National Laboratory Association of South Africa - NPC

P.O. Box 298
Persequor Park
Pretoria, South Africa, 0020
Reg. No: 1994/002856/08
Tel: (+27) 012 349 1500
Fax: (+27) 012 349 1501
http://www.nla.org.za

1 De Havilland Crescent
Persequor Technopark

Measurement Protocol for the calibration of a 500 kN HBM Loadcell in compression, together with an HBM Scout 55 Readout Unit

ILC 120

Compiled by:

Floris van der Walt

Approved By:

Steve Sidney

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1. Introduction

This Proficiency Testing Scheme (PT) is designed to evaluate the participant laboratories competence in the calibration of Force Machines and Loadcells. Participation by both accredited and non-accredited laboratories is welcomed.

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 against their accredited measurement capabilities.

2. Participants

This PT Scheme is open to all calibration Laboratories capable of generating Force, for the purpose of calibrating Loadcells.

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 1 week time-slots to pre-registered participating laboratories.

The Scheme is run as a “Sequential” scheme in that the artefact is transported from one participant to the next in scheduled sequence. The artefact will be couriered from one participant to the next, being delivered by the Monday of the participant’s scheduled week and collected on the Friday of the participant’s scheduled week. 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.

The artefact will be returned to the NLA-SA at the end of the scheme, for verification measurements.

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 one 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

Although it will be transparent as to which laboratories participated in the scheme, the identity of their results will be kept confidential by means of a unique code known only to the participant.

For SANAS accredited participants, the final report, together with the identity of each accredited participant's results, will also be made available to SANAS by the NLA-SA as part of the process.

5. PT Artefact Description

The artefact is a 500 kN Loadcell with Readout Unit.

Transducer Manufacturer:	HBM
Transducer Model:	ULP.G (50T)
Transducer Serial Number:	3763
Readout Manufacturer:	HBM
Readout Model:	Scout 55
Readout Serial Number:	817435601

6. Financial Liabilities

Each participant is responsible for the following costs:-

- The participation fee,
- Performing the measurements according to the requirements as laid down in the audit 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 being the interpolated mV/V value using a 3rd order polynomial equation and coefficients as obtained from the calibration of the artefact and Readout Unit by the National Metrology Institute of South Africa (NMISA). This value will be accepted as the "REF" value.

The Reference Uncertainty associated with the Reference Value is accepted as being the calculated uncertainty including the calibration uncertainty, the standard error of the curve fit and the stability of the artefact as determined from repeated calibrations. This will be accepted as the "U_{REF}" value.

8. Analysis of Scheme Results

The “Calculated Mean mV/V values”, as reported by the participant, will be used to generate a 3rd order polynomial equation. mV/V values will then be interpolated for the nominal forces at the measurement points. These values will be deemed the “LAB” value.

The measurement uncertainty associated with the “LAB” value is accepted as being the calculated uncertainty, including the calibration uncertainty as reported by the participant, together with the standard error of the curve fitted by the PT provider. This will be accepted as the “U_{REF}” value.

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 and calculated as described in para 8 above.

“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 and calculated as described in para 8 above.

9. Measurement Instructions

It should be noted that the artefact, should be treated in exactly the same way than 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.

9.1 On arrival of the artefacts, a visual inspection is to be conducted and if necessary, the results reported to the NLA-SA.

9.2 Connect the Loadcell to the Scout 55, taking appropriate care not to damage the connector pins.

9.3 Switch on the Scout 55 and allow a minimum of 1 hour warm-up time.

Note:
the Scout 55 is to be used in the "Switch-on" default mode. No additional settings to the front panel are to be made.

9.4 Place the Loadcell in the Force Machine and align it in such a way to apply the load through the principle axis. Record this position as the 0° position. Use the loading button and platten supplied.

9.5 Preload the loadcell 3 times, in compression, from 0 kN up to 500 kN to exercise the loadcell, recording the values at zero and full scale in the result sheet supplied in Appendix A (2.1.1).

Note:
the Scout 55 must be zeroed before each run by pressing the "→0←" button.

9.6 Apply forces in ten nominally 50 kN steps from 0 kN to 500 kN and record the Scout 55 displayed mV/V value for each step, ***after 30 seconds***.

9.7 For repeatability measurements, three runs at the 0° position have to be performed from 0 kN to 500 kN at 50 kN steps. Record the values for all 3 runs in the result sheet supplied in Appendix A (2.2)

9.8 Rotate the loadcell through 120° and preload from 0 kN to 500 kN. Record the values in the result sheet supplied in Appendix A (2.1.2).

9.9 Repeat the measurements in para 9.6 and record the values in the result sheet supplied in Appendix A (2.3)

9.10 Rotate the loadcell through 240° and preload from 0 kN to 500 kN. Record the values in the result sheet supplied in Appendix A (2.1.3)

9.11 Repeat the measurements in para 9.6 and record the values in the result sheet supplied in Appendix A (2.3)

9.12 Calculate the mean output in mV/V, using measurement runs 1, 2 and 3 and report on the result sheet in Appendix 1 (2.4).

9.13 Perform a “zero drift test” as follows and record the results on the supplied results sheet in Appendix 1 (2.5):

After the last run, (Run 3), remove the force and immediately record the Scout 55 display. Record again after 30 seconds and then again after 5 minutes.

10. 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. Since no calibration certificate is issued bearing the SANAS accreditation symbol, the SANAS limitations do not apply.

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

Appendix 1

Measurement Result Form (ILC120)

1. Participant Details

Company Name	
Contact name	
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 table on next page.

2.1 **Pre-Load measurements**

2.1.1 **Pre-load Measurement @ 0° position**

Nominal Force (kN)	Applied Force (kN)	0° Pre-load 1A (mV/V)	0° Pre-load 1B (mV/V)	0° Pre-load 1C (mV/V)
0,00				
500,00				

2.1.2 **Pre-load Measurement @ 120° position**

Nominal Force (kN)	Applied Force (kN)	120° Pre-load (mV/V)
0,00		
500,00		

2.1.3 **Pre-load Measurement @ 240° position**

Nominal Force (kN)	Applied Force (kN)	240° Pre-load (mV/V)
0,00		
500,00		

2.2 **Repeatability Measurements**

Nominal Force (kN)	Applied Force (kN)	Run 1 @ 0° Indicated Reading (mV/V)	Run 2 @ 0° Indicated Reading (mV/V)	Run 3 @ 0° Indicated Reading (mV/V)
0,00				
50,00				
100,00				
150,00				
200,00				
250,00				
300,00				
350,00				
400,00				
450,00				
500,00				

2.3 **Measured Results – Compression (mV/V)**

Nominal Force (kN)	Applied Force (kN)	Run 1 @ 0° Indicated Reading (mV/V)	Run 2 @ 180° Indicated Reading (mV/V)	Run 3 @ 270° Indicated Reading (mV/V)	Mean Calculated Reading (mV/V)	Measurement Uncertainty (± mV/V)
0,00						
50,00						
100,00						
150,00						
20,00						
250,00						
300,00						
350,00						
400,00						
450,00						
500,00						

2.4 **Calculated Force – Compression (kN)**

Nominal Force (kN)	Applied Force (kN)	Mean Calculated Reading (from previous table) (mV/V)	Calculated Force (kN)	Measurement Uncertainty (± kN)
0,00				
50,00				
100,00				
150,00				
20,00				
250,00				
300,00				
350,00				
400,00				
450,00				
500,00				

2.5 **Zero Drift Test**

Applied Force (kN)	Scout 55 display with Force removed (mV/V)	Scout 55 display after 30 seconds (mV/V)	Scout 55 display after 5 minutes (mV/V)
0,00			