CRITERIA FOR ACCREDITATION IN PRESSURE METROLOGY

Prepared by: SADCAS Advisory Committee – CLAS	**Approved by**: SADCAS CEO	**Approval Date**: 2022-03-29 **Effective Date**: 2022-03-29

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1. PURPOSE AND SCOPE

The purpose of this document is to define the specific environmental, general and technical requirements to be met by accredited metrology service providers in the field of pressure metrology.

This document is applicable to Southern African Development Community Accreditation System (SADCAS) accredited metrology service providers.

2. DEFINITIONS

2.1 Absolute Pressure

If a vessel were to contain no molecules the pressure would be zero. Pressures measured on the scale which uses these zero values as its reference point are said to be absolute pressures.

2.2 Atmospheric Pressure

Atmospheric pressure is the force exerted on a surface area caused by the earth's gravitational attraction of the air vertically above that area. Atmospheric pressure is subject to change in air density caused by changes in temperature and global weather patterns. Atmospheric pressure decreases with increasing altitude. Atmospheric pressure is synonymous with *barometric* pressure.

2.3 Gauge Pressure

The value of pressure measured with reference to atmospheric pressure is called gauge pressure. Pressure excursions below atmospheric pressure are sometimes known as a negative gauge pressure.

2.4 Pressure Balance

An Instrument consisting of a finely machined piston mounted vertically in a close-fitting cylinder used for maintaining a calculable pressure; also known as a piston gauge. When fitted with a means of pressure control, additional pressure ports, masses etc., the complete system is commonly known as a dead-weight tester.

2.5 Vacuum

Vacuum is commonly known to imply any pressure below atmospheric pressure.

3. ENVIRONMENTAL REQUIREMENTS

An accredited metrology service provider working in the field of pressure measurements shall operate under the following conditions:

- The temperature in any laboratory where pressure or vacuum calibration is conducted must be maintained at 22 °C ± 3 °C however no temperature control is necessary when quoting uncertainties of larger than ± 0,25 %.
- Laboratories quoting uncertainties of equal to or less than ± 0,10 % shall ensure that temperature gradients within the laboratory are limited to less than 1ºC per hour.
- Where necessary the laboratory shall maintain appropriate records to demonstrate and confirm the temperature and temperature gradients within the laboratory.
- Vibration levels in the laboratory shall be such that they do not have an adverse effect on the measurement result.
- Lighting within the laboratory shall be adequate to facilitate the correct performance of the calibration work undertaken.
- Draughts in the laboratory caused by doors, fans and/or air conditioners should be such that they do not have an adverse effect on the measurement results. Where necessary local isolation in the form of draught shields shall be utilized.
- Thermometers and/or temperature recorders used for the measurement and recording of the ambient temperature in the laboratory and onsite, shall be calibrated.

4. GENERAL REQUIREMENTS

4.1 All cotton and chamois leather gloves used for the handling of pressure balance weights shall be kept clean.

4.2 Weighing of pressure balance weights, and the use, or calibration of a pressure balance in the laboratory must take place on a work bench of adequate construction, which will facilitate the stable and correct operation of the balance. The work bench design shall take cognizance of vibration, stability, and support.

4.3 Raw data shall not be recorded in pencil, erasable ink or amended using correction fluid.

4.4 The laboratory shall have Material Safety Data Sheet (MSDS) available for all chemicals used in the laboratory, including fluids used in pressure balances.

4.5 Where the laboratory uses or calibrates mercury manometers, or barometers, the laboratory shall have a MSDS available, that shall include all the details of the necessary action to be taken in the event of a mercury spill.

4.6 Laboratory procedures shall address temperature stabilization times for all equipment received by the laboratory for calibration.

4.7 Laboratory procedures shall address the use of various types of tubing and connectors used to interconnect equipment during calibration. Particular attention shall be paid to the applicable maximum pressure rating of the tubing used.

4.8 Where appropriate localized temperature measurement shall be performed and the temperature recorded during calibration, e.g. for Piston Cylinder units or Mercury columns.

4.9 Whenever Pressure Balances are either calibrated or used during a calibration and an uncertainty of ± 0.005 % is quoted, the air density must be determined and a buoyancy correction applied.

4.10 The calibration certificate shall provide all relevant information necessary for intelligent interpretation, and the application of appropriate corrections by the user.

5. TECHNICAL REQUIREMENTS

5.1 Local Gravity

5.1.1. Whenever a pressure or vacuum calibration laboratory calibrates or uses a pressure balance or liquid column manometer in the laboratory, the laboratory shall have determined, or calculated, the local gravity at the location of the laboratory.

5.1.2. The National Physical Laboratory (NPL) (UK) has recommended the following formula for the calculation of an approximate value for local gravity.

$$g = 9.780\ 327\ (1 + A \sin^2 L - B \sin^2 2L) - 3.086 \times 10^{-6}\ H\ m{\cdot}s^{-2}$$

where:
A = 0.005 302 4
B = 0.000 005 8
L = latitude
H = height in meters above sea level
The uncertainty in the value of g so obtained is generally less than ± 5 parts in 10^5.

5.2 Calibration of Pressure Balances

Laboratories conducting the calibration of pressure balances, shall be accredited for pressure balance calibration as a separate entry on their accreditation schedule. The laboratory will require a Calibration and Measurement Capability (CMC) of at least 0.05% in order to be accredited for this function. The standard used to perform the calibration shall be appropriate in order to achieve the desired uncertainty.

5.3 Calibration of Pressure Balance Weights

The calibration laboratory shall report in the calibration certificate at least the conventional mass, the associated uncertainty of measurement, nominal pressure (where indicated on the pressure balance weight), and the calculated pressure determined from the mass, standard gravity, nominal piston area (where available), and measured or assumed air and metal densities.

Pressure calibration laboratories are limited in the CMC they may report for the calibration of pressure balance weights to 0,005% + 2 mg. Calibration of pressure balance weights to a smaller uncertainty should be referred to a laboratory accredited for mass calibration.

5.4 Calibration of effective Area of Piston / Cylinder

Where a laboratory reports the effective area of a piston cylinder unit, the area shall be referenced to zero pressure at 20° C. $A_{(0,t)}$.

5.5 Calibration of Pressure Gauges

The laboratory shall have a procedure/s that address the calibration of pressure gauges reserved for oxygen use. This procedure/s shall describe the steps to be undertaken in order to avoid the contamination of these gauges with oil.

6. REFERENCES

- SADCAS TR 12 Estimation of the uncertainty of measurement by calibration laboratories and specification of calibration and measurement capability on schedules of accreditation.
- ISO/IEC 17025:2017 General requirements for the competence of testing and calibration laboratories.
- EN 837-1: 1996 Bourdon Tubes.
- NPL Guide 101 – Guide to the Measurement of Pressure and Vacuum (ISBN 0 904457 29 X).

- BIPM Classification of Services in Mass and related quantities.

APPENDIX A: SAMPLE OF SCHEDULE OF ACCREDITATION

ANNEXURE A
SCHEDULE OF ACCREDITATION
PRESSURE METROLOGY

Laboratory Accreditation Number: CAL-12 00x (ISO/IEC 17025:2017)

Permanent Address of Laboratory: … … … …… **Postal Address:** … … … **Tel** : … **Cell** : … **Fax** : … **Email** : …		**Technical Signatories** : … **Nominated Representative** : … **Issue No**. : … **Date of issue** : … **Expiry Date** : …

ITEM	MEASURED QUANTITY OR TYPE OF GAUGE OR INSTRUMENT	METHOD	RANGE OF MEASURED QUANTITY	CALIBRATION AND MEASUREMENT CAPABILITY EXPRESSED AS AN UNCERTAINTY (±)
3.1	Gauge Pressure			
3.2.1	Gas Medium • Pressure Gauge	Internal: Reference: SADCAS TR XX	0 kPa to 500 kPa	0.8% + 15 Pa
3.2.2	Liquid Medium • Pressure Gauge	Internal: Reference: SADCAS TR XX	0 kPa to 100 MPa	0.8% + 120 Pa

Original date of accreditation: …

The CMC, expressed as an expanded uncertainty of measurement, is stated as the standard uncertainty of measurement multiplied by a coverage factor k = 2, corresponding to a confidence level of approximately 95%.

APPENDIX B - AMENDMENT RECORD

Revision status	Change			Approved by	Effective Date
	Page No.	Clause	Description of change		
Issue 1			-	CEO	2022-03-29