Australian Government
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NITP 3.1
National Instrument Test Procedures for Trade Masses of 1 mg to 20 kg

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PREFACE

On 30 June 2010 the uniform test procedures (i.e. relevant NMI V documents) were deemed to be national instrument test procedures (NITPs) for the purposes of section 18GG of the *National Measurement Act 1960* (Cth).

In 2011 the NITPs were renumbered to better align the numbers with the classes of pattern approval and servicing licensee. As a result this document (NMI V 19) became NITP 3.1.

The only changes that have been made to the latest edition of this document are it has been rebranded, renumbered, renamed and its cross-references have been updated. In all other respects it is identical with NMI V 19.

NMI's Chief Metrologist has determined that NITP 3.1 contains the test procedures for the verification of trade masses of 1 mg to 20 kg.

CONTENTS

EXPLANATION OF TERMS

For explanations of other terms see *General Information for Test Procedures*.

Adjustment

Alteration of the measurement parameters to bring the instrument within the allowable MPEs for an instrument in use.

Calibration

The set of operations that (under specified conditions) establishes the relationship between the indicated or nominal value of an instrument and the corresponding known value of the measured quantity.

Certification

The examination of an instrument by a **certifier** (the holder, or an employee of the holder, of a servicing licence) in order to mark the instrument indicating that it conforms with the relevant test procedures.

- **Initial certification** is the certification of a new instrument by a certifier, which does not bear a verification or certification mark and has never been verified or certified before.
- **Subsequent certification** is any certification of an instrument by a certifier because the mark is no longer valid due to such reasons as:
  - repairs or adjustments have been made that affect metrological performance; or
  - the mark has been defaced or removed.

In-service Inspection

The examination of an instrument by an **inspector or certifier** to check that:

- the verification or certification mark is valid; and
- the errors do not exceed the MPEs permitted for in-service inspection.

In-service inspection does not permit the instrument to be marked with a verification or certification mark.

Verification

The examination of an instrument by an **inspector** in order to mark the instrument indicating that it conforms with the relevant test procedures.

- **Initial verification** is the verification of a new instrument by an inspector, which does not bear a verification or certification mark and has never been verified or certified before.
- **Subsequent verification** is any verification of an instrument by an inspector because the mark is no longer valid due to such reasons as:
  - repairs or adjustments have been made that affect metrological performance; or
  - the mark has been defaced or removed.
- **Re-verification** is the examination of an instrument by an inspector to check that:
  - the verification or certification mark is valid; and
  - the instrument has not been modified in any way since verification or certification;

  in order to mark the instrument indicating that it conforms with the relevant test procedures.

1. SCOPE

NITP 3.1 describes the test procedures for the verification, certification and in-service inspection of trade masses in denominations of 1 mg to 20 kg to ensure that they weigh to within the maximum permissible errors (MPEs) specified in the National Measurement Regulations and that they comply with the relevant Certificate of Approval. Refer to these general certificates for all metrological and technical requirements.

Trade masses must also comply with the relevant Trade Measurement Act and Regulations.

2. EQUIPMENT

1. The Certificate of Approval.
2. A weighing instrument suitable for weighing the masses under test. Suitability shall be determined in accordance with either:
   - *NITP 6.1 to 6.4 National Instrument Test Procedures for Non-automatic Weighing Instruments*; or
   - *Monograph 4. The Calibration of Weights and Balances*, 3rd edition, E.C. Morris and K.M.K. Fen, Chapter 6.
3. Appropriate reference standards of mass.
4. Current Regulation 13 certificates for all reference standards of measurement. The sum of the maximum permissible variation or uncertainty detailed in the certificate of verification for all masses used, together with the scale interval of the weighing instrument being used, must not be greater than one-third of the prescribed MPE for the mass under test.

3. VISUAL INSPECTION

Visually inspect the mass under test.

1. Does the mass comply with its appropriate general certificate?
2. Are all mandatory descriptive markings clearly and permanently marked on the mass in the prescribed location?
3. Is the mass constructed from an approved material?
4. Is the mass unbroken and free of defects?
5. Is the mass clean?
6. Is the finish of the mass appropriate?
7. Is the shape of the mass approved?
8. Is the adjusting hole of the mass approved?
9. Are correct units used for the denomination?

4. ACCURACY TEST

The accuracy of each mass under test shall be determined by direct substitution using any of the following weighing instruments as a comparator:

- digital indication with tare facility (see clause 4.1);
- digital indication without tare facility or analogue indication (see clause 4.2); and
- equal arm balance (see clause 4.3).

The MPE shall not exceed the limitation of error specified in Table 1.

4.1 Digital Indication with Tare Facility

1. If the weighing instrument has zero tracking, disable the zero tracking function.
2. Set up the weighing instrument on a stable bench and allow it to warm up for at least 30 minutes.
3. Test the weighing instrument for compliance with NITP 6.1 to 6.4. This is not required if its standard deviation has been determined in accordance with Monograph 4.
4. Place reference masses equal to the denomination of the mass under test on the load receptor.

Table 1. MPEs for trade masses

Denomination	MPE (mg)		
	Certification / verification	Reverification	
		Deficiency	Excess
Non-ferrous weights marked 'A'			
1 mg	+0.1	−0.05	+0.1
2 mg	+0.2	−0.1	+0.2
5 mg	+0.3	−0.15	+0.3
10 mg	+0.4	−0.2	+0.4
20 mg	+0.6	−0.3	+0.6
50 mg	+0.9	−0.45	+0.9
100 mg	+1.3	−0.65	+1.3
200 mg	+2	−1	+2
500 mg	+3	−1.5	+3
1 g	+4	−2	+4
2 g	+5.5	−2.75	+5.5
5 g	+9	−4.5	+9
10 g	+12.5	−6.25	+12.5
20 g	+18	−9	+18
50 g	+28	−14	+28
100 g	+40	−20	+40
200 g	+60	−30	+60
500 g	+90	−45	+90
1 kg	+130	−65	+130
2 kg	+220	−110	+220
5 kg	+280	−140	+280
10 kg	+400	−200	+400
20 kg	+560	−280	+560
Non-ferrous weights not marked 'A'			
1 g	+60	−30	+60
2 g	+60	−30	+60
5 g	+60	−30	+60
10 g	+120	−60	+120
20 g	+120	−60	+120
50 g	+120	−60	+120
100 g	+120	−60	+120
200 g	+170	−85	+170
500 g	+270	−135	+270
1 kg	+380	−190	+380
2 kg	+650	−325	+650
5 kg	+850	−425	+850
10 kg	+1 200	−600	+1 200
20 kg	+1 700	−850	+1 700
Iron weights			
100 g	+240	−120	+240
200 g	+340	−170	+340
500 g	+540	−270	+540
1 kg	+760	−380	+760
2 kg	+1 300	−650	+1 300
5 kg	+1 700	−850	+1 700
10 kg	+2 400	−1 200	+2 400
20 kg	+3 400	−1 700	+3 400
Metric carat weights			
0.005	+0.1	−0.05	+0.1
0.01	+0.1	−0.05	+0.1
0.02	+0.1	−0.05	+0.1
0.05	+0.1	−0.05	+0.1
0.1	+0.1	−0.05	+0.1
0.2	+0.15	−0.075	+0.15
0.5	+0.2	−0.1	+0.2
1	+0.2	−0.1	+0.2
2	+0.3	−0.15	+0.3
5	+0.5	−0.25	+0.5
10	+0.7	−0.35	+0.7
20	+1	−0.5	+1
50	+2	−1	+2
100	+2	−1	+2
200	+3	−1.5	+3
500	+5	−2.5	+5

5. Set the weighing instrument to zero using the tare function.
6. Remove the reference masses from the load receptor.
7. Place the mass under test on the load receptor.
8. Record the error (e.g. the indication).
9. Replace the mass under test with the reference masses used in step 4 and ensure the indication returns to zero. If the indication does not return to zero repeat steps 4 to 9.
10. Determine the error of the mass under test. If it is:
    - **equal to or less than** the value in Table 1 — remove any existing verification/certification marks from the mass and stamp the mass;
    - **greater than** the value in Table 1 — adjust the mass and repeat steps 4 to 10;
11. If the mass cannot be adjusted, remove any existing verification or certification marks from the mass.

4.2 Digital Indication without Tare Facility or Analogue Indication

1. If the weighing instrument has zero tracking, disable the zero tracking function.
2. Set up the weighing instrument on a stable bench and allow it to warm up for at least 30 minutes.
3. Test the weighing instrument for compliance with NITP 6.1 to 6.4. This is not required if its standard deviation has been determined in accordance with Monograph 4.
4. Place reference masses equal to the denomination of the mass under test on the load receptor.
5. Record the indication (I_1).
6. Remove the reference masses from the load receptor.

7. Place the mass under test on the load receptor.
8. Record the indication (I_2).
9. Remove the mass under test from the load receptor and ensure that the indication returns to zero. If the indication does not return to zero repeat steps 4 to 9.
10. Determine the error of the mass under test ($I_2 - I_1$). If it is:
    - **equal to or less than** the value in Table 1 — remove any existing verification/certification marks from the mass and stamp the mass;
    - **greater than** the value in Table 1 — adjust the mass and repeat steps 4 to 10.
11. If the mass cannot be adjusted, remove any existing verification or certification marks from the mass.

4.3 Equal Arm Balance

Where an equal arm balance is used, the scale interval is deemed to be the mass required to permanently displace the indicating element 5 mm from the equilibrium position for a load equivalent to the mass under test.

1. Apply a load equal to the nominal value of the mass under test to each load receptor and bring the weighing instrument to equilibrium.
2. Determine the additional load required to permanently displace the indicating element 5 mm from the equilibrium position.
3. Determine the sum of the maximum permissible variations and uncertainties of all reference masses to be used.
4. Assess the suitability of the reference masses and weighing instrument: the sum of values determined in steps 2 and 3 must be equal to or less than one-third of the MPE for the mass under test.
5. Place reference masses equal to the denomination of the mass under test, on the right-hand load receptor.
6. Place a load (e.g. masses, lead etc) on the left-hand load receptor until the instrument is in equilibrium.
7. Replace the reference masses on the right-hand load receptor with the mass under test.
8. If required, add additional reference masses to either load receptor until the instrument returns to the equilibrium position. Record the value of these additional reference masses. The value of these additional reference masses is the error of the mass under test.
9. Remove the small reference masses used in step 8 from the appropriate load receptor.
10. Replace the mass under test with the reference masses used in step 5.
11. If required, add additional reference masses to either load receptor to bring the instrument to the equilibrium position. Record the value of these additional reference masses.
12. If the sum of the load determined in steps 2, 3 and 11 is greater than one-third of the MPE of the mass under test repeat steps 5 to 12.
13. If the error of the mass under test recorded in step 8 is:
    - **equal to or less than** the value in Table 1 — remove any existing verification/certification marks from the mass and stamp the mass;
    - **greater than** the value in Table 1 — adjust the mass and repeat steps 5 to 13.
14. If the mass cannot be adjusted, remove any existing verification or certification marks from the mass.