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Title: **STANDARD FOR CALIBRATING SINGLE AND THREE PHASE (3-ELEMENT) INDUCTION TYPE ACTIVE ENERGY METERS – CLASS 2 WHOLE CURRENT AND TRANSFORMER OPERATED**

Unique Identifier: 240-77224539

Alternative Reference Number: <n/a>

Area of Applicability: Engineering

Next Review Date: **STABILIZED**

Compiler/Requestor  Henri Groenewald Chief Engineer Date: 2024-02-29	Approved by  Deon van Rool Middle Manager Dx PTM&C Date: 01/03/2024
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This document is **STABILIZED**. All comments received have been addressed. The technical content in this document is not expected to change because the document covers: (Tick applicable motivation)

1	A specific plant, project or solution	
2	A mature and stable technical area/technology	X
3	Established and accepted practices	X

Motivation for Conditional Stabilizing:

The calibration standard is accepted within the business without any request for amendments. The document has been discussed at the last Standards Working Group meeting of the Metering and Measurements study committee and no further amendments are required.

PCM Reference: 240-53459042 Perform Substation Engineering
SCOT Study Committee Number/Name: SC07-06/Substation Study Committee

Title: **STANDARD FOR CALIBRATING SINGLE AND THREE PHASE (3-ELEMENT) INDUCTION TYPE ACTIVE ENERGY METERS – CLASS 2 WHOLE CURRENT AND TRANSFORMER OPERATED**

Unique Identifier: **240-77224539**

Alternative Reference Number: **34-860**

Area of Applicability: **Engineering**

Documentation Type: **Standard**


Revision: **2**

Total Pages: **11**

Next Review Date: **March 2024**

Disclosure Classification: **Controlled Disclosure**

Compiled by



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Date: 20 March 2019

Approved by

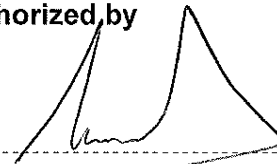


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1. Introduction

This document describes the calibration and adjustment standard for three-phase, induction type, class 2, three element active energy meters and single phase, induction type, active energy meters, class 2. Limits of errors are also provided. Error limits as listed in this document reflect minimum calibration and adjustment requirements.

2. Supporting clauses

2.1 Scope

2.1.1 Purpose

The purpose of this document is to set a standard procedure for the calibration and adjustment for three-phase, induction type, class 2, three element active energy meters and single phase induction type active energy meters, class 2.

2.1.2 Applicability

This document is applicable to all staff in Distribution who are responsible for the calibration of induction type three phase meters.

2.2 Normative/informative references

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

2.2.1 Normative

- [1] ISO 9001 Quality Management Systems.
- [2] SANS 62052 part 11, Electricity metering equipment (AC) - General requirements, tests and test conditions
- [3] SANS 62053 part 11, Electricity metering equipment (AC) - Particular requirements: Electromechanical meters for active energy (classes 0.5, 1 and 2)
- [4] IEC 62058 part 21: Electricity metering equipment (AC) – Acceptance inspection Part 21: Particular requirements for electromechanical meters for active energy (classes 0.5, 1 and 2)
- [5] 240-76628631, Standard for sealing metering equipment.

2.2.2 Informative

None

2.3 Definitions

2.3.1 General

Definition	Description
“Tested” sticker	A sturdy label applied to the side of the meter cover, indicating that the meter was calibrated by whom, and when.
Active energy meter	An instrument intended to measure active energy by integrating active power with respect to time. For metering purposes, the unit of active energy is kWh

Definition	Description
Basic current (I_b)	Basic current is that value of the current in accordance with which the relevant performance of the meter is fixed.
Calibration	Comparison of the indication of an instrument under test, or registration of the meter under test, with an appropriate standard.
Induction meter	A meter in which currents in fixed coils react with currents induced in the conducting moving element, generally a disk(s), which cause their movement proportional to the energy to be measured.
Maximum current (I_{max})	Highest value of the current at which the meter purports to meet the accuracy requirements.
Meter constant	Value expressing the relation between the energy registered by the meter and the corresponding value of the test output. If the test output is pulses, the constant should be either pulses per kilowatt-hour (imp/kWh) or watt-hours per pulse (Wh/imp).
Nominal current (I_n)	Value of current in accordance with which the relevant performance of a transformer operated meter are fixed (1 A or 5 A).
Register	This term was derived from the visible dial on the faceplate of the electro-mechanical meters, where the register provided an indication of the energy usage. In electronic meters, this term refers to the non-volatile memory locations within the metering device where similar energy usage information is stored.
Starting current (I_{st})	The lowest value of the current at which the meter starts and continues to register.

2.3.2 Disclosure classification

Controlled disclosure: controlled disclosure to external parties (either enforced by law, or discretionary).

2.4 Abbreviations

Abbreviation	Description
I	Current.
I_b	The basic current of the meter (direct connect or whole current meters).
I_{max}	The maximum current of the meter.
I_n	The nominal current of the meter (transformer connected meters).
kWh	Kilowatt hour
pf	Power factor
SABS	South African Bureau of Standards
SANAS	South African National Accreditation System.
V	Voltage
V_{nom}	Nominal voltage. For the purpose of this specification the voltage is 230V

2.5 Roles and responsibilities

The requirements of this document shall be used in the calibration of inductive type energy meters by calibration laboratories.

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2.6 Process for monitoring

The Metering and Measurement Study Committee shall ensure that this standard be implemented.

2.7 Related/supporting documents

Not applicable.

3. Calibration and adjustment procedure – Three phase meters

3.1 Initial calibration check

- 3.1.1** Open all the voltage links on the meter. (Not applicable to transformer operated meters (1 A and 5 A meters))
- 3.1.2** Connect the meters to the test bench – the meter covers shall be on where possible.
- 3.1.3** Apply 100% V_{nom} for at least 60 min to the meters.
- 3.1.4** In the following tests, the number of revolutions of the disc shall be chosen such that the resolution of the results is not compromised.
- 3.1.5** Apply 5% I_b or 2% I_n at unity power factor and record the error.
- 3.1.6** Apply 100% I_b or 100% I_n at unity power factor and record the error (reference table in paragraph 3.3).
- 3.1.7** Apply 100% I_b or 100% I_n at 0,5 lagging power factor and record the error (reference table in paragraph 3.3).
- 3.1.8** Apply 100% I_{max} at unity power factor and record the error.
- 3.1.9** Remove the meter covers.

3.2 Balancing of the phases and adjustment of the meter

Notes:

- When adjusting, care shall be taken that the errors for the different phases at the different load points are in the same "direction", i.e. all positive or all negative.
- When balancing individual phases, voltage shall be applied to all three phases

- 3.2.1** Apply 100% I_b or 100% I_n at unity power factor to the red phase only and adjust the full load red phase adjustment for an error better than +/- 1%.
- 3.2.2** Apply 100% I_b or 100% I_n at 0,5 lagging power factor to the red phase only and adjust the inductive load adjustment for an error better than +/- 1%.
- 3.2.3** Repeat 3.2.1 and 3.2.2 and readjust if necessary.
- 3.2.4** Repeat 3.2.1, 3.2.2 and 3.2.3 for the white phase and the blue phase.
- 3.2.5** Apply 100% I_b or 100% I_n at unity power factor to all three phases and adjust the polyphase adjustment for an error better than +/- 1%.
- 3.2.6** Apply 100% I_b or 100% I_n at 0,5 lagging power factor for all three phases and adjust all three inductive load adjustments equally for an error better than +/- 1%.
- 3.2.7** Repeat 3.2.5 and 3.2.6.

(Tests 3.2.8 and 3.2.9 are optional)

- 3.2.8** Apply 5% I_b or 2% I_n at unity power factor to the red phase only and adjust the light load red phase adjustment for an error better than +/- 1%.
- 3.2.9** Repeat 3.2.8 for white phase and blue phase.

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3.2.10 Apply 5% I_b or 2% I_n at unity power factor for all three phases and adjust the three light load adjustments equally for an error better than +/- 1%.

3.2.11 Record the 5% I_b or 2% I_n errors on the test sheet.

3.2.12 Perform a starting current test. Apply the value of current as specified in table 1. The meter disc will start and continue to run. It shall be verified that the disc completes at least one revolution. Where a “reverse running stop” is fitted, 1% I_b or 1% I_n shall be used.

Table 1: Value of current for starting test

Meter type	Class of meter				Power factor
	0.2S	0.5S	1	2	
Direct connection	-	-	0.4% I _b	0.5% I _b	1
Transformer connected	0.1% I _n	0.1% I _n	0.2% I _n	0.3% I _n	1

3.2.13 Replace the meter covers if it is practical to do so.

3.2.14 Record the errors at the following load points.

5% I_b or 2% I_n at unity power

100% I_b or 100% I_n at unity power factor

100% I_b or 100% I_n at 0,5 lagging power factor

100% I_{max} at unity power factor

Note: Where the test bench cannot produce I_{max}, the maximum current that can be produced by the test bench shall be used. The actual current used shall be recorded.

3.2.15 Apply 100% I_b or 100% I_n at unity power factor and perform the register test. The least significant drum shall rotate at least 1 revolution. The advance of the registers shall agree with the known amount of energy simulated.

3.2.16 Perform the creep test. Apply 110% V_{nom}. No current shall be applied. The disc shall not complete 1 revolution within 10 minutes.

3.2.17 Disconnect the meters from the test bench.

3.2.18 Close all the voltage links.

3.2.19 Apply the “TESTED” sticker (after writing month and year of calibration on the sticker) to the nameplates of the meters.

3.2.20 Verify the electrical continuity between the “MAIN (M)” terminals and the “NEUTRAL (N)” terminal.

3.2.21 Verify the electrical continuity between the “LOAD (L)” terminals and the “NEUTRAL (N)” terminal.

3.2.22 Replace the meter covers and seal the covers in accordance with 240-76628631.

3.3 Specifications/error limits

The final error results shall be within the limits as specified in table 2.

Table 2: Calibration limits for electromechanical active energy meters

Load Point	Current		Pf	Applicable for meter type	Load	Max error limit for meters of class		
	Direct connect meters	Transformer operated meters				0.5S	1	2
1	5% I _b	2% I _n	1	Single - and polyphase	Balanced	+/- 1	+/- 1.5	+/- 2.5
2	100% I _b	100% I _n	1	Single - and polyphase	Balanced	+/- 0.5	+/- 1	+/- 2
3	100% I _b	100% I _n	0,5 lag	Single - and polyphase	Balanced	+/- 0.8	+/- 1	+/- 2
4	100% I _b	100% I _n	1	Polyphase	Single phase ⁽¹⁾	+/- 1.5	+/- 2	+/- 3
5	100% I _b	100% I _n	1	Polyphase	Single phase ⁽²⁾	+/- 1.5	+/- 2	+/- 3
6	100 % I _{max}	100 % I _{max}	1	Polyphase	Balanced	+/- 0.5	+/- 1	+/- 2

Notes:

- 1) The meter shall be supplied with three phase symmetrical voltage. The current shall be applied to any of the phases.
- 2) The meter shall be supplied with three phase symmetrical voltage. The current shall be applied to a phase different from the phase in test 4.

4. Calibration and adjustment procedure – Single phase meters

4.1 Calibration

- 4.1.1 Open all voltage links.
- 4.1.2 Connect meters to test bench – the meter cover shall be on where possible.
- 4.1.3 Apply 100% V_{nom} for at least 60 minutes.
- 4.1.4 In the following tests, the number of revolutions of the disc shall be chosen such that the resolution of the results is not compromised.
- 4.1.5 Apply 5% I_b or 2% I_n at unity power factor and record the error.
- 4.1.6 Apply 100% I_b or 100% I_n at unity power factor and record the error (reference table in paragraph 3.3).
- 4.1.7 Apply 100% I_b or 100% I_n at 0,5 lagging power factor and record the error (reference table in paragraph 3.3).
- 4.1.8 Apply 100% I_{max} at unity power factor and record the error.
- 4.1.9 If the errors are within specifications (see table 2), then proceed to 4.1.15.
- 4.1.10 Remove the meter cover.
- 4.1.11 Apply 100% I_b or 100% I_n at unity power factor and adjust the full load adjustment for an error of better than ±1%.
- 4.1.12 Apply 100% I_b or 100% I_n at 0,5 lagging power factor and adjust the inductive load adjustment for an error of better than ±1%.
- 4.1.13 Repeat 4.1.11 and 4.1.12 and readjust if necessary.
- 4.1.14 Apply 5% I_b or 2% I_n at unity power factor and adjust the light load adjustment for an error of better than ±1%.
- 4.1.15 Replace the cover if it is practical to do so.

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- 4.1.16** Record the errors at the following load points.
- 5% I_b or 2% I_n at unity power
 - 100% I_b or 100% I_n at unity power factor
 - 100% I_b or 100% I_n at 0,5 lagging power factor
 - 100% I_{max} at unity power factor
- 4.1.17** Apply 100% I_b or 100% I_n at unity power factor and perform the register test. The least significant drum shall rotate at least 10 revolutions. The advance of the registers shall agree with the known amount of energy simulated. In order to reduce the time for this test, 200% I_b may be used.
- 4.1.18** Perform the starting current test. Apply the value of current as specified in table 1. The meter disc shall start and continue to run. It shall be verified that the disc completes at least one revolution. Where a “reverse running stop” is fitted, 1% I_b shall be used.
- 4.1.19** Perform the creep test. Apply 110% V_{nom} . No current shall be applied. The disc shall not complete 1 revolution within a reasonable time (10 minutes).
- 4.1.20** Disconnect the meters from the test bench.
- 4.1.21** Close all the voltage links.
- 4.1.22** Apply the “TESTED” sticker (after writing month and year of calibration on the sticker) to the nameplate of the meter.
- 4.1.23** Verify electrical continuity between the “MAIN (M)” terminal and the “NEUTRAL (N)” terminal.
- 4.1.24** Verify electrical continuity between the “LOAD (L)” terminal and the “NEUTRAL (N)” terminal.
- 4.1.25** Replace the meter covers and seal the covers in accordance with 240-76628631.

4.2 Specifications/error limits

For final error limits, see Table 2.

5. Authorization

This document has been seen and accepted by:

Name and surname	Designation
P Moyo	General Manager: Power Delivery Engineering
Sikelela Mkhabela	Senior Manager Maintenance and Operations

6. Revisions

Date	Rev	Compiler	Remarks
March 2019	2	HPD Groenewald	Changed reference to the sealing document.
March 2014	1	HPD Groenewald	New number allocated to document No technical content changes.

Date	Rev	Compiler	Remarks
Dec. 2008	0	A Scheepers	Development team, Keywords, Introduction added Document formatted into new template Reactive energy meter removed Single phase meter added Error tables modified to align with IEC 62058 part 21 Unique Identifier changed from SCSPVADO2 and SCSPVADA8 to 34-860

7. Development team

The following people were involved in the development of this document:

- Henri Groenewald PTM&C
- D Solomons WCOU

8. Acknowledgements

Not applicable.

Annex A – Requirements for the "Tested" sticker

- It shall be a polyurethane, permanent sticker.
- Printing shall be black on a yellow background.
- The sticker surface shall accept writing with a permanent marker.
- The size of the sticker shall be 40mm long and 8mm wide.
- The test facility's name shall be pre-printed on the sticker by using a bold Arial font, size 8 and all in capital letters - see samples.
- The "TESTED /20" shall be pre-printed on the sticker by using a bold Arial font, size 12 and all in capital letters - see samples.
- The letter spacing shall be as shown in the samples.



A yellow rectangular sticker with black text. The top line reads "SCHLUMBERGER TESTING" in a smaller font. The bottom line reads "TESTED /20" in a larger, bold font.



A yellow rectangular sticker with black text. The top line reads "ESKOM BRACKENFELL" in a smaller font. The bottom line reads "TESTED /20" in a larger, bold font.

Figure A.1: Sample sticker

Instructions for the use of the sticker

- A permanent, black marker shall be used for writing. The month of calibration shall be written in the space between "TESTED" and "/20" on the sticker. Numbers shall be used, for example 01 for January and 12 for December. The year of calibration shall be written in the space after "/20" on the sticker. Two digits shall be used, for example 01 for 2001 and 05 for 2005.
- The sticker shall be applied to the nameplate of the meter. It shall be clearly visible from outside the meter with the meter cover in place. It shall not obscure information on the nameplate of the meter.