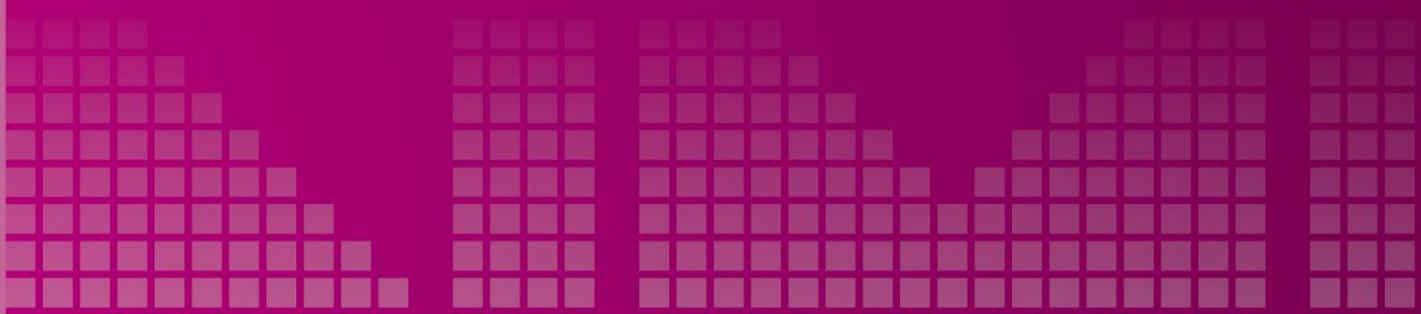




Australian Government
**National Measurement
Institute**



NITP 14
National Instrument Test Procedures for Utility Meters



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National Measurement Institute
 Bradfield Road, Lindfield, NSW 2070
 PO Box 264, Lindfield, NSW 2070

T (61 2) 8467 3600
 F (61 2) 8467 3610
 W www.measurement.gov.au

AMENDMENTS

Erratum	Date	Page	Location	Details of change
1	16/01/2013	3	clause 4.4.1	Reference to the required test procedures has been changed to remove any ambiguity in relation to the requirements for overseas testing laboratories
2	16/01/2013	5	clause 4.4.6	A note has been added to clarify the use of appendices for certificates of verification
3	16/01/2013	7	clause 6	A note has been added to clarify the inappropriateness of skip-lot sampling and switching rules for verification purposes
4	16/01/2013	8	clause 7.1	The following sentence has been added: For meters capable of negative and positive flow measurements, the mandatory test points for negative flow are I_b (or I_n) and I_{max} at power factors of unity and 0.5 inductive.
5	16/01/2013	4, 5, 7, 9, 10	clauses 4.4.4, 4.4.5, 6, 7.3, 9.4	The term 'AQL' has been replaced by the term 'acceptance level'
6	15/03/2013	2	3.3.4	A new clause 3.3.4 has been included as follows: 3.3.4 Uncertainty When verifying a utility meter, the expanded uncertainty in the determination of the reference quantity shall not exceed one-third of the applicable maximum permissible error (MPE). The expanded uncertainty shall be determined in accordance with the Joint Committee on Guides to Metrology (JCGM) 100:2008 Evaluation of measurement data — Guide to the Expression of Uncertainty in Measurement with a coverage factor, $k = 2$.
7	15/03/2013	2	3.3.5	The following amendment has been made to the clause: NMI may require additional or alternative tests (related to the determination of error or ensuring that the utility meter conforms with the approved pattern) to be performed as part of the verification test procedure; these shall-may be specified in the corresponding Certificate of Approval.
8	15/03/2013	3	3.5	The following text has been inserted into the clause: A verification test result shall be considered compliant with the relevant acceptance criteria if the result lies within the relevant MPE, and if the expanded uncertainty of the reference quantity is within one-third of the MPE.
9	15/03/2013	4	clause 4.4.1	The following text has been inserted into the clause: NMI may provide approval in writing for a batch of utility meters to be verified via batch verification in the event of minor omissions or variations in the test procedure performed in the country of manufacture. In such cases, NMI will generally require additional testing and/or larger samples to be tested by a utility meter verifier.
101	15/03/2013	5	clause 4.4.4	The following text has been deleted from the end of the clause: Approved alternative sampling plans shall be specified in the certificate issued when a person is appointed as a utility meter verifier.

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PREFACE

The *National Measurement Act 1960* (Cth) (the Act) provides that national instrument test procedures (NITPs) are:

- the procedures for testing measuring instruments determined in writing by the Chief Metrologist under section 18GG of the Act;
- for use by verifiers of measuring instruments pattern approved for use for trade, i.e. trade measurement inspectors, servicing licenses and/or their employees and utility meter verifiers;
- the sole means by which compliance with the requirements for verification under section 18GK of the Act may be determined, i.e. that measuring instruments pattern approved for use for trade are operating within the prescribed maximum permissible errors (MPEs) or the MPEs stated in their Certificate of Approval;
- to be used in conjunction with reference standard of measurement such that the verification of a measuring instrument of a pattern approved for use for trade complies with the legal traceability imperatives of section 10 of the Act.

Note: NITPs are not in themselves a legislative instrument, however, under the Act failure to comply with their provisions may constitute grounds for disciplinary action against verifiers.

The Chief Metrologist of NMI has determined that NITP 14 contains the test procedures for the verification of utility meters.

This document:

- outlines procedures for the verification of utility meters including batch/lot sampling regimes for utility meters imported into Australia from other jurisdictions, as well as the production and issue of certificates of verification as a means of identifying verified imported utility meters in lieu of a verification mark; and
- stipulates the related provisions for utility meter verifiers appointed under section 18RA of the Act.

This document does not:

- mandate the pattern approval or verification of utility meters that are of a type and class exempt from the operation of the Act under regulation 5.6 of the *National Trade Measurement Regulations 2009* (Cth);
- specify any requirements for gas meters;
- apply to the re-verification of utility meters.

The main differences between the first and second editions of this document are given below.

- Inclusion of sample sizes and acceptance criteria tables (adopted from AS 1199) for use in verification methodologies and test procedures – see clause 6.
- Expanded verification test procedure for electricity meters – see clause 7.
- Inclusion of test procedure for in-service inspection of water meters – see clause 10.
- Revision of model format for a certificate of verification – see Appendix A.

1. SCOPE

This document applies to the verification (initial and subsequent) of utility meters in use for trade which have been either manufactured within or imported into Australia. It is designed to provide guidance to utility meter verifiers in meeting their responsibilities under:

- *National Measurement Act 1960* (Cth) (the Act);
- *National Measurement Regulations 1999* (Cth); and
- *National Trade Measurement Regulations 2009* (Cth).

This document also applies to the in-service inspection of water meters.

This document does not apply to the re-verification of utility meters.

2. TERMINOLOGY

Terms used are defined in the legislation given above, *OIML V 1 International Vocabulary of Terms in Legal Metrology* and *OIML V 2-200 International Vocabulary of Metrology – Basic and General Concepts and Associated Terms*. In particular the following definitions apply:

- *verification* and *Certificate of Approval* (refer to the National Measurement Regulations);
- *in-service inspection* and *maximum permissible error* (MPE) (refer to the National Trade Measurement Regulations); and
- *utility meter*, *utility meter verifier* and *verification mark* (refer to the Act).

2.1 Batch

Definite quantity of utility meters of the same pattern manufactured under uniform conditions (also referred to as a *lot*).

2.2 Certificate of Approval

A certificate issued by NMI to attest that the design (pattern) of a utility meter is approved and suitable for use for trade (also referred to as a pattern approval certificate).

2.3 Certificate of Verification

A certificate issued by a utility meter verifier as evidence that a batch of utility

meters is verified in accordance with section 18GG of the Act.

2.4 Country of Manufacture

The jurisdiction in which assembly and sealing of all component parts of a utility meter took place.

2.5 In-service Inspection

The inspection and testing of a water meter following a period of in-service operation.

2.6 Initial Verification, Subsequent Verification and Re-verification

Initial verification and subsequent verification are both considered to be verification, undertaken at different times during the operational life of a utility meter. As such, all the requirements of the Act, as it pertains to verification, apply in both cases.

Initial verification is the verification of utility meter that has never before been verified, undertaken prior to the use of the utility meter.

Subsequent verification is verification performed on a utility meter following repair, maintenance or adjustment affecting the metrological performance and/or sealing of a utility meter. Following such incidents, verification shall be undertaken for a utility meter to continue to comply with the requirements of the Act.

Re-verification is the periodic verification of a measuring instrument undertaken throughout the operational lifetime of that instrument. In accordance with the Act, utility meters are not required to be re-verified and this document specifies no requirements in this regard.

2.7 Manufacture

The process involving the assembly and sealing of a utility meter.

2.8 Sample

A definite quantity of utility meters drawn at random from a batch of utility meters.

2.9 Sampling Plan

A specified procedure in which a sample of utility meters is drawn from a predefined

batch, tested in accordance with NMI requirements and decisions regarding the batch are made based upon the results of the sample under test.

2.10 Serial Number

A unique number marked on a utility meter which varies from the previous and subsequent number by a fixed discrete integer value.

2.11 Verification Test Procedure

A test procedure performed by a utility meter verifier in order to demonstrate that a utility meter complies with the verification requirements for that class/type of utility meter, i.e. compliance with Certificate of Approval, MPEs, registration tests etc.

3. REQUIREMENTS FOR VERIFICATION

3.1 Fundamental Requirements

The fundamental requirements of verification are included in section 18GK of the Act and are reproduced below:

- (a) the measuring instrument (i.e. a utility meter) must operate within the appropriate limits of error that are permitted under the National Trade Measurement Regulations; and
- (b) the measuring instrument must be of an approved pattern.

3.2 Utility Meter Verifiers

Utility meters can only be verified by utility meter verifiers appointed in accordance with section 18RA of the Act. The conditions of appointment are included in section 18RB of the Act.

3.3 Verification Test Procedures

3.3.1 General

In order to demonstrate that a utility meter complies with the verification requirements outlined in the Act, a utility meter verifier is required to test the utility meter in accordance with the appropriate verification test procedure and mark the utility meter with a verification mark or produce a verification certificate for meters verified as a batch (see clause 4.4).

3.3.2 Electricity Meters

Electricity meters shall be verified in accordance with the test procedure specified in clause 7.

3.3.3 Water Meters

Water meters shall be verified in accordance with the test procedure specified in clause 8.

Domestic-sized, mechanical water meters which are manufactured in the same location on a continuous and uniform basis in a facility which is appointed as a utility meter verifier may be verified in accordance with the test procedure specified in clause 9. NMI will provide written approval for the use of this test procedure.

Water meters that are imported into Australia shall be tested in the country of manufacture in accordance with clause 8. Upon importation, the sample of water meters tested by a utility meter verifier as part of batch verification (see clause 4.4) shall be tested in accordance with clause 9.

3.3.4 Uncertainty

When verifying a utility meter, the expanded uncertainty in the determination of the reference quantity shall not exceed one-third of the applicable MPE.

The expanded uncertainty shall be determined in accordance with the Joint Committee on Guides to Metrology (JCGM) 100:2008 Evaluation of measurement data — Guide to the Expression of Uncertainty in Measurement with a coverage factor, $k = 2$.

3.3.5 Alternative and Additional Tests

NMI may require additional or alternative tests (related to the determination of error or ensuring that the utility meter conforms with the approved pattern) to be performed as part of the verification test procedure; these may be specified in the corresponding Certificate of Approval. NMI reserves the right to vary any verification test procedure. Notification of any such variation shall be made by NMI in writing.

3.3.6 Reference Conditions

Unless otherwise indicated in the corresponding Certificate of Approval, the testing of utility meters for verification purposes shall be performed at the reference conditions specified in NMI M 6-1 for electricity meters and NMI R 49-2 for water meters.

3.4 Sealing

All utility meters shall be sealed such that tampering and access to metrologically significant components and operations of the utility meter is made clearly evident.

Utility meter verifiers shall ensure that utility meters are sealed in accordance with the corresponding Certificate of Approval.

3.5 Acceptance Criteria

All utility meters shall comply with the corresponding Certificate of Approval and the MPEs for verification (see clause 5) when tested in accordance with the specified verification test procedure.

All utility meters shall comply with any additional acceptance criteria as specified in the relevant verification test procedure or Certificate of Approval.

A verification test result shall be considered compliant with the relevant acceptance criteria if the result lies within the relevant MPE, and if the expanded uncertainty of the reference quantity is within one-third of the MPE.

Utility meters that fail to comply with these requirements shall not be marked with a verification mark, shall not be included in a certificate of verification and shall not be used for trade or billing purposes.

3.6 Documentation and Records

Utility meter verifiers shall document and record the verification of utility meters in an appropriate manner for the purposes of record-keeping and external reporting.

The format of the certificate of verification provided in Appendix A is only for use in the batch verification of imported utility meters. Utility meter verifiers may use

alternative means of documenting the verification of individual meters in addition to the inscription of a verification mark.

Records of all verified utility meters, including verification test results, the details of imported batches of utility meters and all certificates of verification issued by a utility meter verifier shall be retained by the utility meter verifier for a period of no less than fifteen years from the date of verification.

4. VERIFICATION METHODOLOGIES

4.1 General

Utility meters:

- manufactured in Australia shall be verified individually (clause 4.2);
- imported into Australia shall be verified either individually (clause 4.3) or in batches (clause 4.4).

Where the utility meter is manufactured in multiple jurisdictions, NMI shall make the final determination regarding the country of manufacture and the necessary verification procedure of the utility meter(s) in question.

Regardless of the country of manufacture, every utility meter shall be clearly and indelibly marked with the relevant Certificate of Approval number and a uniquely identifiable serial number.

4.2 Individual Verification of Meters Manufactured in Australia

Where utility meters are manufactured in Australia, each utility meter shall be individually verified by a utility meter verifier in accordance with clause 3.

4.3 Individual Verification of Imported Meters

Imported utility meter may be verified individually. In this case, every imported utility meter shall be individually tested and verified by a utility meter verifier in accordance with clause 3.

Individually verified imported utility meters **do not require** any testing or calibration to be performed in the country of manufacture.

4.4 Batch Verification of Imported Meters

4.4.1 General

Alternatively, imported utility meters may be verified in *batches*. In this case, all utility meters that constitute a batch shall be tested in the country of manufacture in accordance with the relevant test procedure specified in either clause 7 or clause 8. Utility meters that do not meet the acceptance criteria shall not be imported into Australia.

NMI may provide approval in writing for a batch of utility meters to be verified via batch verification in the event of minor omissions or variations in the test procedure performed in the country of manufacture. In such cases, NMI will generally require additional testing and/or larger samples to be tested by a utility meter verifier.

Testing in the country of manufacture shall be performed in a facility with third-party accreditation to ISO/IEC 17025, which has reference standards traceable to primary national standards of that country. The facility shall also have accreditation to a relevant technical standard (for the type of utility meter under test) or field of testing. Third-party accreditation shall be performed by an organisation that is a signatory to the International Laboratory Accreditation Cooperation (ILAC) Mutual Recognition Agreement (MRA).

4.4.2 Defining a Batch

All utility meters that constitute a batch shall have at least the following details in common:

- (a) manufacturer;
- (b) country of manufacture;
- (c) type or model of the meter;
- (d) year of manufacture (within the same 12 month period);
- (e) year of initial verification (however described) in the country of manufacture (within the same 12 month period);
- (f) accuracy class; and
- (g) Certificate of Approval number.

Furthermore, based upon the type of utility meter in question, the following details shall also be applied to the definition of a batch:

- (a) Electricity meters:
 - (i) reference voltage (U_{nom});
 - (ii) maximum current (I_{max});
 - (iii) basic current (I_b) for direct-connected meters;
 - (iv) rated current (I_n) for transformer-operated meters; and
 - (v) number of phases.
- (b) Water meters:
 - (i) maximum continuous flow rate (Q_3);
 - (ii) ratio of the maximum continuous flow rate to the minimum flow rate (Q_3/Q_1); and
 - (iii) nominal diameter.

Further details that define a batch of utility meters may be required depending upon the type and class of utility meter in question. These shall be specified in the corresponding Certificate of Approval.

4.4.3 Batch Details

Upon or prior to importation into Australia, the details of each batch of utility meters shall be supplied to a utility meter verifier. These details shall include:

- (a) the exact batch size;
- (b) serial numbers of the utility meters that constitute the batch;
- (c) Certificate of Approval number;
- (d) manufacturer;
- (e) type or model of the meter;
- (f) year of manufacture;
- (g) country of manufacture;
- (h) year of initial testing in the country of manufacture;
- (i) the contact details of the laboratory that performed initial testing in the country of manufacture;
- (j) the results of testing performed in accordance with the relevant verification test procedure specified in clause 3.3; and

- (k) any other relevant details pertaining to the specifications, manufacture or testing of the utility meters that constitute the batch.

The utility meter verifier shall be responsible for ensuring that the details of the batch comply with the above requirements and recording all details of the batch.

4.4.4 Sampling Plan

The utility meter verifier shall draw a sample of utility meters at random from the batch.

All utility meters that form part of a sample shall be tested in accordance with the relevant verification test procedure specified in clause 3.3.

The sampling plan shall be in accordance with clause 6 with the following characteristics:

- (a) Inspection level II.
- (b) Acceptance level: 1%.
- (c) Response to an accepted batch: in this case a verification certificate may be issued by the utility meter verifier for the defined batch in accordance with clause 4.4.6.
- (d) Response to a rejected batch: in this case no verification certificate may be issued and each utility meter from the rejected batch shall be individually tested and marked with a verification mark in accordance with clause 4.3.

The sampling plans specified in clause 6 are based upon single sampling plans from AS 1199.1. NMI may approve in writing the use of alternative sampling plans for the verification of batches of imported utility meters, such those described in AS 2490.

4.4.5 Verification of a Batch

In accordance with sub-paragraph 18GG (1)(a)(ii) of the Act, a utility meter verifier shall have the authority to verify a batch of utility meters provided that the utility meter verifier is satisfied that the utility meters that constitute that batch comply with the

requirements of verification as specified in section 18GK of the Act.

Decisions regarding the verification of a batch of utility meters shall be based upon the results of testing performed on a sample of utility meters drawn from that batch and the defined acceptance level.

4.4.6 Certificate of Verification

Where a utility meter verifier is satisfied that a batch of utility meters complies with the requirements of verification, the utility meter verifier is required to either:

- (a) mark each utility meter in the batch with a verification mark; or
- (b) issue a certificate of verification for that batch of utility meters.

The form of the certificate of verification shall include at least the following:

- (a) name and contact details of the utility meter verifier;
- (b) NATA accreditation number of the facility;
- (c) name, model and Certificate of Approval number of the utility meters that constitute the batch;
- (d) name and contact details of the facility that performed the testing in the country of manufacture;
- (e) date that the batch of utility meters was verified;
- (f) date(s) that sample testing was performed;
- (g) list of serial numbers of the utility meters that constitute the batch; and
- (h) statement indicating that all utility meters that constitute the batch are verified.

Where the serial numbers of a batch are sequential and uninterrupted, the first and last numbers shall be provided on the certificate of verification (with a statement confirming that the serial numbers are sequential and uninterrupted). Otherwise the complete list shall be included as an appendix to the certificate.

A model format of a certificate of verification for batch verification can be found in Appendix A.

The test results of sample testing performed by the utility meter verifier shall be included as an appendix to the certificate of verification.

The test results performed in the country of manufacture shall be included as an appendix to the certificate of verification.

Note: If it is impractical to provide the test results as an appendix, alternative methods may be used, e.g. include a reference or link to a full set of test results, which is available upon request by either the meter purchaser or NMI.

4.4.7 Meters taken to be Marked with a Verification Mark

Utility meters identified on a certificate of verification via the serial number and pattern approval number shall be taken to be marked with a verification mark in accordance with regulation 2.36B of the National Trade Measurement Regulations.

4.4.8 Access and Availability of Certificates of Verification

It is strongly recommended that the certificate of verification (and any associated test reports) be provided to any person or organisation upon purchase or acquisition of any utility meter that is identified on the certificate.

A copy of any certificate of verification shall be provided to NMI upon request.

NMI may make individual certificates of verification available, subject to written request, to any person or organisation upon or subsequent to the purchase or acquisition of any utility meter that is identified on that certificate.

5. MAXIMUM PERMISSIBLE ERRORS

MPEs for the verification of water meters (Table 1) and electricity meters (Tables 2 and 3) are specified in Schedule 1 of the National Trade Measurement Regulations or the relevant pattern approval documents.

Table 1. MPEs for water meters

Accuracy class	Flow rate range	
	$Q_1 \leq Q < Q_2$	$Q_2 \leq Q \leq Q_4$
Class 1	±3%	±1%
Class 2	±5%	±2%

Table 2. MPEs for single phase and polyphase direct-connected electricity meters with balanced loads

Current range	Power factor	Class 1	Class 1.5
$0.05 I_b \leq I < 0.1 I_b$	1	±1.5%	±1.5%
$0.1 I_b \leq I \leq I_{max}$	1	±1.0%	±1.5%
$0.1 I_b \leq I < 0.2 I_b$	0.5 inductive	±1.5%	±1.5%
	0.8 capacitive	±1.5%	—
$0.2 I_b \leq I \leq I_{max}$	0.5 inductive	±1.0%	±1.5%
	0.8 capacitive	±1.0%	—

6. SAMPLING PLANS FOR BATCH VERIFICATION

Tables 4 and 5 determine sample sizes and acceptance/rejection criteria for the purposes of verifying batches of utility meters. The following requirements apply:

- (a) The inspection level determines the sample size that shall be tested and is dependent upon the size of the batch. If sample size equals or exceeds batch size, perform 100% testing.
- (b) The acceptance level specifies the maximum number of meter failures that any sample may have. Based upon the number of meter failures and the acceptance levels used, the batch shall be either accepted or rejected as specified in Table 4.
- (c) A meter failure is defined as a utility meter that, when tested in accordance with the relevant verification test procedure, does not meet the associated acceptance criteria.
- (d) Where the number of meter failures within the sample tested is:

- equal to **or less than** the acceptance number of the relevant acceptance level, the batch shall be accepted; or
- equal to **or higher than** the rejection number, the batch shall be rejected.

Note: The sampling plans do not allow the use of switching rules or skip-lot sampling (as described in AS 1199). Each batch shall be considered in isolation without reference to the performance of previously tested batches. The sample size shall be determined and implemented consistently, without adjustment, in accordance with Tables 4 and 5.

7. TEST PROCEDURE FOR ELECTRICITY METERS

Electricity meters shall undergo the following verification tests:

- (a) accuracy (see clause 7.1);
- (b) running with no load (see NMI M 6-1, clause 5.7.3); and
- (c) starting (see NMI M 6-1, clause 5.7.4).

Any additional tests to be performed as part of the verification test procedure shall be specified in the corresponding Certificate of Approval.

Table 3. MPEs for single phase and polyphase transformer-operated electricity meters with balanced loads

Current range	Power factor	Class 0.2	Class 0.5	Class 1
$0.01 I_n \leq I < 0.05 I_n$	1	±0.4%	±1.0%	—
$0.02 I_n \leq I < 0.05 I_n$	1	—	—	±1.5%
$0.05 I_n \leq I \leq I_{max}$	1	±0.2%	±0.5%	±1.0%
$0.02 I_n \leq I < 0.1 I_n$	0.5 inductive	±0.5%	±1.0%	—
	0.8 capacitive	±0.5%	±1.0%	—
$0.05 I_n \leq I < 0.1 I_n$	0.5 inductive	—	—	±1.5%
	0.8 capacitive	—	—	±1.5%
$0.1 I_n \leq I \leq I_{max}$	0.5 inductive	±0.3%	±0.6%	±1.0%
	0.8 capacitive	±0.3%	±0.6%	±1.0%

Table 4. Sample sizes and acceptance levels for inspection level I

Size of batch	Sample size	Acceptance levels					
		Special		0.1%		1%	
		Accept	Reject	Accept	Reject	Accept	Reject
Inspection level I							
2 to 8	2	0	1	0	1	0	1
9 to 15	2	0	1	0	1	0	1
16 to 25	3	0	1	0	1	0	1
26 to 50	5	0	1	0	1	0	1
51 to 90	5	0	1	0	1	0	1
91 to 150	8	0	1	0	1	0	1
151 to 280	13	0	1	0	1	0	1
281 to 500	20	0	1	0	1	0	1
501 to 1200	32	0	1	0	1	1	2
1201 to 3200	50	0	1	0	1	1	2
3201 to 10 000	80	0	1	0	1	2	3
10 001 to 35 000	125	0	1	0	1	3	4
35 001 to 150 000	200	0	1	0	1	5	6
150 001 to 500 000	315	0	1	1	2	7	8
500 001 and over	500	0	1	1	2	10	11

Table 5. Sample sizes and acceptance levels for inspection level II

Size of batch	Sample size	Acceptance levels					
		Special		0.1%		1%	
		Accept	Reject	Accept	Reject	Accept	Reject
Inspection level II							
2 to 8	2	0	1	0	1	0	1
9 to 15	3	0	1	0	1	0	1
16 to 25	5	0	1	0	1	0	1
26 to 50	8	0	1	0	1	0	1
51 to 90	13	0	1	0	1	0	1
91 to 150	20	0	1	0	1	0	1
151 to 280	32	0	1	0	1	1	2
281 to 500	50	0	1	0	1	1	2
501 to 1200	80	0	1	0	1	2	3
1201 to 3200	125	0	1	0	1	3	4
3201 to 10 000	200	0	1	0	1	5	6
10 001 to 35 000	315	0	1	1	2	7	8
35 001 to 150 000	500	0	1	1	2	10	11
150 001 to 500 000	800	0	1	2	3	14	15
500 001 and over	1250	0	1	3	4	21	22

7.1 Accuracy

Electricity meters shall undergo the accuracy test at the test points specified in Table 6 (for direct-connected meters) and Table 7 (for transformer-operated meters).

Test points in bold and marked with an asterisk (*) must be included in the accuracy testing for every individual meter. The remaining test points must either be included in the individual testing, or where applicable may be batch tested in accordance with clause 7.2.

For meters capable of negative and positive flow measurements, the mandatory test points for negative flow are I_b (or I_n) and I_{max} at power factors of unity and 0.5 inductive.

The MPE at each test point shall not exceed the values specified in Tables 2 and 3 for the specified class of meter.

Table 6. Mandatory test points for direct-connected electricity meters

Current (A)	Power factor	
	1	0.5 inductive
$0.05 I_b$	Yes	No
$0.1 I_b$	Yes*	Yes
I_b	Yes*	Yes*
I_{max}	Yes	Yes

Table 7. Mandatory test points for transformer-operated electricity meters

Current (A)	Power factor	
	1	0.5 inductive
$0.01 I_n$	Yes ¹	No
$0.1 I_n$	Yes*	Yes
I_n	Yes*	Yes*
I_{max}	Yes	Yes

¹ This test point is not applicable for class 1 transformer-operated meters.

7.2 Provisions for Batch Testing

For electronic (solid-state) meters produced from a continuously operating process resulting in a large number of identical units, it is acceptable to conduct the

following tests in accordance with the sampling plan specified in clause 7.3:

- accuracy for only the applicable test points (Tables 6 and 7);
- running with no load (see NMI M 6-1, clause 5.7.3); and
- starting (see NMI M 6-1, clause 5.7.4).

Otherwise, all individual meters shall undergo all of the above tests.

7.3 Sampling Plan

Batches shall only comprise electricity meters of the same pattern, manufactured in the same location and shall be determined in a manner consistent with the continuous and uniform nature of the assembly process.

Batch sizes shall be determined and documented by the facility undertaking the assembly and testing of the electricity meters.

A batch of utility meters is not considered to be verified until all testing has been completed and all acceptance criteria have been met. In particular, testing on all samples from a batch shall be completed, and meet the acceptance criteria, before any individual meters that form part of the batch may be considered as verified.

A sample shall be drawn at random from each batch of electricity meters. All electricity meters that comprise a sample shall be tested for all tests (see clause 7.2).

The sample size shall be determined in accordance with clause 6 with the following characteristics:

- Inspection level I.
- Acceptance level: special.
- Response to an accepted batch: upon the completion of all sample testing, all electricity meters that constitute the batch are considered to meet the requirements for the tests specified in clause 7.2.
- Response to a rejected batch: the entire batch shall be subjected to

tests specified in clause 7.2.
Non-conforming electricity meters cannot be taken as verified.

8. TEST PROCEDURE FOR WATER METERS

8.1 General

Water meters shall undergo the verification tests indicated below. NMI may require additional tests to be performed as part of the verification test procedure; these shall be specified in the corresponding Certificate of Approval.

Water meters of the same size and the same pattern may be tested in series; however in this case the requirements of NMI R 49-1, clause 6.2.3 shall be met for each water meter, and there shall be no significant interaction between water meters.

8.2 Procedure

The errors (of indication) of the water meters in the measurement of actual volume shall be determined for at least the following flowrates:

- (a) between Q_1 and $1.1 Q_1$;
- (b) between Q_2 and $1.1 Q_2$;
- (c) between $0.9 Q_3$ and Q_3 ;
- (d) for combination meters, between $1.05 Q \times 2$ and $1.15 Q \times 2$.

During a test, the water temperature shall be maintained at $20^\circ\text{C} \pm 10^\circ\text{C}$. All other influence factors shall be held within the rated operating conditions.

8.3 Acceptance Criteria

The errors (of indication) determined at each of the above flowrates shall not exceed the MPEs given in Table 1 for the specified class of meter.

If all the errors (of indication) of the water meter have the same sign, at least one of the errors shall not exceed one half of the MPE.

9. TEST PROCEDURE FOR BATCH-TESTING WATER METERS

9.1 General

Water meters of the same size and the same pattern may be tested in series; however in

this case the requirements of NMI R 49-1, clause 6.2.3 shall be met for each water meter, and there shall be no significant interaction between water meters.

All water meters verified in accordance with this test procedure shall be marked with a verification mark.

9.2 Procedure

All water meters shall be tested to determine the errors (of indication) in the measurement of actual volume at the flowrate:

- (a) between Q_2 and $1.1 Q_2$.

A sample of water meters shall be drawn in accordance with clause 9.4 and tested to determine the errors (of indication) in the measurement of actual volume at the following flow rates:

- (a) between Q_1 and $1.1 Q_1$ and
- (b) between $0.9 Q_3$ and Q_3 .

During a test, the water temperature shall be maintained at $20^\circ\text{C} \pm 10^\circ\text{C}$. All other influence factors shall be held within the rated operating conditions.

9.3 Acceptance Criteria

The errors (of indication) determined at each of the above flowrates shall not exceed the MPEs given in Table 1 for the specified class of meter.

For water meters tested as part of the sample, if all the errors (of indication) of the water meter have the same sign, at least one of the errors shall not exceed one half of the MPE.

9.4 Sampling Plan

All water meters tested at a flowrate between Q_2 and $1.1 Q_2$ (see clause 9.2) shall be separated into batches.

Batches shall only comprise water meters of the same pattern, manufactured in the same location and shall be determined in a manner consistent with the continuous and uniform nature of the manufacturing process.

Batch size shall be determined and documented by the facility undertaking the assembly and testing of the water meters.

A batch is not considered to be verified until all sample testing has been completed and all acceptance criteria have been met.

A sample of meters shall be drawn at random from each batch in accordance with clause 6 with the following characteristics:

- (a) Inspection level II.
- (b) Acceptance level: 0.1%.
- (c) Response to an accepted batch: upon the completion of all sample testing, all water meters that constitute that batch shall be considered to be verified and shall be marked with a verification mark.
- (d) Response to a rejected batch: all water meters that constitute that batch shall not be considered to be verified and shall not be marked with a verification mark. All water meters that constitute that batch shall be verified in accordance with clause 8.

NMI may approve the use of alternative sampling plans for the sampling and acceptance criteria for batches. Such approval shall be made in writing.

10. IN-SERVICE INSPECTION

10.1 Electricity Meters

This document specifies no requirements for the in-service inspection of electricity meters.

10.2 Water Meters

10.2.1 General

Water meters may undergo in-service inspection in accordance with the procedure indicated below.

Water meters of the same size and the same pattern may be tested in series; however in this case the requirements of NMI R 49-1, clause 6.2.3 shall be met for each water meter, and there shall be no significant interaction between water meters.

The MPEs for water meters (see Table 8) are specified in the National Trade Measurement Regulations.

Table 8. MPEs for the in-service inspection of water meters

Accuracy class	Flow rate range
	$0.075 Q_3 \leq Q \leq Q_4$
Class 2	$\pm 4\%$

In-service inspection is undertaken on an individual meter and should not be confused with the testing of meter fleets undertaken in accordance with AS 3565.4.

In-service inspection may be undertaken at the discretion of the user of the water meter. NMI specifies no requirements concerning when in-service inspection is to be undertaken. However, in order for a water meter to be used for trade following in-service inspection, the meter must comply with the acceptance criteria specified below.

10.2.2 Procedure

The errors (of indication) of the water meters in the measurement of actual volume shall be determined at four flowrates across the flowrate range $0.075 Q_3 \leq Q \leq Q_4$.

The following flowrates shall be used for water meters with a maximum continuous flowrate (Q_3) equal to or less than 4 kL/h:

- (a) between $0.075 Q_3$ and $0.085 Q_3$;
- (b) between $0.1 Q_3$ and $0.2 Q_3$;
- (c) between $0.3 Q_3$ and $0.4 Q_3$;
- (d) between $0.6 Q_3$ and $0.7 Q_3$.

This document does not specify flowrates for larger water meters. However it is recommended that flowrates for larger water meters be selected such that they are representative of known usage patterns for the size and type of water meter under test.

During a test, the water temperature shall be maintained at $20^\circ\text{C} \pm 10^\circ\text{C}$. All other influence factors shall be held within the rated operating conditions.

10.2.3 Acceptance Criteria

The errors (of indication) determined at each of the above flowrates shall not exceed the MPEs given in Table 8.

11. REFERENCES

AS 1199.1 (2003) Sampling Procedures for Inspection by Attributes – Sampling Schemes Indexed by Acceptance Quality Limit (AQL) for Lot-by-lot Inspection

AS 2490 (1997) Sampling Procedures and Charts for Inspection by Variables for Percent Nonconforming

AS 3565.4 (2007) Meters for water supply – In-service compliance testing

ISO/IEC 17025 (2005) General Requirements for the Competence of Testing and Calibration Laboratories

JCGM 100:2008 Evaluation of measurement data — Guide to the Expression of Uncertainty in Measurement

NMI M 6-1 (2012) Electricity Meters. Part 1: Metrological and Technical Requirements

NMI R 49-1 (2009) Water Meters Intended for the Metering of Cold Potable Water and Hot Water. Part 1: Metrological and Technical Requirements

NMI R 49-2 (2009) Water Meters Intended for the Metering of Cold Potable Water and Hot Water. Part 2: Test Methods

OIML V 1 (2000) International Vocabulary of Terms in Legal Metrology

OIML V 2-200 (2010) International Vocabulary of Metrology – Basic and General Concepts and Associated Terms

APPENDIX A. MODEL CERTIFICATE OF VERIFICATION OF A BATCH OF UTILITY METERS

Certificate of verification of a batch of utility meters

in accordance with regulation 2.36B of the *National Trade Measurement Regulations 1999* (Cth) in accordance with section 18GG(4)(c) of the *National Measurement Act 1960* (Cth)

Utility Meter Verifier¹

Name

Address

Telephone..... Fax

Email..... Website

Utility Meter Pattern²

Certificate of Approval number..... Variant number

Supplier³

Manufacturer.....

Model/type

Facility that Tested the Batch of Meters upon Assembly in the Country of Manufacture

Name

Address

Telephone..... Fax

Email..... Website

Accreditation details⁴

Batch Details

Date of importation

Verification Methodology and Test Procedure

Verification test procedure as specified in:

clause 7 clause 8 clause 9 Other (please specify).....

Sampling plan as specified in:

clause 4.4.4 Other (please specify)

Identification of Verified Meters

Identifying serial numbers for the batch⁵

Verification

Date of verification⁶

Date(s) of sample testing

Batch size..... Sample size

Being a person, or a person representing a body, appointed as a utility meter verifier under section 18RA of the *National Measurement Act 1960* (Cth), I hereby certify that the batch of utility meters identified above are verified in accordance with section 18GG of the *National Measurement Act 1960* (Cth).

NATA accreditation number.....

Signature..... Date

Name of signatory..... Position held

¹ If the certificate is prepared on stationery which contains this information, do not repeat it in the body of the certificate.

² As stated in the Certificate of Approval.

³ The individual or company applying for the certificate; the supplier may be the manufacturer.

⁴ Accreditation number, or similar identifier is required as well as the responsible accreditation body/authority. Accreditation is required to ISO 17025 by an ILAC MRA Signatory.

⁵ If serial numbers are sequential and uninterrupted, the first and last serial numbers shall be given. Otherwise the complete list shall be included as an appendix to this certificate.

⁶ Date on which the certificate is issued – all required testing shall be completed prior to or upon this date.