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Measurement Protocol for the calibration of DC Voltage – Zener Reference Standard

ILC 135

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1. Introduction

This Proficiency Testing Scheme (PT) is designed to evaluate the participant laboratories competence in the calibration of a DC Voltage – Zener reference standard at 10 V output.
As a second measurement the participant have to measure and report the Thermistor Resistance of the oven. Participation by both accredited and non-accredited laboratories is welcome.

The PT should enable SANAS accredited calibration laboratories, in the Direct Current Low Frequency (DCLF) metrology field, to demonstrate their capability over the relevant dc voltage measurements.

For most accredited laboratories, the accuracy of the PT artefact has been specifically chosen such that the measurement results should be capable of proving satisfactory performance.

2. Participants

This PT Scheme is open to all calibration Laboratories capable of measuring dc voltage for the purpose of calibrating a dc voltage reference standard.

3. Organisation

This Scheme is “closed” in nature meaning that it has defined start and end dates together with a defined date by which the final report will be issued. A schedule is planned beforehand, allocating specific 2-week time-slots to pre-registered participating laboratories.

The unit does not have batteries so it will be powered down for transport to the next laboratory which is acceptable as long as the unit is powered up again for one week before measurements are made.

The 2-week time slot will allow one week for the unit to stabilize and one week to perform the measurements.

The Scheme is run as a “Star-shaped” scheme in that the artefact is returned back to the NLA-SA (for South Africa) or to the appointed agent (for International participants), in between participants. The artefact will be couriered from one participant to the next, being delivered by the Monday of the participant’s scheduled week (before 12h00) and collected on the Friday of the participant’s scheduled week (after 12h00). The cost of these courier services is already covered in the cost of the scheme and all that is required is for the participating laboratory to notify the NLA-SA to arrange for the collection by the courier. ***It should be noted that failure to have the ILC artefact ready for collection at the scheduled time, will have a severe knock-on effect on all future participants. Laboratories are therefore respectfully requested to rigidly adhere to the timing schedule. Failure to meet the allocated time may result in disqualification of the participant without refund.***

Verification measurements will be performed by NMISA at the start and at the end of the scheme.

Potential participants will be made aware of the scheme by means of direct E-mail notification, and requested to contact the NLA-SA to register. They will then be required to pay the participation fee, upon receipt of which they will be scheduled for participation.

The participants will receive the artefact via courier in their allotted two-week time slot during which they must perform their measurements. They are then required to submit their measurement results to the NLA-SA within one week after participation.

A final report will be issued to the participants by the scheduled date which will contain the results obtained by each of the participants against the scheme Reference Value. The report will also contain the Normalised Error (E_n) values obtained by each laboratory.

Normalised Error values ≤ 1 indicate satisfactory performance of the participant within their reported measurement uncertainties. Normalised Error values > 1 indicate unsatisfactory performance of the participant which require investigation (root cause analysis) and subsequent corrective action.

4. Confidentiality

The identity of participants' results will be kept confidential by means of a unique code known only to the participant.

Note: As per agreement between the NLA-SA and SANAS, and the permission of SANAS accredited participants, the final report together with the identity of each accredited participant's results, will also be made available to SANAS. The identity of all participants will remain confidential and their identity will not be made available to SANAS.

5. ILC Artefact Description

The artefact is a DC Voltage reference standard.

Manufacturer:	Fluke
Model:	732A
Serial Number:	3345005

6. Financial Liabilities

Each participant is responsible for the following costs:

- The participation fees.
- Performing the measurements according to the requirements as laid down in the instructions and reporting the results.
- Any damage to the artefact whilst in their possession which includes in their laboratory. Delivery notes and receipt condition forms will be used to transfer custody between the participant and the courier company.

7. Reference Value

The Reference Value is accepted as the value measured during the calibration of the artefact by the National Metrology Institute of South Africa. The Reference Uncertainty associated with the Reference Value is accepted as being the associated measurement uncertainty as reported by NMISA extended to allow for the drift of the artefact during the duration of the PT scheme.

8. Analysis of Scheme Results

The measurement results together with their associated uncertainties of measurement, as reported by the participants, will then be used to calculate "Normalised Error" (E_n) values as follows:

$$E_n = \frac{(LAB - REF)}{\sqrt{(U^2_{LAB} + U^2_{REF})}}$$

Where:

"REF" is the Reference Value obtained as described in para 7 above.

"LAB" is the value reported by the participating laboratory.

"U_{REF}" is the Expanded Uncertainty at a Level of Confidence of 95,45% assigned to the Reference Value as described in para 7 above.

"U_{LAB}" is the Expanded Uncertainty at a Level of Confidence of 95,45% reported by the participant.

9. Operating Features

9.1 The 732A is designed to be **powered continuously**, including during storing or shipment, to maintain standardization.
If the Fluke 732A did not have an internal rechargeable battery and is powered from ac line power only, at least one week must been allowed for stabilisation of the unit after power up.

9.2 The Fluke 732A dc Reference Standard is a highly stable, rugged and transportable, solid state dc voltage reference standard with 10 V, 1,018 V and 1 V outputs which are available on the front panel binding posts. A complete user's manual has been supplied with the instrument to enable the user to look up the relevant connection points in order to configure the instrument for the various measurements.

10. Measurement Instructions

It should be noted that the artefact, should be treated in exactly the same way that any item that is brought into your laboratory would normally be treated. One of the purposes of conducting such a PT is to establish whether under 'normal conditions" all laboratories can produce comparable results.

10.1 The Fluke 732A should be power up for at least a week to allow the unit to stabilize before performing measurements. Perform spot checks at 10 V output with DMM to determine the stability if the dc voltage output.

10.3 Participants will perform measurements according to methods used in their laboratories.

11. Uncertainty of measurement

To have a comparable uncertainty evaluation for each reported value, main uncertainty contributors are listed below, and depending on the method used, this list may be varied from one participant to another.

- Reference standard (calibration, drift)
- Measuring system (stability, gain, offset effects)
- Standard Deviation or Experimental Standard Deviation of the Mean in case the reported mean was calculated from more than one set of measurement results.

12. Environmental conditions

All measurements shall be performed under the following conditions:

Ambient temperature: 23 ^{o}C ± 2 ^{o}C
Relative humidity 50 %rh ± 10 %rh

13. Submission of Results

The results must be submitted to the NLA-SA Office within 1 week of the completion of the measurements.

The measurement results, together with the estimated Expanded Measurement Uncertainties for a Level of Confidence of 95,45% must be reported on the attached result sheet (See Appendix 1).

NOTE: **These uncertainties should be the calculated values and need not be limited to the participant's SANAS accredited Measurement Capabilities to allow them to report measurement uncertainties which are smaller than their accredited calibration measurement capabilities (CMCs).**
Since no calibration certificate is issued bearing the SANAS accreditation symbol, the SANAS limitations do not apply.

The results must either be faxed to +27 12 349-1501 or E-mailed to florisvdw@nla.org.za.

14. Artefact Damaged or Unstable

14.1 Should you find that on inspection the artefact is physically damaged you are to immediately inform the organizer (NLA – SA).

14.2 Depending on the outcome of the damage a decision will be made as to whether the measurements can still be made or further remedial action is required.

14.3 In the event that the problem cannot satisfactorily resolved all participants will be informed of either a delay in conducting the scheme or the cancellation of the scheme entirely.

14.4 The same process mentioned in 14.1 – 14.3 will be used should the artefact appear to be unstable.

Appendix 1

Measurement Result Form (ILC135)

1. Participant Details

Company Name	
Laboratory Name	
Address	
Contact name	
E-mail Address	
Calibrated by	
Telephone Number	
E-mail Address	
Date/s of calibration	

For SANAS accredited participants only:

I/We agree that the reported results for this laboratory will be made available to SANAS by the NLA-SA as part of the process.

_____ _____

Name Signature

_____

Date

2. Results

Refer to the tables on next pages.

2.1 **dc Voltage Measurement**

Nominal dc Voltage Output (V)	**Measured dc Voltage Output (V)**	**Measurement Uncertainty (V)**
10		

2.2 **Thermistor Resistance Measurement**

Measured Resistance (kΩ)	**Measurement Uncertainty (kΩ)**