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Amendments

No.	Date	Page/s	Location	Details of change
1	August 2024	-	Various	Separation of test procedures for different kinds of utility meter – gas meter, electricity meter and water meter.
2	August 2024	-	Various	Inclusion of test procedures for hot water meters and non-urban water meters.
3	August 2024	1	2.1.1.1	Inclusion of static pressure (preconditioning) test.
4	August 2024	-	Various	Clarification of sampling plans and selection.
5	August 2024	-	-	Removal of references to in-service inspection.
6	August 2024	-	Various	Clarification of requirements for marking of verification marks and issuing of batch verification certificates.

Preface

The Chief Metrologist has determined that NITP 14.0 together with NITP 14.3 are the national instrument test procedures for water meters.

This document specifies:

- the test procedures for the verification of water meters including individual verification for individual water meters, individual verification using batch/lot sampling regimes to allow for a reduction in the number of test points and batch verification of imported water meters
- the related requirements for utility meter verifiers.

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 *National Measurement Act 1960* (Cth) (the Act) under regulation 5.6 of the *National Trade Measurement Regulations 2009* (Cth) (the Regulations).

Contents

Abbreviations

Refer to NITP 14.0 for all terms and abbreviations.

1. Scope

NITP 14.3 describes the specific test procedures for the verification of water meters. Together with NITP 14.0 these are the test procedures to assess whether water meters operate within the maximum permissible errors (MPEs) and are of an approved pattern.

Certificates of approval for water meters are based on:

1. *NMI R 49 Water meters for cold potable and hot water* (NMI R 49)
2. *NMI M 10 Meters intended for the metering of water in full flowing pipes* (NMI M 10), or
3. *NMI M 11 Meters intended for the metering of water in open channels and partially filled pipes* (NMI M 11).

All water meters must also comply with the Act and the Regulations.

2. Standard procedures

2.1 Accuracy

2.1.1 General

An accuracy test determines whether a water meter complies with the MPEs for specified test points (see clause 2.1.2).

The test requires a quantity (volume) of water to be passed through the water meter at the specified flowrate. That volume of water must be measured by a reference device to determine the reference volume. The reference device must comply with clause 2.1 of NITP 14.0.

The reference volume and the volume indicated by the water meter are then used to calculate the error of indication of the water meter under test and compared to the applicable MPE to determine if the water meter passes or fails the test.

2.1.1.1 Preconditioning

1. A static pressure test shall be performed at the maximum admissible pressure (MAP) for 1 min.
2. During the test no leaks shall be observed.

   Note: For imported water meters subject to batch verification, this test may be completed in either the country of manufacture or locally.

2.1.1.2 Procedure

1. Install the water meters for testing either singly or in series in accordance with the manufacturer's instructions.
2. Ensure that during the test, the actual volume of water that flows through the water meter(s) is equal to that measured by the reference device.
3. Bleed all air from the interconnecting pipework and the water meter(s).
4. Ensure that there is no significant interaction between water meters installed in series.
5. Ensure that the outlet pressure of any water meter is not less than 0.03 MPa (0.3 bar).
6. Ensure that during a test the pressure upstream of the water meter does not vary by more than 10 %.
7. Ensure that the working water temperature is within the applicable range, based on the accuracy class and temperature class of the water meter.

   For class 1 and class 2 water meters the temperature ranges are:

- T30, T50: 20 °C ± 10 °C
- T70 to T180: 20 °C ± 10 °C and 50 °C ± 10 °C
- T30/70 to T30/180: 50 °C ± 10 °C.

For class 2.5 water meters the temperature range is 20 °C ± 10 °C.

8. Ensure that during a test, the working water temperature does not vary by more than 5 °C.
9. Ensure that the variation in the flow rate during each test (not including starting and stopping) does not exceed:
   - ±2.5 % for tests at Q_1
   - ±5.0 % for tests at Q_2 and Q_3.
10. Ensure that all other influence factors are held within the rated operating conditions of the water meter.
11. Perform a test at each specified flow rate (e.g. Q_1, Q_2 and/or Q_3) by passing the reference volume of water through the water meter and record the volume indicated by the water meter.
12. Calculate the error (of indication) for each flow rate and compare with the applicable MPE.

$$E_m = \frac{(V_i - V_a)}{V_a} \times 100\%$$

where: E_m is the error of indication of the water meter under test, expressed as a percentage

V_a is the reference volume measured by the reference device

V_i is the volume indicated by the water meter under test.

2.1.1.3 Acceptance criteria

1. The water meter passes the test if the error (of indication) does not exceed the applicable MPE.
2. Otherwise, the water meter fails the test.

2.1.2 Maximum permissible errors

MPEs are specified in the Regulations. Alternative MPEs may be stated in certificates of approval issued on or after 1 July 2007.

For reference, the usual MPEs are provided below in:

1. Table 1 for class 1 and class 2 water meters approved under NMI R 49
2. Table 2 for class 2.5 water meters approved under NMI M 10 or NMI M 11.

Table 1. MPEs for Class 1 and Class 2 water meters (NMI R 49)

Accuracy class	Working water temp.	Flow rate range	
		$Q_1 \leq Q < Q_2$	$Q_2 \leq Q \leq Q_4$
Class 1	≤ 30 °C	±3%	±1%
Class 2	≤ 30 °C	±5%	±2%
Class 1	> 30 °C	±3%	±2%
Class 2	> 30 °C	±5%	±3%

Table 2. MPEs for Class 2.5 water meters (NMI M 10 / NMI M 11)

Accuracy class	Flow rate range
	$Q_1 \leq Q \leq Q_4$
Class 2.5	±2.5%

3. Test procedures

3.1 General requirements

The following test procedures determine if a water meter meets the requirements for verification.

Water meters of the same size and the same pattern may be tested in series, however in this case the outlet pressure of any water meter must not be less than 0.03 MPa and there must be no significant interaction between water meters.

Reference conditions and water quality must meet the requirements of NMI R 49, NMI M 10 or NMI M 11 (as applicable). Ensure that all other influence factors are held within the rated operating conditions of the water meter.

Check the certificate of approval for any additional tests that may be required.

Consider and comply with any relevant safety requirements.

There are three separate procedures for verifying water meters in clauses 3.2, 3.3 and 3.4.

The procedure in clause 3.2 must be used when verifying an individual water meter. Water meters verified using this procedure must be individually verified and marked with a verification mark.

The procedure in clause 3.3 may be used when verifying a batch of locally manufactured water meters. Refer to the procedure for more details and conditions. Water meters verified using this procedure must be individually verified and marked with a verification mark.

The procedure in clause 3.4 may be used when verifying a batch of imported water meters. Refer to the procedure for more details and conditions. Water meters verified using this procedure must be batch verified and identified in a batch verification certificate.

3.2 Individual verification – individual water meters

3.2.1 General

Use this procedure when verifying an individual water meter.

3.2.2 Class 1 & Class 2

For class 1 and class 2 water meters, complete an accuracy test (clause 2.1) at the following flowrates:

1. between Q_1 and 1.1 Q_1
2. between Q_2 and 1.1 Q_2
3. between 0.9 Q_3 and Q_3
4. for combination water meters, between 1.05 Q_{x2} and 1.15 Q_{x2}.

3.2.3 Class 2.5

For class 2.5 water meters, complete an accuracy test (clause 2.1) at the following flowrates:

1. between Q_1 and 1.1 Q_1
2. between 0.5 Q_3 and 0.6 Q_3
3. between 0.9 Q_3 and Q_3.

3.3 Individual verification – batch of locally manufactured water meters

3.3.1 General

For class 1 and class 2 water meters, the utility meter verifier may undertake batch testing to allow for a reduction in the number of test points required to be tested.

Use this procedure to verify a batch of locally manufactured water meters that comply with the requirements in clause 3.3.2. This procedure permits the utility meter verifier to undertake batch testing to allow for a reduction in the number of test points required to be tested. See example (A.1) provided in Appendix A.

Note: This procedure may also be used for a batch of imported water meters if the procedure in clause 3.4 cannot be used.

3.3.2 Requirements for determining a batch

A batch must only comprise utility meters that meet all of the following conditions:

1. of the same pattern
2. of the same accuracy class
3. manufactured in the same location
4. manufactured within the same 12-month period
5. produced in a uniform and continuously operating process resulting in a large number of identical units
6. compliant with any additional criteria for a batch that is specified in the certificate of approval.

3.3.3 Test procedure

1. Complete an accuracy test (clause 2.1) at a flowrate between Q_2 and 1.1 Q_2 for every water meter in the batch.
2. Draw a sample of water meters at random from a batch in accordance with Table 3. Batch sizes and sample sizes must be determined and documented by the utility meter verifier.

   Note 1: The sampling plans specified below are based upon single sampling plans from *AS 1199.1 Sampling procedures for inspection by attributes*. Utility meter verifiers may develop and implement alternative sampling plans, such as those described in *AS 2490 Sampling procedures and charts for inspection by variables for percent nonconforming*. All sampling plans must be of reasonable and appropriate design, providing confidence equal to or better than the examples provided and therefore a sound statistical basis for decision making concerning the verification of a batch of utility meters.

   Note 2: The sampling plans do not allow the use of switching rules or skip-lot sampling (as described in AS 1199.1). Each batch must be considered in isolation without reference to the performance of previously tested batches. The sample size must be determined and implemented consistently, without adjustment.

3. For all water meters in the sample complete an accuracy test (clause 2.1) at the following flow rates:
   a) Between Q_1 and 1.1 Q_1
   b) Between 0.9 Q_3 and Q_3.
4. Determine if the batch passes or fails. The batch passes if:
   a) every water meter in the batch passes the testing in step 1
   b) the sample of water meters passes the testing in step 3. The sample passes if the number of water meter failures is equal to or less than the acceptance number (see Table 3). The sample of water meters fails if the number of water meter failures is equal to or higher than the rejection number (see Table 3).

      Note: An individual water meter in the sample fails if it fails any one or more of the tests in step 3.

   If a batch of water meters fails, the batch must be rejected and cannot be verified.

If the batch of water meters passes, all water meters in the batch, except for any individual water meters that failed, can be verified. Any individual water meters in the sample that fail must not be verified.

In this procedure (clause 3.3) verified water meters must be marked with a verification mark.

Note: Water meters from a failed batch may be individually tested for verification in accordance with clause 3.2.

Table 3. Sampling plans – sample sizes and acceptance levels (inspection level II)

Size of sample	Sub-sample size	Acceptance level	
		0.1%	
		Accept	Reject
2 to 8	2	0	1
9 to 15	3	0	1
16 to 25	5	0	1
26 to 50	8	0	1
51 to 90	13	0	1
91 to 150	20	0	1
151 to 280	32	0	1
281 to 500	50	0	1
501 to 1200	80	0	1
1201 to 3200	125	0	1
3201 to 10 000	200	0	1
10 001 to 35 000	315	1	2
35 001 to 150 000	500	1	2
150 001 to 500 000	800	2	3
500 001 and over	1250	3	4

3.4 Batch verification – batch of imported water meters

3.4.1 General

Use this procedure to verify a batch of imported water meters produced from a continuously operating process resulting in a large number of identical units. This procedure permits the utility meter verifier to take a sub-sample of the sample of water meters selected from the batch in accordance NITP 14.0. This sub-sampling allows for a reduction in the number of test points required to be tested.

This procedure must only be used if the batch of imported water meters is accepted as a batch in accordance with NITP 14.0 (see clauses 2.2.4.1 and 2.2.4.2 of NITP 14.0). Otherwise, the water meters may be considered for individual verification in accordance with clauses 3.2 or 3.3.

See example (A.2) provided in Appendix A.

3.4.2 Test procedure

1. Complete an accuracy test (clause 2.1) at a flowrate between Q_2 and 1.1 Q_2 for every water meter in the sample (i.e. the sample selected in accordance with NITP 14.0).

2. Draw a sub-sample of water meters at random from the sample in accordance with Table 4. Sample sizes and sub-sample sizes must be determined and documented by the utility meter verifier.

Note 1: The sampling plans specified below are based upon single sampling plans from *AS 1199.1 Sampling procedures for inspection by attributes*. Utility meter verifiers may develop and implement alternative sampling plans, such as those described in *AS 2490 Sampling procedures and charts for inspection by variables for percent nonconforming*. All sampling plans must be of reasonable and appropriate design, providing confidence equal to or better than the examples provided and therefore a sound statistical basis for decision making concerning the verification of a batch of utility meters.

Note 2: The sampling plans do not allow the use of switching rules or skip-lot sampling (as described in AS 1199.1). Each batch must be considered in isolation without reference to the performance of previously tested batches. The sample size must be determined and implemented consistently, without adjustment.

3. For all water meters in the sub-sample complete an accuracy test (clause 2.1) at the following flow rates:

   a) Between Q_1 and 1.1 Q_1

   b) Between 0.9 Q_3 and Q_3.

4. Determine if the sub-sample of water meters passes or fails. The sub-sample of water meters passes if the number of water meter failures is equal to or less than the acceptance number in Table 4. The sub-sample of water meters fails if the number of water meter failures is equal to or higher than the rejection number in Table 4.

   Note: An individual water meter in the sub-sample fails if it fails one or more of the tests in step 3.

5. If the sub-sample of water meters fails, the sample of water meters fails. This means the batch of water meters (in accordance with NITP 14.0) must not be verified.

6. If the sub-sample of water meters passes, then determine if the batch of water meters is accepted or rejected based on the number of water meter failures within the sample (see step 1). Refer to NITP 14.0, clause 2.2.4.3 to determine if the batch of water meters must be accepted or rejected.

If the batch of water meters is rejected, it cannot be verified.

If the batch of water meters is accepted, all water meters in the batch, except for any individual water meters that failed, can be verified. The utility meter verifier must issue a batch verification certificate as per NITP 14.0, clause 2.7.1.

In this procedure (clause 3.4) verified water meters must be identified with a batch verification certificate (see NITP 14.0).

Note: Water meters from a failed batch may be individually tested for verification in accordance with clause 3.2.

Table 4. Sub-sampling plans – sub-sample sizes and acceptance criteria (inspection level II)

Size of sample	Sub-sample size	Acceptance level	
		0.1%	
		Accept	Reject
2 to 8	2	0	1
9 to 15	3	0	1
16 to 25	5	0	1
26 to 50	8	0	1
51 to 90	13	0	1
91 to 150	20	0	1
151 to 280	32	0	1
281 to 500	50	0	1
501 to 1200	80	0	1
1201 to 3200	125	0	1

Appendix A: Examples

A.1 Example 1

This example shows a batch of locally manufactured class 2 water meters that have been batch tested in order to allow for a reduction in the number of test points in accordance with the provisions for batch testing detailed in clause 3.3.

It is assumed the water meters comply in all other respects not detailed. This example does not meet the requirements for verification as a batch.

The number of water meters forming the batch is 14 000.

The utility meter verifier tests all 14 000 water meters at Q_2.

- Test results indicate all 14 000 water meters are within the MPE at Q_2.

The utility meter verifier randomly selects a sample of 315 water meters from the batch (in accordance with Table 3) and tests each sample at Q_1 and Q_3.

- Test results indicate the following:
    - 313 sample water meters are within MPE at Q_1 and Q_3
    - 1 sample water meter failed when tested at Q_1
    - 1 sample water meter failed when tested at Q_3.

Based on the results of testing, the utility meter verifier determines that the batch of 14 000 water meters does not meet the acceptance criteria and therefore none of the 14 000 water meters can be verified.

The utility meter verifier tests the remaining 13 998 water meters individually in accordance with clause 3.2.

- Test results indicate the following:
    - 13 989 water meters individually tested are within MPE
    - 9 water meters individually tested failed accuracy testing.

The utility meter verifier marks each of the 13 989 water meters that passed with a verification mark.

The 11 water meters that failed are repaired several days later and then individually tested in accordance with clause 3.2. All 11 water meters meet the acceptance criteria and the utility meter verifier marks each of the 11 water meters with a verification mark.

A.2 Example 2

This example shows a batch of imported class 2 water meters that have been batch tested to allow for a reduction in the number of water meters tested in accordance with the provisions for batch verification detailed in NITP 14.0, in addition to batch testing to allow for a reduction in test points in accordance with the provisions for batch testing detailed in clause 3.4.

It is assumed the water meters comply in all other respects not detailed. This example does not meet the requirements for verification as a batch.

The number of water meters forming the batch is 14 000.

- All 14 000 water meters have been tested in the country of manufacture and meet the acceptance criteria in accordance with clause 2.1.
- Test results supplied to the utility meter verifier indicate that all 14 000 water meters pass the required testing.

Following importation, the utility meter verifier randomly selects a sample of 315 water meters from the batch (in accordance with the provisions for batch verification detailed in NITP 14.0) and tests the 315 water meters at Q_2.

- Test results indicate that 314 of the 315 sample water meters are within MPE at Q_2 (so far meeting acceptance criteria in accordance with NITP 14.0 (clause 2.2.4 and Table 1)).

The utility meter verifier randomly selects a sub-sample of 50 water meters from the sample (in accordance with Table 4) and tests each sub-sample at Q_1 and Q_3.

- Test results indicate the following:
    - 49 sub-sample water meters are within MPE at Q_1 and Q_3.
    - 1 sub-sample water meter failed when tested at Q_1.

Based on the results of testing, the utility meter verifier determines that the batch of 14 000 water meters does not meet the acceptance criteria and therefore none of the 14 000 water meters can be verified.

The utility meter verifier tests the remaining 13 998 water meters individually in accordance with clause 3.3.

- Test results indicate the following:
    - 13 114 water meters individually tested are within MPE.
    - 884 water meters individually tested failed accuracy testing.

The utility meter verifier marks each of the 13 114 water meters that passed with a verification mark.

The 886 water meters that failed are disposed of.