hydrometric worked examples)
 - Substantial rework of Section 9 (Section 10 in updated ISO) – Uncertainties in flow measurement
 - The revised section of uncertainties in flow measurement aligns the Standard with Standard Uncertainty equivalent to one standard deviation.
 - This revised section, and the accompanying worked example in Section 10 provides considerable additional detail on measurement uncertainty and aligns it with standard uncertainty (one standard deviation).
 - The equation for modular flow measurement uncertainty has been updated from  to reflect one standard deviation
 - An additional equation for uncertainty in drowned flow conditions is presented.

- The updated ISO removes Annex A – Nomenclature and brings this section into a new section (Section 4 – Symbols).
 - Some changes to symbols have been made including:
 - Inclusion of symbols relevant to drowned flow equations
 - Revision of symbols relating to uncertainty

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
1. Scope and field of application	Minor	Title revised to Scope. Removal of references to Annexes.
2. References	Minor	Removal of references to ISO 748, ISO 1100-1, ISO 5168, ISO 8368
3. Definitions	Minor	Removal of reference to Annex A – Nomenclature and replacement with new Section (4) in updated ISO
4. Installation	No Change	Section 5.1 in updated ISO but content unchanged.
4.1 Selection of site	Minor	Section 5.2 in updated ISO but content unchanged except for the removal of a reference to ISO24154 – Measuring river velocities using acoustic doppler profilers.
4.2.1 General requirements	Minor	Section 5.3.1 in updated ISO but content unchanged. Title changed to General.
4.2.2 The approach channel	Minor	Section 5.3.2 in updated ISO but content relatively unchanged with the exception of the following: <ul style="list-style-type: none"> • Revision of the acceptable straight length of channel from ■ times the channel width to ■ times the channel width • Revision of the acceptable Froude number (Fn) for weir approach from ■■■■
4.2.3 The measuring structure	No Change	Section 5.3.3 in updated ISO but content unchanged.
4.2.4 Downstream of the structure	Minor	Section 5.3.4 in updated ISO. Wording has been improved in updated ISO but meaning unchanged.
5. Maintenance – General Requirements	Minor	Section 6 in updated ISO. Similar in content and meaning to updated ISO, but updated ISO includes additional information regarding remediation/mitigation of scouring downstream.

Section (AS section number)	Classification of change AS to ISO	More detail and comment on changes in the updated ISO
6 Measurement of head(s) 6.1 General requirements	Minor	Section 7 and 7.1 in updated ISO. Title changed to General. Content identical.
6.2 Stilling or float well	Minor	Section 7.2 in updated ISO. Minor wording changes and improvements in updated ISO but meaning the same.
6.3 Zero setting	No change	Section 7.3 in updated ISO but content identical
7. Rectangular broad-crested weirs 7.1 Specification for the standard weir	No change	Section 8 and 8.1 in updated ISO but content identical
7.2 Location of the head gauge section	Significant change	Section 8.2 in updated ISO. Updated ISO has been split into two sections: 8.2.1 Upstream head measurement 8.2.2 Downstream head measurement Section 8.2.1 is identical to content in Section 7.2 of the aged standard Section 8.2.2 provides specifications for measurement of water level downstream of the weir for measurement of flow in drowned conditions. Figure 1 has been updated to reference the additional information regarding downstream head measurement.
7.3 Provision for modular flow	Minor	Section 8.2 in updated ISO. Minor wording changes and improvements in updated ISO but meaning the same. Includes formula for Submergence Ratio (S).
8 Discharge Relationships 8.1 Modular flow discharge equation	No change	Section 9 and 9.1 in updated ISO but content identical
8.2 Discharge coefficient	Minor	Section 9.2 in updated ISO and title changed to Modular coefficient of discharge. Content of section identical.

Section (AS section number)	Classification of change AS to ISO	More detail and comment on changes in the updated ISO
8.3 Limitations	Minor	Section 9.3 in updated ISO and title changed to Limitations for operation in the modular flow range. Content of section identical.
No existing Section Reference	Significant change	Inclusion of a new section (Section 9.4 – Drowned flow discharge equation). The additional section provides a revised formula for flow estimation with the inclusion of a drowned flow reduction factor (f). The section provides a formula for determining the drowned flow reduction factor (f) as a function of the upstream and downstream heads (within a specified range) and incorporates this factor into the standard broad-crested weir equation as an additional coefficient.
No existing Section Reference	Significant change	Inclusion of a new section (Section 9.5 – Limitations for operation in the drowned flow range). The additional section provides the general limitations of operation under drowned flow conditions and application of the drowned flow reduction factor (f) to avoid surface tension and viscous effects. It also specifies the range of calibration data used for determining applicable weirs ($L/p = \blacksquare$) and the applicable range of calibration data as a function of H_1 and H_2 .
8.4 Accuracy	Significant change	This section has been completely removed in the updated standard as its relevant content is now incorporated into the reworked section “Uncertainties in flow measurement” (Section 10 in updated standard)

Section (AS section number)	Classification of change AS to ISO	More detail and comment on changes in the updated ISO
9. Uncertainties in flow measurement	Significant change	<p>Section 10 in updated standard.</p> <p>The changes in this section are numerous and significant. The updated standard aligns the Standard with the <i>Guide to the expression of uncertainty in measurement (GUM)</i> and <i>ISO/TS 25377</i>. The changes include the following:</p> <ul style="list-style-type: none"> • AS3778.4.2 expresses measurement uncertainty of the discharge coefficient at the ■ confidence interval (equivalent to two standard deviations). The updated ISO expresses the discharge coefficient as standard uncertainty in accordance with <i>GUM</i> as one standard deviation. • Substantial rework of all subsections in this section to align with standard uncertainty. Removal of term “error” in preference to “uncertainty” <ul style="list-style-type: none"> ○ The revised section of uncertainties in flow measurement aligns the Standard with Standard Uncertainty equivalent to one standard deviation. ○ This revised section, and the accompanying worked example in Section 10 provides considerable additional detail on measurement uncertainty and aligns it with standard uncertainty (one standard deviation). ○ The equation for modular flow measurement uncertainty has been updated from ■■■■■ to reflect one standard deviation ○ An additional equation for uncertainty in drowned flow conditions is presented. <p>The multiple sub-sections of this section have been modified considerably and as-such, cannot be directly compared. However the updated standard brings it in-line with ISO25377 – Hydrometry uncertainty guidance. It is therefore recommended that all changes to this section be adopted in their entirety.</p>

Section (AS section number)	Classification of change AS to ISO	More detail and comment on changes in the updated ISO
10. Example	Significant Change	<p>Section 11 in the updated standard. This section and all sub-sections are considerably different to the example presented in the aged standard as the approach to uncertainty determination has changed considerably.</p> <p>As such, if the changes proposed to Section 9 are to be implemented, it is also recommended that all changes to this section be adopted in their entirety.</p>
Annex A – Nomenclature	Significant Change	<p>This Annex has been removed from the updated Standard and is now Section 4 - Symbols. See the comments above regarding minor changes to content.</p>
Annex B – Submerged Flow	Minor Change	<p>Annex A in updated standard. Title changed to “Modular limit”. Content similar with minor changes to symbols and layout.</p>
Annex C – Gauged head discharge coefficient and total head discharge coefficient	Minor Change	<p>Annex B in updated standard. Content and meaning similar with minor changes to formatting and symbols.</p>
No reference in current standard	Significant Change	<p>Inclusion of a new Annex (Annex C – Introduction to measurement uncertainty) A detailed informative Annex relating to the updated methods for determining measurement uncertainty.</p> <p>This Annex is referenced extensively in the revised version of Section 9 (Section 10 in updated standard) - Uncertainties in flow measurement.</p> <p>If the proposed changes to Section 9 are adopted, the inclusion of this additional Annex will be required.</p>
No reference in current standard	Significant Change	<p>Inclusion of a new Annex (Annex D – Sample measurement performance for use in hydrometric worked examples) A supplementary document referenced extensively in the revised version of Section 10 (Section 11 in updated standard) – Example.</p> <p>If the proposed changes to Section 10 are adopted, the inclusion of this additional Annex will be required.</p>