Australian Government
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National Measurement Institute

NMI M 6-2
Active-energy electricity meters (a.c.)

Part 2: Test report format

June 2022

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Preface

This document provides the test report format for active-energy electricity meters to accompany NMI M 6-1, v4.0 (June 2022) *Active-energy Electricity Meters (a.c.), Part 1: Metrological and Technical Requirements*.

This test report format may clarify NMI M 6-1, but it does not add to or alter any requirements. This document is primarily intended for use by test laboratories that are testing meters against the requirements of NMI M 6-1. This test report format is intended to make testing more efficient and consistent.

Note, the test report format provides for meters with different accuracy classes, connection types and capabilities. Refer to NMI M 6-1 to determine which tests are applicable for a particular meter.

This edition contains numerous changes from the first edition. The changes have been made to:

- align with the requirements specified in NMI M 6-1, v4.0
- update and clarify the information and results required by NMI
- increase alignment with the OIML test report format specified in OIML R 46-3.

Contents

1 Test Information

Test Report	
Report reference number	
Date of issue	
Date of testing	
Laboratory details	
Name	
Address	
Contact details	
Test specification	
Standard	NMI M 6-1, v4.0 (June 2022)
Client details	
Applicant	
Address	

Remarks:

2 Meter Information

Manufacturer	
Model	
Serial number(s)	

Remarks:

3 Technical Specifications

Accuracy

Accuracy class	☐	0.2	☐	0.5	☐	1	☐ 1.5

Temperature ranges	*Low*	*High*
Specified operating range	°C	°C
Limit range of operation	°C	°C
Storage and transportation	°C	°C

Connection type and design

Connection type	☐	Direct-connected	☐	Transformer-operated
Design type	☐	Static	☐	Induction

Electrical and measurement

Number of phases			
Number of wires			
Number of elements			
Reference frequency f_{nom}	50	Hz	
Reference voltage(s) U_{nom}		V AC	
Basic current I_b		A	*(for direct-connected)*
Rated current I_n		A	*(for transformer-operated)*
Maximum current I_{max}		A	
Meter constant			*(include units)*
Measurement direction(s)	☐	Positive	☐ Negative

Enclosure and Protective Class

Enclosure type	
Protective class	

Software/Firmware

Software/firmware version	

Internal Clock

Clock type(s)	☐	Synchronous	☐	Crystal

4 Requirements Checklist

Clause number and requirement (from NMI M 6-1)		Value / Remark	Result
3	**Units of measurement**		
	Valid units of measurement used		
4.1	**Minimum measured quantity**		
	Minimum measured quantity		N/A
	Smallest interval marked on indicator		N/A
	The minimum measured quantity has the form 1×10^n authorised units of energy, where n is an integer		
	The smallest interval marked on indicator shall not be less than the minimum measured quantity		
4.2	**Maximum permissible variation between indicators**		
	No indicated difference between indications of same quantity on different indicators		
4.3	**Calculated quantities**		
	Indicated quantity equals value obtained using indicated values with applicable rounding		
	If rounding applied it is ±0.5 minimum measured quantity		
4.6	**Meter constant**		
	No error in relationship between test output and indication on display		
4.7	**Class indices (accuracy class)**		
	Meter classified as one of 0.2, 0.5, 1 or 1.5		
5.2	**Temperature range** (ranges shall comply with the minimum acceptable ranges in Table 5)		
	Specified operating range		
	Limit range of operation		
	Storage and transportation		
5.7.2	**Initial start up of the meter**		
	Time to start – shall be functional within 5 s		
5.7.3	**Running with no load**		
	Test voltage value (V AC)		N/A
	Test current value (A)		N/A
	Test period (s)		N/A
	Test output pulses – shall be no more than one		
	Rotor revolutions – may start but shall not complete a revolution		
5.7.4	**Starting**		
	Test current value (A)		N/A
	Meter starts and continues to register		
	Rotor revolutions – shall start and complete at least one revolution		

Clause number and requirement (from NMI M 6-1)		Value / Remark	Result
7.2	**Acting upon significant faults** (static meters only)		
	Either: No significant faults occur, or		
	Has capability to detect, log and communicate significant faults. Logged data kept in permanent record with date and time stamp.		
7.3	**Display**		
	Meter has a display which is legible whilst operating		
	Visible to consumer in normal installation position		
	There is a procedure to show all relevant elements of indicator display, with sufficient time to check them		
	Able to display quantity of energy corresponding to I_{max} for at least 4 000 h without returning to same index		
	Calculated value (energy at I_{max} for 4 000 h)		N/A
	Number of display digits		N/A
8.1	**Information to be displayed on meter exterior**		
	a) Manufacturer's name or mark		
	b) Model designation		
	c) Serial or identification number		
	d) Space for NMI pattern approval number		
	e) Number of phases, number of wires		
	f) Reference frequency		
	g) Specified operating temperature limits (if more restrictive than –10 °C to +55 °C)		
	h) Meter constant		
	i) Rated voltage		
	j) Rated currents		
	k) Class index		
	l) 'for indoor use only' if for indoor use only		
8.2	**Notices**		
	Any special notices or limitations of use shall be clearly marked or provided in manual		
9.1	**Verification mark**		
	Provision for a verification mark		
9.2	**Sealing**		
	Do mechanical seal protect parameters?		
	If not, solid state sealing is required:		
	Access to protected parameters protected		
	Access to protected parameters recorded		
	Records readily accessible		
	Record easily identifiable (not confused)		
	Reference record marked on meter		
	Record shall not repeat in a sequence of less than 99 alterations; record shall persist reliably for at least 2 years and persist through influence and disturbance tests		

5 Maximum Permissible Errors

Refer to NMI M 6-1, **clause 4.8 (Tables 1 to 3)**.

5.1 Direct-connected meters with balanced loads

Meter serial no.	
Observer:	
Date:	

	At start	**At end**
Temperature (°C):		
Time (hh:mm):		

Requirement (during test)	**Remark**	**Result**
Errors shall not exceed limits (see below)		
Where applicable in both directions		

Direction of energy measurement

Current (A)	**Power factor**	**Percentage error**	**Limit (±%) for class**	
			1	**1.5**
0.05 I_b	1		1.5	1.5
0.1 I_b			1.0	1.5
0.2 I_b				
I_b				
I_{max}				
0.1 I_b	0.5 inductive		1.5	1.5
0.2 I_b			1.0	1.5
I_b				
I_{max}				
0.1 I_b	0.8 capacitive		1.5	N/A
0.2 I_b			1.0	N/A
I_b				
I_{max}				

5.2 Direct connected meters – single-phase load with balanced polyphase voltages

Meter serial no.	
Observer:	
Date:	

	At start	**At end**
Temperature (°C):		
Time (hh:mm):		

Requirement (during test)	**Remark**	**Result**
Errors shall not exceed limits (see below)		
Where applicable in both directions		

Direction of energy measurement

Phase	**Current (A)**	**Power factor**	**Percentage error**	**Limit (±%) for class**	
				1	**1.5**
Phase 1	0.1 I_b	1		2.0	2.5
	0.2 I_b				
	I_b				
	I_{max}				
	0.2 I_b	0.5 inductive		2.0	2.5
	I_b				
	I_{max}				
Phase 2	0.1 I_b	1		2.0	2.5
	0.2 I_b				
	I_b				
	I_{max}				
	0.2 I_b	0.5 inductive		2.0	2.5
	I_b				
	I_{max}				
Phase 3	0.1 I_b	1		2.0	2.5
	0.2 I_b				
	I_b				
	I_{max}				
	0.2 I_b	0.5 inductive		2.0	2.5
	I_b				
	I_{max}				

5.3 Transformer-operated meters with balanced loads

Meter serial no.	
Observer:	
Date:	

	At start	**At end**
Temperature (°C):		
Time (hh:mm):		

Requirement (during test)	**Remark**	**Result**
Errors shall not exceed limits (see below)		
Where applicable in both directions		

Direction of energy measurement

Current (A)	**Power factor**	**Percentage error**	**Limit (±%) for class**		
			0.2	**0.5**	**1**
0.01 I_n	1		0.4	1.0	
0.02 I_n					1.5
0.05 I_n			0.2	0.5	1.0
0.1 I_n					
I_n					
I_{max}					
0.02 I_n	0.5 inductive		0.5	1.0	
0.05 I_n					1.5
0.1 I_n			0.3	0.6	1.0
I_n					
I_{max}					
0.02 I_n	0.8 capacitive		0.5	1.0	
0.05 I_n					1.5
0.1 I_n			0.3	0.6	1.0
I_n					
I_{max}					

5.5 Transformer-operated meters – single-phase load with balanced polyphase voltages

Meter serial no.	
Observer:	
Date:	

	At start	**At end**
Temperature (°C):		
Time (hh:mm):		

Requirement (during test)	**Remark**	**Result**
Errors shall not exceed limits (see below)		
Where applicable in both directions		

Direction of energy measurement

Phase	**Current (A)**	**Power factor**	**Percentage error**	**Limit (±%) for class**		
				0.2	**0.5**	**1**
Phase 1	0.05 I_n	1		0.3	0.6	2.0
	0.1 I_n					
	I_n					
	I_{max}					
	0.1 I_n	0.5 inductive		0.4	1.0	2.0
	I_n					
	I_{max}					
Phase 2	0.05 I_n	1		0.3	0.6	2.0
	0.1 I_n					
	I_n					
	I_{max}					
	0.1 I_n	0.5 inductive		0.4	1.0	2.0
	I_n					
	I_{max}					
Phase 3	0.05 I_n	1		0.3	0.6	2.0
	0.1 I_n					
	I_n					
	I_{max}					
	0.1 I_n	0.5 inductive		0.4	1.0	2.0
	I_n					
	I_{max}					

6 Influence Factors and Disturbances

6.1 Voltage Variation

Refer to NMI M 6-1, **Table 4** and **A.2.12**.

6.1.1 Direct-connected Meters, Classes 1 and 1.5

Meter serial no.	
Observer:	
Date:	

	At start	At end
Temperature (°C):		
Time (hh:mm):		

Requirement	Remark	Result
Variation in error does not exceed limits (see below)		

Value of U_{nom}

Voltage variation (% from U_{nom})	Current (A)	Power factor	Variation in error (%)	Limit of variation (%) by class	
				1	1.5
+10	0.05 I_b	1		0.7	1.0
	I_b				
	I_{max}				
	0.1 I_b	0.5 inductive		1.0	1.0
	I_b				
	I_{max}				
–10	0.05 I_b	1		0.7	1.0
	I_b				
	I_{max}				
	0.1 I_b	0.5 inductive		1.0	1.0
	I_b				
	I_{max}				
+15	0.05 I_b	1		2.1	3.0
	I_b				
	I_{max}				
	0.1 I_b	0.5 inductive		3.0	3.0
	I_b				
	I_{max}				
–20	0.05 I_b	1		2.1	3.0
	I_b				
	I_{max}				
	0.1 I_b	0.5 inductive		3.0	3.0
	I_b				
	I_{max}				
–50	0.05 I_b	1		–100 to +10	
	I_b				
	I_{max}				
	0.1 I_b	0.5 inductive			
	I_b				
	I_{max}				

6.1.2 Transformer-operated Meters, Class 1

Meter serial no.	
Observer:	
Date:	

	At start	**At end**
Temperature (°C):		
Time (hh:mm):		

Requirement	**Remark**	**Result**
Variation in error does not exceed limits (see below)		

Value of U_{nom} ____

Voltage variation (% from U_{nom})	**Current (A)**	**Power factor**	**Variation in error (%)**	**Limit of variation (%) by class**
				1
+10	0.02 I_n	1		0.7
	I_n			
	I_{max}			
	0.05 I_n	0.5 inductive		1.0
	I_n			
	I_{max}			
–10	0.02 I_n	1		0.7
	I_n			
	I_{max}			
	0.05 I_n	0.5 inductive		1.0
	I_n			
	I_{max}			
+15	0.02 I_n	1		2.1
	I_n			
	I_{max}			
	0.05 I_n	0.5 inductive		3.0
	I_n			
	I_{max}			
–20	0.02 I_n	1		2.1
	I_n			
	I_{max}			
	0.05 I_n	0.5 inductive		3.0
	I_n			
	I_{max}			
–50	0.02 I_n	1		–100 to +10
	I_n			
	I_{max}			
	0.05 I_n	0.5 inductive		
	I_n			
	I_{max}			

6.1.3 Transformer-operated Meters, Classes 0.2 and 0.5

Meter serial no.	
Observer:	
Date:	

	At start	**At end**
Temperature (°C):		
Time (hh:mm):		

Requirement	**Remark**	**Result**
Variation in error does not exceed limits (see below)		

Value of U_{nom} ____

Voltage variation (% from U_{nom})	**Current (A)**	**Power factor**	**Variation in error (%)**	**Limit of variation (%) by class**	
				0.2	**0.5**
+10	0.05 I_n	1		0.1	0.2
	I_n				
	I_{max}				
	0.1 I_n	0.5 inductive		0.2	0.4
	I_n				
	I_{max}				
–10	0.05 I_n	1		0.1	0.2
	I_n				
	I_{max}				
	0.1 I_n	0.5 inductive		0.2	0.4
	I_n				
	I_{max}				
+15	0.05 I_n	1		0.3	0.6
	I_n				
	I_{max}				
	0.1 I_n	0.5 inductive		0.6	1.2
	I_n				
	I_{max}				
–20	0.05 I_n	1		0.3	0.6
	I_n				
	I_{max}				
	0.1 I_n	0.5 inductive		0.6	1.2
	I_n				
	I_{max}				
–50	0.05 I_n	1		–100 to +10	
	I_n				
	I_{max}				
	0.1 I_n	0.5 inductive			
	I_n				
	I_{max}				

6.2 Frequency Variation

Refer to NMI M 6-1, **Table 4** and **A.2.13**.

6.2.1 Direct-connected meters, Classes 1 and 1.5

Meter serial no.	
Observer:	
Date:	

	At start	**At end**
Temperature (°C):		
Time (hh:mm):		

Requirement	**Remark**	**Result**
Variation in error does not exceed limits (see below)		

Frequency variation (%)	**Current (A)**	**Power factor**	**Variation in error (%)**	**Limit of variation (%) by class**	
				1	**1.5**
+2	0.05 I_b	1		0.5	1.0
	I_b				
	I_{max}				
	0.1 I_b	0.5 inductive		0.7	1.0
	I_b				
	I_{max}				
–2	0.05 I_b	1		0.5	1.0
	I_b				
	I_{max}				
	0.1 I_b	0.5 inductive		0.7	1.0
	I_b				
	I_{max}				

6.2.2 Transformer-operated Meters, Class 1

Meter serial no.	
Observer:	
Date:	

	At start	**At end**
Temperature (°C):		
Time (hh:mm):		

Requirement	**Remark**	**Result**
Variation in error does not exceed limits (see below)		

Frequency variation (%)	**Current (A)**	**Power factor**	**Variation in error (%)**	**Limit of variation (%) by class**
				1
+2	0.02 I_n	1		0.5
	I_n			
	I_{max}			
	0.05 I_n	0.5 inductive		0.7
	I_n			
	I_{max}			
–2	0.02 I_n	1		0.5
	I_n			
	I_{max}			
	0.05 I_n	0.5 inductive		0.7
	I_n			
	I_{max}			

6.2.3 Transformer-operated Meters, Classes 0.2 and 0.5

Meter serial no.	
Observer:	
Date:	

	At start	**At end**
Temperature (°C):		
Time (hh:mm):		

Requirement	**Remark**	**Result**
Variation in error does not exceed limits (see below)		

Frequency variation (%)	**Current (A)**	**Power factor**	**Variation in error (%)**	**Limit of variation (%) by class**	
				0.2	**0.5**
+2	0.05 I_n	1		0.1	0.2
	I_n				
	I_{max}				
	0.1 I_n	0.5 inductive		0.1	0.2
	I_n				
	I_{max}				
–2	0.05 I_n	1		0.1	0.2
	I_n				
	I_{max}				
	0.1 I_n	0.5 inductive		0.1	0.2
	I_n				
	I_{max}				

6.3 Harmonic Components in the Current and Voltage Circuits

Refer to NMI M 6-1, **Table 4**.
The variation in percentage error shall be measured under the most unfavourable phase displacement of the fifth harmonic in the current compared with the fundamental error.

Meter serial no.	
Observer:	
Date:	

	At start	**At end**
Temperature (°C):		
Time (hh:mm):		

Requirement	**Remark**	**Result**
Variation in error does not exceed limits (see below)		

Current (A)	**Power factor**	**Percentage error**		**Variation in error (%)**	**Limit of variation (%) by class**			
		f_{nom}	f_{nom} + harmonics		**0.2**	**0.5**	**1**	**1.5**
0.5 I_{max}	1				0.4	0.5	0.8	1.0

6.4 Reversed Phase Sequence

Refer to NMI M 6-1, **Table 4**.
Polyphase (three-phase four wire) meters shall measure and register within the limits of variation in percentage error if any one or two phases of the three phase network are interrupted.

Meter serial no.	
Observer:	
Date:	

	At start	**At end**
Temperature (°C):		
Time (hh:mm):		

Requirement	**Remark**	**Result**
Variation in error does not exceed limits (see below)		

Current (A)	**Power factor**	**Percentage error**		**Variation in error (%)**	**Limit of variation (%) by class**			
		ABC	**CBA**		**0.2**	**0.5**	**1**	**1.5**
0.1 I_b (0.1 I_n)	1				0.05	0.1	1.5	1.5

6.5 Voltage Unbalance

Refer to NMI M 6-1, **Table 4**.
Polyphase (three-phase four wire) meters shall measure and register within the limits of variation in percentage error if any one or two phases of the three phase network are interrupted.

Meter serial no.	
Observer:	
Date:	

	At start	**At end**
Temperature (°C):		
Time (hh:mm):		

Requirement	**Remark**	**Result**
Variation in error does not exceed limits (see below)		

Current (A)	**Power factor**	**Phases interrupted**	**Variation in error (%)**	**Limit of variation (%) by class**		
				0.2	**0.5**	**1**
I_b (I_n)	1	1 phase – A		0.5	1.0	2.0
		1 phase – B				
		1 phase – C				
		2 phases – AB				
		2 phases – AC				
		2 phases – BC				

6.6 Auxiliary Voltage ±15%

Refer to NMI M 6-1, **Table 4**.
Applicable only if the auxiliary supply is not internally connected to the voltage measuring circuit.

Meter serial no.	
Observer:	
Date:	

	At start	**At end**
Temperature (°C):		
Time (hh:mm):		

Requirement	**Remark**	**Result**
Variation in error does not exceed limits (see below)		

Voltage (% from reference)	**Current (A)**	**Power factor**	**Percentage error**		**Variation in error (%)**	**Limit of variation (%) by class**	
			Reference	**Measured**		**0.2**	**0.5**
+15	0.01 I_n	1				0.05	0.1
–15							

6.7 DC Component in the AC Circuit

Refer to NMI M 6-1, **Table 4**.
This test does not apply to transformer-operated meters.

Meter serial no.	
Observer:	
Date:	

	At start	**At end**
Temperature (°C):		
Time (hh:mm):		

Requirement	**Remark**	**Result**
Variation in error does not exceed limits (see below)		

Current (A)	**Power factor**	**Percentage error**		**Variation in error (%)**	**Limit of variation (%) by class**	
		f_{nom}	**+ DC component**		**1**	**1.5**
$I_{max} / \sqrt{2}$	1				3.0	6.0

6.8 Continuous Magnetic Induction of External Origin

Refer to NMI M 6-1, **Table 4**.

Meter serial no.	
Observer:	
Date:	

	At start	**At end**
Temperature (°C):		
Time (hh:mm):		

Requirement	**Remark**	**Result**
Variation in error does not exceed limits (see below)		

Current (A)	**Power factor**	**Position of magnet**	**Variation in error (%)**	**Limit of variation (%) by class**			
				0.2	**0.5**	**1**	**1.5**
I_b (I_n)	1	Front		2.0	2.0	2.0	3.0
		Left-hand side					
		Right-hand side					
		Top					
		Bottom					

6.9 Magnetic Induction of External Origin 0.5 mT

Refer to NMI M 6-1, **Table 4**.

Meter serial no.	
Observer:	
Date:	

	At start	**At end**
Temperature (°C):		
Time (hh:mm):		

Requirement	**Remark**	**Result**
Variation in error does not exceed limits (see below)		

Current (A)	**Power factor**	**Variation in error (%)**	**Limit of variation (%) by class**			
			0.2	**0.5**	**1**	**1.5**
I_b (I_n)	1		0.5	1.0	2.0	N/A
I_b (0.5 I_n)	1		N/A	N/A	N/A	2.0

6.10 Electromagnetic RF Fields

Refer to NMI M 6-1, **Table 4** and **A.2.9** (test with current test).
Meters constructed with passive elements only, including electromechanical meters, are exempt from this test.

Meter serial no.	
Observer:	
Date:	

	At start	**At end**
Temperature (°C):		
Time (hh:mm):		

Frequency range: 80 to 2 400 MHz
Modulation: 80% AM, 1 kHz sine wave
Field strength: 10 V/m

Requirement	**Remark**	**Result**
During the test, the behaviour of the meter shall not be perturbed		
Variation in error does not exceed limits (see below)		

Current (A)	**Power factor**	**Limit of variation (%) by class**			
		0.2	**0.5**	**1**	**1.5**
I_b (I_n)	1	1.0	2.0	2.0	3.0

Antenna / facility	**Frequency value / range (MHz)**	**Polarisation**	**Facing meter**	**Variation in error (%)**	**Limit of variation (%)**

6.11 Conducted RF Fields

Refer to NMI M 6-1, **Table 4** and **A.2.10**.
Meters constructed with passive elements only, including electromechanical meters, are exempt from this test.

Meter serial no.	
Observer:	
Date:	

	At start	**At end**
Temperature (°C):		
Time (hh:mm):		

RF amplitude (50 Ω): 10 V (e.m.f.)
Modulation: 80% AM, 1 kHz sine wave
Frequency range: 0.15 to 80 MHz

Requirement	**Remark**	**Result**
During the test, the behaviour of the meter shall not be perturbed		
Variation in error does not exceed limits (see below)		

Current (A)	**Power factor**	**Power port or I/O port**	**Variation in error (%)**	**Limit of variation (%) by class**			
				0.2	**0.5**	**1**	**1.5**
I_b (I_n)	1			1.0	2.0	2.0	3.0

6.12 Fast Transient Bursts

Refer to NMI M 6-1, **Table 4** and **A.2.15**.
Meters constructed with passive elements only, including electromechanical meters, are exempt from this test. During the test, a temporary degradation or loss of function or performance is acceptable.

Meter serial no.	
Observer:	
Date:	

	At start	**At end**
Temperature (°C):		
Time (hh:mm):		

- Voltage and auxiliary circuits energised with reference voltage.

Requirement (during test)	**Remark**	**Result**
Variation in error does not exceed limits (see below)		

Current (A)	**Power factor**	**Limit of variation (%) by class**			
		0.2	**0.5**	**1**	**1.5**
I_b (I_n)	1	1.0	2.0	4.0	6.0

Circuit	**Voltage peak (kV)**	**Polarity (60 s at each)**	**Variation in error (%)**	**Limit of variation (%)**
Voltage	4	Positive		
		Negative		
Current	4	Positive		
		Negative		
Auxiliary circuit	2	Positive		
		Negative		

6.13 Variations due to Short-time Overcurrents

Refer to NMI M 6-1, **Table 4** and **A.2.16**.

Meter serial no.	
Observer:	
Date:	

	At start	**At end**
Temperature (°C):		
Time (hh:mm):		

6.13.1 Test A

Requirement	**Remark**	**Result**
Variation in error does not exceed limits (see below)		

Current (A)	**Power factor**	**Test**	**Over-current value (A)**	**Duration (ms)**	**Phase**	**Variation in error (%)**	**Limit of variation (%) by class**			
							0.2	**0.5**	**1**	**1.5**
I_b	1	A	30 I_{max}	10	1		N/A	N/A	1.5	1.5
					2					
					3					

6.13.2 Test B

Requirement	**Remark**	**Result**
Variation in error does not exceed limits (see below)		

Current (A)	**Power factor**	**Test**	**Over-current value (A)**	**Duration (ms)**	**Phase**	**Variation in error (%)**	**Limit of variation (%) by class**			
							0.2	**0.5**	**1**	**1.5**
I_n	1	B	20 I_{max}	500	1		0.05	0.05	0.5	N/A
					2					
					3					

6.13.3 Tests C

- 250 A, 60 ms

Requirement	**Remark**	**Result**
No damage to surrounding equipment		

6.13.4 Tests D

- 50 A, 60 ms

Requirement	**Remark**	**Result**
No damage to surrounding equipment		

6.14 Operation of Accessories

Refer to NMI M 6-1, **Table 4**.

Meter serial no.	
Observer:	
Date:	

	At start	**At end**
Temperature (°C):		
Time (hh:mm):		

Requirement	**Remark**	**Result**
Variation in error does not exceed limits (see below)		

- Accessories are continuously operated
- Value of current is 0.05 I_b for class 1 direct-connected meters, 0.05 I_n for class 1 transformer-operated meters, and 0.01 I_n for class 0.2 / class 0.5 transformer-operated meters.

Current (A)	**Power factor**	**Accessory**	**Variation in error (%)**	**Limit of variation (%) by class**			
				0.2	**0.5**	**1**	**1.5**
	1			0.05	0.1	0.5	1.0

6.15 Sub-harmonics in the AC Circuit

Refer to NMI M 6-1, **Table 4** and **A.2.17**.

Meter serial no.	
Observer:	
Date:	

	At start	**At end**
Temperature (°C):		
Time (hh:mm):		

Test waveform: sinusoid, 2 cycles on, 2 cycles off
Current amplitude: 2 × reference current

Requirement	**Remark**	**Result**
Variation in error does not exceed limits (see below)		

Current (A)	**Power factor**	**Percentage error**		**Variation in error (%)**	**Limit of variation (%) by class**			
		f_{nom}	**Test waveform**		**0.2**	**0.5**	**1**	**1.5**
0.5 I_b (0.5 I_n)	1				0.5	0.75	1.5	3.0

6.16 Odd Harmonics in the AC Circuit

Refer to NMI M 6-1, **Table 4** and **A.2.18**.

Meter serial no.	
Observer:	
Date:	

	At start	**At end**
Temperature (°C):		
Time (hh:mm):		

Test waveform: sinusoid, set to zero for first and third quarters of each period
Current amplitude: 2 × reference current

Requirement	**Remark**	**Result**
Variation in error does not exceed limits (see below)		

Current (A)	**Power factor**	**Percentage error**		**Variation in error (%)**	**Limit of variation (%) by class**			
		f_{nom}	**Test waveform**		**0.2**	**0.5**	**1**	**1.5**
0.5 I_b (0.5 I_n)	1				0.4	0.5	0.8	1.0

6.17 Tilt at 3° in any Direction from the Vertical

Refer to NMI M 6-1, **Table 4**.
This test is only required for induction meters and any other meters which may be influenced by their working position.

Meter serial no.	
Observer:	
Date:	

	At start	**At end**
Temperature (°C):		
Time (hh:mm):		

Requirement	**Remark**	**Result**
Variation in error does not exceed limits (see below)		

Current (A)	**Power factor**	**Direction of 3° tilt**	**Variation in error (%)**	**Limit of variation (%) by class**			
				0.2	**0.5**	**1**	**1.5**
0.1 I_b	1	Forward		1.0	2.0	2.0	3.0
		Backward					
		Left					
		Right					

6.18 Current Coil Self-heating

Refer to NMI M 6-1, **Table 4**.
This test is only required for induction meters and any other meters which may be influenced by their working position.

Meter serial no.	
Observer:	
Date:	

	At start	**At end**
Temperature (°C):		
Time (hh:mm):		

Initial error: determine for each load while current coil is still unheated
Precondtioning: 1 h with voltage circuit at U_{nom}, current circuit with zero current
Test: continue until error becomes constant

Requirement	**Remark**	**Result**
Variation in error does not exceed limits (see below)		

Current (A)	**Power factor**	**Percentage error**		**Variation in error (%)**	**Limit of variation (%) by class**
		Coil unheated (initial error)	**Coil heated**		**1.5**
I_{max}	1				1.0
I_{max}	0.5 inductive				1.0

6.19 Alternative Usage and Phase Reversal (Balanced Two-element Driven)

Refer to NMI M 6-1, **Table 4**.
This test is only required for induction meters and any other meters which may be influenced by their working position.

Meter serial no.	
Observer:	
Date:	

	At start	**At end**
Temperature (°C):		
Time (hh:mm):		

Requirement	**Remark**	**Result**
Variation in error does not exceed limits (see below)		

Current (A)	**Power factor**	**Phase sequence**	**Percentage error**	**Variation in error (%)**	**Limit of variation (%) by class**
					1.5
0.05 I_b	1	A1 leading A2 by 180°			
		A1 leading A2 by 120°			1.0
		A2 leading A1 by 120°			
I_b	1	A1 leading A2 by 180°			
		A1 leading A2 by 120°			0.5
		A2 leading A1 by 120°			

6.20 Alternative Usage and Phase Reversal (Single-element Driven)

Refer to NMI M 6-1, **Table 4**.
This test is only required for induction meters and any other meters which may be influenced by their working position.

Meter serial no.	
Observer:	
Date:	

	At start	**At end**
Temperature (°C):		
Time (hh:mm):		

Requirement	**Remark**	**Result**
Variation in error does not exceed limits (see below)		

Current (A)	**Power factor**	**Phase sequence**	**Percentage error**	**Variation in error (%)**	**Limit of variation (%) by class**
					1.5
0.1 I_b	1	A1 leading A2 by 180°		N/A	N/A
		A1 leading A2 by 120°			1.0
		A2 leading A1 by 120°			
2 I_b	1	A1 leading A2 by 180°		N/A	N/A
		A1 leading A2 by 120°			0.5
		A2 leading A1 by 120°			

6.21 Register Friction

Refer to NMI M 6-1, **Table 4**.
This test is only required for induction meters and any other meters which may be influenced by their working position. For a multi-rate meter, the changeover device shall be in each operating condition in turn.

Meter serial no.	
Observer:	
Date:	

	At start	**At end**
Temperature (°C):		
Time (hh:mm):		

Requirement	**Remark**	**Result**
Variation in error does not exceed limits (see below)		

Current (A)	**Power factor**	**Changeover device operating condition**	**Rotor Speed**		**Variation in error (%)**	**Limit of variation (%) by class**
			Heaviest load	**Register disengaged**		**1.5**
0.05 I_b	1					0.5

6.22 Register Changeover

Refer to NMI M 6-1, **Table 4**.
This test is only required for induction meters and any other meters which may be influenced by their working position.

Meter serial no.	
Observer:	
Date:	

	At start	**At end**
Temperature (°C):		
Time (hh:mm):		

Requirement	**Remark**	**Result**
Variation in error does not exceed limits (see below)		

Current (A)	**Power factor**	**Changeover device operating condition**	**Rotor Speed**	**Variation in error (%)**	**Limit of variation (%) by class**
					1.5
0.05 I_b	1			N/A	N/A
					0.4*

* An additional variation of 0.5% may be permitted for certain multiple-element meters (refer to AS 1284.1, clause 4.3.15).

6.23 Shock

Refer to NMI M 6-1, Table 4.
This test is only required for induction meters and any other meters which may be influenced by their working position.

Meter serial no.	
Observer:	
Date:	

	At start	**At end**
Temperature (°C):		
Time (hh:mm):		

Requirement	**Remark**	**Result**
Variation in error does not exceed limits (see below)		

Initial error: determine for each load prior to subjecting to shock

Current (A)	**Power factor**	**Initial error (before shock)**	**After shock test**	**Variation in error (%)**	**Limit of variation (%) by class**
					1.5
0.05 I_b	1				0.5
I_b	1				0.3
I_b	0.5 inductive				0.3

7 Ambient Temperature Variation

Refer to NMI M 6-1, **Table 6** and **A.2.3**.
The meter error shall be determined at a minimum of four temperature values across the whole operating range. The mean temperature coefficient shall then be determined for each of the temperature intervals between successive temperature values.
In the tables below:

- T_L is the lower temperature in the range
- T_L is the upper temperature in the range
- e_L is the error at the lower temperature in the range
- e_L is the error at the upper temperature in the range
- Mean temperature coefficient is calculated as $\frac{e_U - e_L}{T_U - T_L}$

7.1 Direct-connected Meters

Meter serial no.	
Observer:	
Date:	

	At start	**At end**
Temperature (°C):		
Time (hh:mm):		

Requirement (during test)	**Remark**	**Result**
The mean temperature coefficient shall not exceed the limits (see below)		
At least four temperature ranges that span the operating temperature range		

Current (A)	**Power factor**	**Mean temperature coefficient (%/°C) by class**	
		1	**1.5**
0.1 I_b to I_{max}	1	0.05	0.05
0.2 I_b to I_{max}	0.5 inductive	0.07	0.07

Temperature Range	T_L (°C)	T_U (°C)
Temperatures		

Current (A)	**Power factor**	**Percentage error**		**Mean temperature coefficient (%/°C)**	
		e_L	e_U	**Calculated**	**Limit**
0.1 I_b	1				
I_b					
I_{max}					
0.2 I_b	0.5 inductive				
I_b					
I_{max}					

(Repeat for all temperature ranges)

7.2 Transformer-operated Meters

Meter serial no.	
Observer:	
Date:	

	At start	**At end**
Temperature (°C):		
Time (hh:mm):		

Requirement (during test)	**Remark**	**Result**
The mean temperature coefficient shall not exceed the limits (see below)		
At least four temperature ranges that span the operating temperature range		

Current (A)	**Power factor**	**Mean temperature coefficient (%/°C) by class**			
		0.2	**0.5**	**1**	**1.5**
0.05 I_n to I_{max}	1	0.01	0.03	0.05	0.05
0.1 I_n to I_{max}	0.5 inductive	0.02	0.05	0.07	0.07

Temperature Range	T_L (°C)	T_U (°C)
Temperatures		

Current (A)	**Power factor**	**Percentage error**		**Mean temperature coefficient (%/°C)**	
		e_L	e_U	**Calculated**	**Limit**
0.05 I_n	1				
I_n					
I_{max}					
0.1 I_n	0.5 inductive				
I_n					
I_{max}					

(Repeat for all temperature ranges)

8 Internal Clocks

Refer to NMI M 6-1, **clause 6**.
This test applies to all solid state internal clock intended for use for trade.

8.1 Synchronous

8.1.1 Mains Supply

Meter serial no.	
Observer:	
Date:	

	At start	**At end**
Temperature (°C):		
Time (hh:mm):		

Testing period: 30 days
Test temperature: 23 °C

Date		Time		Difference (s)	Variation (s/day)	
		Ref	Test		Result	Limit
Start						0.167
End						

8.1.2 Operational Reserve

Meter serial no.	
Observer:	
Date:	

	At start	**At end**
Temperature (°C):		
Time (hh:mm):		

Testing period: 36 h
Test temperature: 23 °C

☐ Spring ☐ battery/super-capacitor/primary cell

Date		Time		Difference (s)	Variation (s/day)		
		Ref	Test		Result	Limit - Spring	Limit - Battery
Start						120	1
End							

8.2 Crystal-controlled

8.2.1 Mains Supply

Meter serial no.	
Observer:	
Date:	

	At start	**At end**
Temperature (°C):		
Time (hh:mm):		

Testing period: 30 days
Test temperature: 23 °C

Date		Time		Difference (s)	Variation (s/day)	
		Ref	Test		Result	Limit
Start						0.5
End						

8.2.2 Operational Reserve

Meter serial no.	
Observer:	
Date:	

	At start	At end
Temperature (°C):		
Time (hh:mm):		

Testing period: 36 h
Test temperature: 23 °C

Date		Time		Difference (s)	Variation (s/day)	
		Ref	Test		Result	Limit
Start						1
End						

8.2.3 High Temperature

Meter serial no.	
Observer:	
Date:	

	At start	At end
Temperature (°C):		
Time (hh:mm):		

Testing period: 24 h
Test temperature: 45 °C

Date		Time		Difference (s)	Variation (s/day)	
		Ref	Test		Result	Limit
Start						0.15
End						

8.2.4 Low Temperature

Meter serial no.	
Observer:	
Date:	

	At start	At end
Temperature (°C):		
Time (hh:mm):		

Testing period: 24 h
Test temperature: –10 °C

Date		Time		Difference (s)	Variation (s/day)	
		Ref	Test		Result	Limit
Start						0.15
End						

8.3 Other requirements

Requirement	Remark	Result
Meters must demonstrate a convenient methodology of clock synchronisation via the local optical or serial port.		
For meters recording load profile for tariff calculation, the clock synchronisation must not permit clock adjustment that crosses an interval boundary.		

9 Performance Tests

9.1 Optical Port Requirements

Refer to NMI M 6-1, **7.4** and **A.1.3**. AS 62056.21, **4.3.5.4** and **5.2**.

Requirement	Remark	Result
The optical path (data transmission) shall not be affected by surrounding light of intensity 16 000 lux.		
Transmission speed		

9.2 Dry Heat Test

Refer to NMI M 6-1, **A.2.1**.

Meter serial no.	
Observer:	
Date:	

	At start	At end
Temperature (°C):		
Time (hh:mm):		

Duration: 72 h

Meter/EUT: In operating condition except whilst temperature is lowered or raised.

High temperature:

Requirement (during test)	Remark	Result
Error shall not exceed limits (see below) taking into account appropriate temperature coefficient		

Requirement (after test)	Remark	Result
No damage to meter		
No change of information		
Meter shall operate correctly (see below)		

Current (A)	Power factor	Percentage error			MPE by class			
		At reference before heat	At high temperature after 72 h	Reference after recovery	0.2	0.5	1	1.5
I_b (I_n)	1				0.2	0.5	1	1.5

9.3 Cold Test

Refer to NMI M 6-1, A.2.2.

Meter serial no.	
Observer:	
Date:	

	At start	**At end**
Temperature (°C):		
Time (hh:mm):		

Duration: 72 h

Meter/EUT: In operating condition except whilst temperature is lowered or raised.

Low temperature:

Requirement (during test)	**Remark**	**Result**
Error shall not exceed limits (see below) taking into account appropriate temperature coefficient		

Requirement (after test)	**Remark**	**Result**
No damage to meter		
No change of information		
Meter shall operate correctly (see below)		

Current (A)	**Power factor**	**Percentage error**			**MPE by class**			
		At reference before heat	**At low temperature after 72 h**	**Reference after recovery**	**0.2**	**0.5**	**1**	**1.5**
I_b (I_n)	1				0.2	0.5	1	1.5

9.4 Damp Heat Cyclic Test

9.4.1 Damp Heat Cyclic Test

Refer to NMI M 6-1, **A.2.4**.

Meter serial no.	
Observer:	
Date:	

	At start	At end
Temperature (°C):		
Time (hh:mm):		

Duration (cycles): 6 × 24 h cycles
Meter/EUT: non-operating condition
Low temperature: 25 °C

High temperature:

Requirement	Remark	Result
No trace of corrosion likely to affect the functional properties of the EUT shall be present		

24 h after the end of this test, submit the EUT to the following tests.

9.4.2 AC Voltage Test

NMI M 6-1, A.2.20 – refer to clause 8.13.

9.4.3 Impulse Voltage Test

NMI M 6-1, A.2.19, except 0.8 of impulse voltage

Refer to NMI M 6-1, A.2.19.
Impulse waveform at no load: 1.2/50 impulse
Meter/EUT: non-operating condition

9.4.3.1 For circuits and between circuits

Impulse voltage: 9.6 kV +0%, –15%
Source capacitance: 0.125 µF
Source impedance: 40 Ω ± 5 Ω
Stored energy: 9.0 J ± 1.0 J

Requirement (during the test)	Remark	Result
No flashover, disruptive discharge or puncture		

Requirement (after the test)	Remark	Result
No mechanical damage to the EUT		
Variation in in error does not exceed the uncertainty of measurement (see below)		

Current (A)	Power factor	Percentage error		Variation in error (%)	Limit
		Before	After		
I_b (I_n)	1				

9.4.3.2 For electric circuits relative to earth

Impulse voltage: 8 kV +0%, –10%
Source impedance: 500 Ω ± 50 Ω
Stored energy: 0.5 J ± 0.05 J

Requirement (during the test)	Remark	Result
No flashover, disruptive discharge or puncture		

Requirement (after the test)	Remark	Result
No mechanical damage to the EUT		
Variation in in error does not exceed the uncertainty of measurement (see below)		

Current (A)	Power factor	Percentage error		Variation in error (%)	Limit
		Before	After		
I_b (I_n)	1				

9.5 Solar Radiation Test

Refer to NMI M 6-1, **A.2.5**.

Meter serial no.	
Observer:	
Date:	

	At start	At end
Temperature (°C):		
Time (hh:mm):		

UV lamp output: 21 750 lm to 27 000 lm
Duration: 48 h and distance of 250 mm
Meter/EUT: non-operating condition

Requirement	Remark	Result
For transparent parts – no noticeable deterioration or loss in transparency		
For non-transparent parts – no noticeable effect		
The function of the meter shall not be impaired (see below)		

Current (A)	Power factor	Percentage error	MPE by class			
			0.2	0.5	1	1.5
I_b (I_n)	1		0.2	0.5	1	1.5

9.6 Dust Test

Refer to NMI M 6-1, **A.2.6**.

Meter serial no.	
Observer:	
Date:	

	At start	**At end**
Temperature (°C):		
Time (hh:mm):		

Enclosure category: 2
Duration: 8 h
Meter/EUT: non-operating condition

Requirement	**Remark**	**Result**
No dust accumulation which could affect meter operation or safety		
No dust deposition that could lead to tracking along creepage distances		
The function of the meter shall not be impaired (see below)		

Current (A)	**Power factor**	**Percentage error**	**MPE by class**			
			0.2	**0.5**	**1**	**1.5**
I_b (I_n)	1		0.2	0.5	1	1.5

9.7 Vibration (Sinusoidal) Test

Refer to NMI M 6-1, **A.2.7**.

Meter serial no.	
Observer:	
Date:	

	At start	**At end**
Temperature (°C):		
Time (hh:mm):		

Severity level: 2
Frequency range: 10 to 150 Hz
Max acceleration level: 10 m/s^2
No sweep cycles per axis: 10
Meter/EUT: non-operating condition

Requirement	**Remark**	**Result**
No damage to meter		
No change of information		
Meter shall operate correctly (see below)		

Current (A)	**Power factor**	**Percentage error**	**MPE by class**			
			0.2	**0.5**	**1**	**1.5**
I_b (I_n)	1		0.2	0.5	1	1.5

9.8 Mechanical Shock Test

Refer to NMI M 6-1, **A.2.8**.

Meter serial no.	
Observer:	
Date:	

	At start	**At end**
Temperature (°C):		
Time (hh:mm):		

Severity level: 1
Pulse shape: half-sine
Peak acceleration: 200 m/s^2
Pulse duration: 18 ms
Meter/EUT: non-operating condition, without packing

Requirement	**Remark**	**Result**
No damage to meter		
No change of information		
Meter shall operate correctly (see below)		

Current (A)	**Power factor**	**Percentage error**	**MPE by class**			
			0.2	**0.5**	**1**	**1.5**
I_b (I_n)	1		0.2	0.5	1	1.5

9.9 Radiated Electromagnetic Radiofrequency Fields Test without Current

Refer to NMI M 6-1, **A.2.9**.

Meter serial no.	
Observer:	
Date:	

	At start	**At end**
Temperature (°C):		
Time (hh:mm):		

Frequency range: 80 to 2400 MHz (continuous)
Modulation: 80% AM, 1 kHz sine wave
Field strength: 30 V/m
Meter/EUT: in operating condition, reference voltage, current terminal open-circuit

Requirement	**Remark**	**Result**
The behaviour of the equipment shall not be perturbed		

9.10 Electrostatic Discharge Test

Refer to NMI M 6-1, **A.2.11**.

Meter serial no.	
Observer:	
Date:	

	At start	**At end**
Temperature (°C):		
Time (hh:mm):		

Number of discharges: at least 10
Polarity of discharges: the most sensitive polarity
Severity level: 4
Meter/EUT: in operating condition, reference voltage, current terminal open-circuit

Application	**Discharge mode**	**Test voltage (kV)**	**Polarity**	**No. of discharges**	**Change in Register**	**Change in test output**	**Limit, *x* (kW·h)**	**Result**
Direct	Contact							
Direct	Air							
Indirect, Horizontal coupling plane	Contact							
Indirect, Vertical coupling plane	Contact							

Remarks:

Requirement (after test)	**Remark**	**Result**
No damage		
Meter shall operate correctly (see below)		

Current (A)	**Power factor**	**Percentage error**	**MPE by class**			
			0.2	**0.5**	**1**	**1.5**
I_b (I_n)	1		0.2	0.5	1	1.5

9.11 Voltage Dips and Short-term Interruptions Test

Refer to NMI M 6-1, **A.2.14**.

Meter serial no.	
Observer:	
Date:	

	At start	**At end**
Temperature (°C):		
Time (hh:mm):		

Meter/EUT: in operating condition, reference voltage, no current

Δ*U*	**Duration**	**Number of interruptions**	**Restoring time**	**Change in Register**	**Change in test output**	**Limit, *x* (kW·h)**	**Result**
100%	1 s	3	50 ms				
100%	20 ms	1	n/a				
50%	1 min	1	n/a				

Remarks:

9.12 Impulse Voltage Test

Refer to NMI M 6-1, **A.2.19**.

Meter serial no.	
Observer:	
Date:	

	At start	**At end**
Temperature (°C):		
Time (hh:mm):		

Impulse waveform at no load: 1.2/50 impulse
Meter/EUT: non-operating condition

9.12.1 For circuits and between circuits

Impulse voltage: 12 kV +0%, –15%
Source capacitance: 0.125 µF
Source impedance: 40 Ω ± 5 Ω
Stored energy: 9.0 J ± 1.0 J

Requirement (during the test)	**Remark**	**Result**
No flashover, disruptive discharge or puncture		

Requirement (after the test)	**Remark**	**Result**
No mechanical damage to the EUT		
Variation in in error does not exceed the uncertainty of measurement (see below)		

Current (A)	**Power factor**	**Percentage error**		**Variation in error (%)**	**Limit**
		Before	**After**		
I_b (I_n)	1				

9.12.2 For electric circuits relative to earth

Impulse voltage: 10 kV +0%, –10%
Source impedance: 500 Ω ± 50 Ω
Stored energy: 0.5 J ± 0.05 J

Requirement (during the test)	**Remark**	**Result**
No flashover, disruptive discharge or puncture		

Requirement (after the test)	**Remark**	**Result**
No mechanical damage to the EUT		
Variation in in error does not exceed the uncertainty of measurement (see below)		

Current (A)	**Power factor**	**Percentage error**		**Variation in error (%)**	**Limit**
		Before	**After**		
I_b (I_n)	1				

9.13 AC Voltage Test

Refer to NMI M 6-1, **A.2.20**.
*This test is performed as part of the damp heat cyclic test (refer to NMI M 6-1, **A.2.4**).*

Requirement (during the test)	**Remark**	**Result**
2 kV: during the test, no flashover, disruptive discharge or puncture shall occur		
4 kV: during the test, no flashover, disruptive discharge or puncture shall occur		
40 V: during the test, no flashover, disruptive discharge or puncture shall occur		

Requirement (after the test)	**Remark**	**Result**
No mechanical damage to the EUT		
Variation in in error does not exceed the uncertainty of measurement (see below)		

Current (A)	**Power factor**	**Percentage error**		**Variation in error (%)**	**Limit**
		Before	**After**		
I_b (I_n)	1				