



Australian Government
Bureau of Meteorology

WATER MONITORING
STANDARDISATION
TECHNICAL COMMITTEE

National Industry Guidelines for hydrometric monitoring

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PART 3: INSTRUMENT AND
MEASUREMENT SYSTEMS
MANAGEMENT

NI GL 100.03–2019
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In 2017 and 2018 the Water Monitoring Standardisation Technical Committee (WaMSTeC) led a periodic review of the National Industry Guidelines for hydrometric monitoring. WaMSTeC subcommittees conducted the review process and coordinated extensive industry consultation.

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Foreword

This guideline is part of a series of ten National Industry Guidelines for hydrometric monitoring. It has been developed in the context of the Bureau of Meteorology's role under the *Water Act 2007* (Cwlth) to enhance understanding of Australia's water resources.

The Bureau of Meteorology first published these guidelines in 2013 as part of a collaborative effort amongst hydrometric monitoring practitioners to establish standardised practice. They cover activities relating to surface water level, discharge and water quality monitoring, groundwater level and water quality monitoring and rainfall monitoring. They contain high level guidance and targets and present non-mandatory Australian industry recommended practice.

The initial versions of these guidelines were endorsed by the Water Information Standards Business Forum (the Forum), a nationally representative committee coordinating and fostering water information standardisation. In 2014, the functions and activities of the Forum transitioned to the Water Monitoring Standardisation Technical Committee (WaMSTeC).

In 2017, as part of the ongoing governance of the guidelines, WaMSTeC initiated a 5-yearly review process to ensure the guidelines remain fit-for-purpose.

These revised guidelines are the result of that review. They now include additional guidance for groundwater monitoring, and other updates which improve the guidelines' currency and relevance. WaMSTeC endorsed these revised guidelines in December 2018.

Industry consultation has been a strong theme throughout development and review of the ten guidelines. The process has been sponsored by industry leaders and has featured active involvement and support from the Australian Hydrographers Association, which is considered the peak industry representative body in hydrometric monitoring.

These guidelines should be used by all organisations involved in the collection, analysis and reporting of hydrometric information. The application of these guidelines to the development and maintenance of hydrometric programs should help organisations mitigate program under-performance and reduce their exposure to risk.

Organisations that implement these guidelines will need to maintain work practices and procedures that align with guideline requirements. Within the guidelines, the term “shall” indicates a requirement that must be met, and the term “should” indicates a recommendation.

The National Industry Guidelines can be considered living documents. They will continue to be subject to periodic WaMSTeC review at intervals of no greater than five years. In the review phase, WaMSTeC will consider any issues or requests for changes raised by the industry. Ongoing reviews will ensure the guidelines remain technically sound and up to date with technological advancements.

National Industry Guidelines for hydrometric monitoring

This document is one part of the National Industry Guidelines for hydrometric monitoring series, which can be found at

<http://www.bom.gov.au/water/standards/niGuidelinesHyd.shtml>.

The series contains the following parts:

Part 0: Glossary

Part 1: Primary Measured Data

Part 2: Site Establishment and Operations

Part 3: Instrument and Measurement Systems Management (*this guideline*)

Part 4: Gauging (stationary velocity-area method)

Part 5: Data Editing, Estimation and Management

Part 6: Stream Discharge Relationship Development and Maintenance

Part 7: Training

Part 8: Application of Acoustic Doppler Current Profilers to Measure Discharge in Open Channels

Part 9: Application of in-situ Point Acoustic Doppler Velocity Meters for Determining Velocity in Open Channels

Part 10: Application of Point Acoustic Doppler Velocity Meters for Determining Discharge in Open Channels.

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National Industry Guidelines for hydrometric monitoring

Part 3: Instrument and Measurement Systems Management

1 Scope and general

1.1 Purpose

The purpose of this document is to provide guidelines for recommended practice for instruments, measurements and instrument management systems that support water monitoring operations.

1.2 Scope

This guideline specifies requirements for the management of hydrometric instruments including their accuracies, resolution, sample frequency, unit of measure and calibration.

1.3 Application

This guideline applies to management of all instrumentation systems including primary sensors and standard test instruments used in the production of hydrometric data, along with the frequency and range of calibrations.

1.4 References

1.4.1 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this guideline:

1. Standards Australia, *Measurement of water flow in open channels – Measuring devices, instruments and equipment – Water level measuring devices*, AS 3778.6.5—2001 (same as ISO 4373:1995).
2. Standards Australia/Standards New Zealand, *Measurement management systems – Requirements for measurement processes and measuring equipment*, AS/NZS ISO 10012:2004.

1.4.2 Bibliography

Cognisance of the following was taken in the preparation of this guideline:

- International Organization for Standardization, *Quality management systems – Fundamentals and vocabulary*, ISO 9000:2015.

1.5 Definitions

For the purpose of this guideline, the definitions given in National Industry Guidelines for hydrometric monitoring, Part 0: *Glossary*, NI GL 100.00–2019 apply.

2 Safety requirements

All work undertaken for hydrometric projects shall be in conformance with the relevant government work health and safety legislation.

3 Instrument management

3.1 General

The organisation shall maintain a register of all instruments that contains the instruments' unique identification and specifications, and records of their maintenance and calibration.

The unique identification of the equipment shall be recorded with the field measurements.

Calibration intervals may vary due to the type of instrument (i.e. manufacturer's specifications), environmental and/or flow conditions, customer requirements or similar. Organisations shall specify and record maximum calibration check intervals for each model of instrument in use.

Intervals between calibrations shall be sufficient to demonstrate that the instruments are performing within specification. The intervals may be based on manufacturer specifications or performance records (e.g., calibration and spot check records).

Calibration adjustments shall only be made by trained operators. Organisations shall ensure that training is provided to identify recognised needs, and that records of competencies are maintained.

3.2 Metrological confirmation process

3.2.1 General

The calibration of an instrument involves carrying out recommended tests and adjustments so that the instrument operates within the organisation's limits of accuracy for the whole range of operation (refer to National Industry Guidelines for hydrometric monitoring, Part 1: *Primary Measured Data*, NI GL 100.01–2019), along with manufacturer's stated accuracy limits (refer to relevant manufacturer's manuals).

To achieve these guidelines it is necessary to compare the results of the instrument being tested to those of a 'standard test instrument' of known (higher) accuracy over a required range of values.

To ensure these guidelines are met, the actions specified in Clause 3.2.2 to Clause 3.2.3, as a minimum, shall be carried out.

3.2.2 Comprehensive instrument records

The organisation's comprehensive instrument records shall include:

- a) the description and unique identification of the equipment manufacturer, type, serial number, accuracy, range, precision and similar;
- b) the date on which the metrological confirmation was completed;
- c) the result of the metrological confirmation;
- d) the assigned interval for metrological confirmation;
- e) identification of the metrological confirmation procedure;
- f) the designated maximum permissible error(s);
- g) the relevant environmental conditions and a statement about any corrections necessary;
- h) the uncertainties involved in calibrating the equipment;
- i) details of any maintenance, such as adjustment, repairs or modifications carried out;
- j) any limitations of use;
- k) identification of the person(s) performing the confirmation;
- l) identification of the person(s) responsible for the recorded information;
- m) unique identification (such as serial numbers) of any calibration certificates and reports, and other relevant documents;
- n) information to ensure traceability of the calibration results;
- o) the metrological requirements for the intended use;
- p) the calibration results obtained after and, where required, before any adjustment, modification or repair—adjustments are required where calibration results lie outside maximum permissible errors, or the instrument is not performing as per manufacturer's specifications; and
- q) deployment history, i.e., dates of previous and current location(s).

3.2.3 Calibration and metrological confirmation

Organisations shall maintain and follow a written procedure for calibration and metrological confirmation of instruments. The following apply:

1. All calibration and metrological confirmation procedures shall be described and maintained in a database.
2. Organisations shall ensure all standard test instruments used in calibrations are within calibration at time of use. Organisations shall also maintain appropriate work instructions to support procedures.
3. Calibrations shall be carried out with reference to manufacturer's specifications.

4. All field deployed sensors, where possible, should be fully ‘bench’ calibrated prior to deployment. Organisations shall maintain written work instructions describing their mandatory practices.
5. Metrological confirmation shall be carried out after any incident that may affect the instrument’s performance and accuracy e.g. power surge or power failure due to lightning strikes. Where such calibrations are carried out, the same procedures and recording shall be followed as with annual calibrations.

3.3 Nonconforming measurement systems, processes and equipment

Measurement systems are said to be nonconforming when:

- a) systems, instruments or equipment fail to operate in accordance with requirements; and
- b) an instrument does not have a current calibration certificate.

AS/NZS ISO 10012:2004, Clause 8.3.2 provides clear guidance on how to manage nonconformities:

Any measurement process known to give, or suspected of producing, incorrect measurement results shall be suitably identified and shall not be used until appropriate actions have been taken.

If a nonconforming measurement process is identified, the process user shall determine the potential consequences, make the necessary correction, and take the necessary corrective action.

A measurement process modified due to a nonconformity shall be included in validation records before use.¹

Organisations shall maintain a written procedure describing the controls and related responsibilities and authorities for dealing with nonconforming systems, processes and equipment. This procedure shall specify how the organisation will:

- a) remove nonconforming equipment from service by segregation or prominent marking;
- b) verify nonconformity and prepare nonconformity report;
- c) define the process to verify that the equipment is ready to return to service after records of reasons for nonconformance and calibration have been completed; and
- d) define the process for handling data gathered with nonconforming equipment.

Organisations shall maintain an instrument management system showing the current and historical status of all instruments in use.

¹ Source: AS/NZS ISO 10012:2004. © Standards Australia Limited. Copied by the Australian Government Bureau of Meteorology with the permission of Standards Australia and Standards New Zealand under Licence 1901-c052.

Appendix A Training

A.1 Training session outline

LEARNING ELEMENTS	RESOURCES	DESCRIPTION	
Identify and understand the 1.1 Purpose, 1.2 Scope and 1.3 Application of this guideline	Copies of all guidelines documents. Access to all reference material.	Discussion with reference to the guidelines document	Face to face delivery
1.4.1 Normative references	Copies of all guidelines documents. Access to all reference material.	Trainers to ensure the learner's ability to source and use reference material.	Face to face delivery
2 Safety requirements	Copies of all guidelines documents. Access to all reference material.	Discussion with reference to the guidelines document	Face to face delivery
3 Instrument management 3.1 General 3.2 Metrological confirmation process 3.2.1 General 3.2.2 Comprehensive instrument records 3.2.3 Calibration and metrological confirmation 3.3 Nonconforming measurement systems, processes and equipment	Copies of all guidelines documents. Access to all reference material.	Describe: <ul style="list-style-type: none"> • instrument register • traceability • calibration frequency • adjustments • record keeping • an instrument's "range of operation" • accuracy limits • procedures for instrument calibration • how to identify nonconformance • how to deal with nonconforming equipment. 	Face to face delivery

A.2 Training learning resources

A.2.1 Introduction

Welcome to the learner resource for National Industry Guidelines for hydrometric monitoring, Part 3: *Instrument and Measurement Systems Management*, NI GL 100.03–2019. The purpose of this resource is to develop your knowledge and skills and improve your competency in this guideline.

A.2.2 Section references

The table below shows elements of the guideline that are covered in this learner resource. This may help the learner to map their progress as they work their way through this resource.

Section	Unit element
1 Scope and general	1.1 Purpose 1.2 Scope 1.3 Application 1.4.1 Normative references 1.5 Definitions
2 Safety requirements	
3 Instrument management 3.1 General 3.2 Metrological confirmation process 3.3 Nonconforming measurement systems, processes and equipment	3.2.1 General 3.2.2 Comprehensive instrument records 3.2.3 Calibration and metrological confirmation

A.2.3 Who needs this competency?

This learning material covers the skills and knowledge required for a person to use and understand National Industry Guidelines for hydrometric monitoring, Part 3: *Instrument and Measurement Systems Management*, NI GL 100.03–2019.

A.2.4 Learning outcomes

At the completion of this learner resource you will be competent in the following:

- use the guideline document for reference
- use the guideline in day to day operations
- access the material referenced in the guideline document
- use and understand related internal procedures and work instructions.

A.2.5 Health and safety considerations

Health and safety legislation shall always be considered when implementing National Industry Guidelines, workplace procedures and work instructions.

Employees carrying out work related to the National Industry Guidelines should be adequately trained in all relevant health and safety matters.

A.2.6 Environmental considerations

Compliance with this guideline may involve working in the environment. As such, care should be taken to:

- prevent unnecessary damage to the site environment
- prevent unnecessary disturbance of the natural environment
- carefully construct any infrastructure to minimise impacts on the environment and river flow conditions
- plan access roads to sites to minimise impacts during all seasonal conditions.

A.2.7 What resources will I need?

- Workplace policies and procedures
- Manufacturer manuals, requirements and specifications
- Codes of practice
- Workplace equipment, tools and instruments
- Workplace reports
- Workplace maps, plans and instructions
- Permits and access to locations and worksites

Other useful resources

- Relevant Health and Safety Act
- Safe Work Australia Model Codes of Practice
- Organisation's procedures and work instructions
- Australian Standards