MINING INDUSTRY
OCCUPATIONAL
SAFETY & HEALTH

MINERALS COUNCIL
SOUTH AFRICA

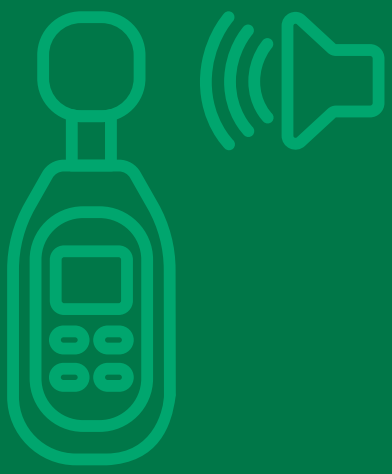

Anglo America Platinum - Polokwane Smelter

GUIDANCE NOTE

FOR THE IMPLEMENTATION OF A QUALITY ASSURANCE PLAN

This document serves as an industry guidance for the implementation of a quality assurance plan as is stipulated in Annexure G of the guideline for a mandatory code of practice for a health programme for noise; 2021.

The guidance note has been developed for use by persons who have been found competent by the occupational hygienist appointed under section 12.1 of the Mine Health and Safety Act (29 of 1996) to conduct noise measurements by virtue of their knowledge, training and experience.



Sound level pressure instruments are being used to classify and quantify the nature, magnitude and origin of noise and sound sources.

The instruments of interest are known as sound level meters (SLM).

PURPOSE

This guidance note was developed to assist industry members in ensuring that all items of sound measuring equipment used are calibrated against the requirements of IEC 60942, SANS 61672 and SANS 61672-2 (by an accredited facility) by recommending and specifying certain sets of tests for the periodic testing of sound level meters and accompanying instruments.

Sound level pressure instruments are being used to classify and quantify the nature, magnitude and origin of noise and sound sources. The instruments of interest are known as sound level meters (SLM). SLM and the accompanying instruments i.e. sound calibrators (SLC), fractional octave band filters, personal sound exposure meters (PSEM) or also known as dosimeters, are all manufactured according to international standards, known as the International Electrotechnical Commission (IEC) standards.

This is done to ensure that all instruments conforming to these IEC standards are accepted to have the same capability in performing the same measurements and achieving the same results, and thus ensuring uniformity.

LEGAL

The Mine Health and Safety Act (MHSA) (No. 29 of 1996) requires the employer to protect the health and safety of employees at mines.

It further requires the employer, in terms of regulation 9.2(2) or in terms of its risk assessment, to establish and maintain a system of occupational hygiene measurements.

The MHSA (No. 29 of 1996) and the Occupational Health and Safety Act (OHSA) (No. 85 of 1993) reference the relevant standard, SANS 10083:2021.

The "relevant national body" means the South African National Accredited System (SANAS). Furthermore, in South Africa the "relevant national legislation" means the South African Qualifications Authority Act (No. 58 of 1995).

The Government Gazette, Act No: 19 of 2006: Accreditation of Conformity assessment, calibration and good laboratory practise Act, 2006 indicates in clause 4:

"Status of SANAS" that SANAS is recognised as the only national body responsible for carrying out accreditations in respect of conformity assessment, which includes accreditation of:

(a) calibration, testing and verification laboratories,

(b) certification bodies,

(c) inspection bodies,

(d) rating agencies, and

(e) any other type of body that may be added to SANAS' scope of activity

SANAS is recognised as the national body to monitor GLP compliance with principles adopted by the OECD for GLP facilities.

STANDARDS

Quality standards are defined as documents that provide requirements, specifications, guidelines, or characteristics that can be used consistently to ensure that the measured results are repeatable and accurate for example ISO 17025 and ISO 9001.

The IEC standards describe a number of tests that should be performed on the noise instruments in order to establish if the instrument conforms to the IEC requirements so that the instrument can be accepted as functioning correctly.

SABS ARP 0109:2014 is a standard implemented specifically for the main purpose to recommend the minimum set of parameters and ranges proposed for periodic testing of sound level meters, microphones used with sound level meters, sound calibrators, fractional octave band filters and personal sound exposure meters to state conformance to the relevant IEC Standards.

ACCREDITED LABORATORY

An accredited laboratory is one that demonstrates its ongoing competence in the field of calibration and/or testing that meets the requirements of ISO/IEC 17025 General Requirements for the Competence of Testing and Calibration Laboratories. An accredited laboratory should be audited on a regular basis by an independent third party and must prove that it meets the management and technical systems requirements of the standard and the laboratory has adequate equipment to perform the tests or calibrations. In addition, the laboratory must demonstrate that it has adequate, technically competent personnel to perform the calibration and/or tests.

The benefit of making use of an accredited laboratory is the assurance that the laboratory has been audited to an international standard based on demonstrating their competence in performing the calibrations and/or tests. Accreditation provides assurance that the laboratory's processes were independently verified by a third party.


Kumba Iron Ore - Sishen Mine

Although IEC 61672 does state what the minimum requirements pertaining to periodic verification are, the purpose of this recommended practice is to define additional requirements. The older IEC standards provided no guidance relating to periodic verification of parameters.

The current standards for SLMs, integrating averaging sound level meters (i.e. those that measure Leq), noise dosemeters and acoustic calibrators which apply in South Africa are listed below.

SLM	Integrating sound level meters	Noise dosemeters	Acoustic calibrators
IEC 61672-1 IEC 61672-2 IEC 61672-3	IEC 61672-1 IEC 61672-2 IEC 61672-3	IEC 61252	IEC 60942
Previously published as: IEC 60651 IEC 651	Previously published as: IEC 60804 IEC 804		

The latest standard for sound level meters and integrating sound level meters is IEC 61672, this however does not mean equipment manufactured according to IEC 651, IEC 60651, IEC 804, and IEC 60804 may not be used anymore. Instruments according to the older standards are still compliant to their specific standards and can still be calibrated.

INSTRUMENTS

Instruments mostly used for measuring noise are:

- SLM
- Integrating sound level meter (ISLM)
- Noise dosimeter, also known as a dose badge or noise exposure meter,
- Sound calibrator

INSTRUMENT TYPE/CLASSIFICATION

Sound Level Meter (SLM) or Integrating Sound Level Meter (ISLM)

A SLM which accumulates the total sound energy over a measurement period and calculates an equivalent average value, usually displayed as a L_{eq}, that complies at least with the accuracy requirements specified for a type 2 instrument in IEC 61672.

SLMs are used for the following type of measurements:

- To spot check noise levels
- To identify noise sources
- To evaluate the effectiveness of noise controls

The current standard for SLMs and ISLMs which apply in South Africa are IEC 61672:

- SLMs and ISLMs are designed to comply to IEC 61672 "Electroacoustics – Sound Level Meters.
- IEC 61672 standard consists of three parts:
- **IEC 61672 Part 1 "Specifications" identify the electro acoustical performance specifications.**

Two performance categories, Class 1 and Class 2 are specified in this standard. In general, specifications for class 1 and class 2 sound level meters have the same design goals and differ in the acceptance limits and the range of operational temperature. Acceptance limits for class 2 are greater than, or equal to, those for class 1.

Class 1

Precision grade meters for laboratory and field use as defined in IEC 61672. This may also be referred to as type 1 although the IEC 61672 standard uses the term class rather than type.

Class 2

General grade meters for field use as defined in IEC 61672. This may also be referred to as type 2 although the IEC 61672 standard uses the term class rather than type.

NOTE: *Laboratory and field grade for SLMs defined in standards such as IEC 60651 and IEC 60804 have been superseded by IEC 61672.*

The type of microphone and the type of sound level meter, as described in the relevant IEC standards, determines the overall type for both the microphone and instrument.

NOTE: *A type 2 microphone with a type 1 sound level meter results in the combined instrument type being type 2.*

Laboratory and field grade for SLMs defined in standards such as IEC 651, IEC 60651, IEC 804, and IEC 60804. These standards have been superseded by IEC 61672 which uses class 1 rather than type 1.

IEC 61672 Part 2 "Pattern Evaluation Tests" provides details of the tests necessary to verify compliance to ALL mandatory specifications given in IEC 61672 part 1.

During pattern evaluation at least three specimens of the same pattern of sound level meter shall be submitted for pattern-evaluation testing. As a minimum, the laboratory shall select two of the specimens for testing. At least one of the specimens shall then be tested fully according to the procedures of this standard. The laboratory shall decide whether the full tests shall also be performed on the second specimen or whether additional limited testing is adequate to approve the pattern.

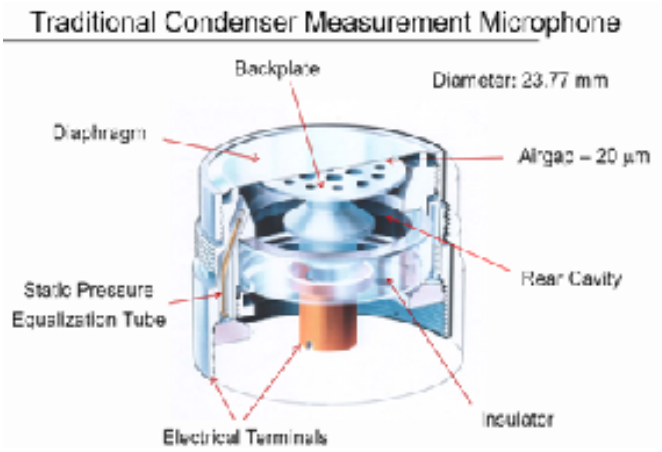
IEC 61672 Part 3: "Periodic testing" describes procedures for periodic testing that were designed to conform to the class 1 or class 2 specifications of IEC 61672 part 1.

The aim of the standard is to ensure that periodic testing is performed in consistent manner by ALL laboratories. The purpose of periodic testing is to assure the user that the performance of a sound level meter conforms to the applicable specifications of IEC 61672 Part 1 for a limit set of KEY tests and for the environmental conditions under which these tests were performed.

Microphone

The Microphone is the interface between the acoustic field and the measuring system. The best type of microphone for sound level meters is the condenser microphone, which combines precision with stability and reliability. The diaphragm of the microphone responds to changes in air pressure caused by sound waves. That is why the instrument is sometimes referred to as a sound pressure level meter (SPL). This movement of the diaphragm, i.e. the sound pressure (unit pascal, Pa), is converted into an electrical signal (unit volt, V).

While describing sound in terms of sound pressure, a logarithmic conversion is usually applied and the sound pressure level is stated instead, in decibels (dB).



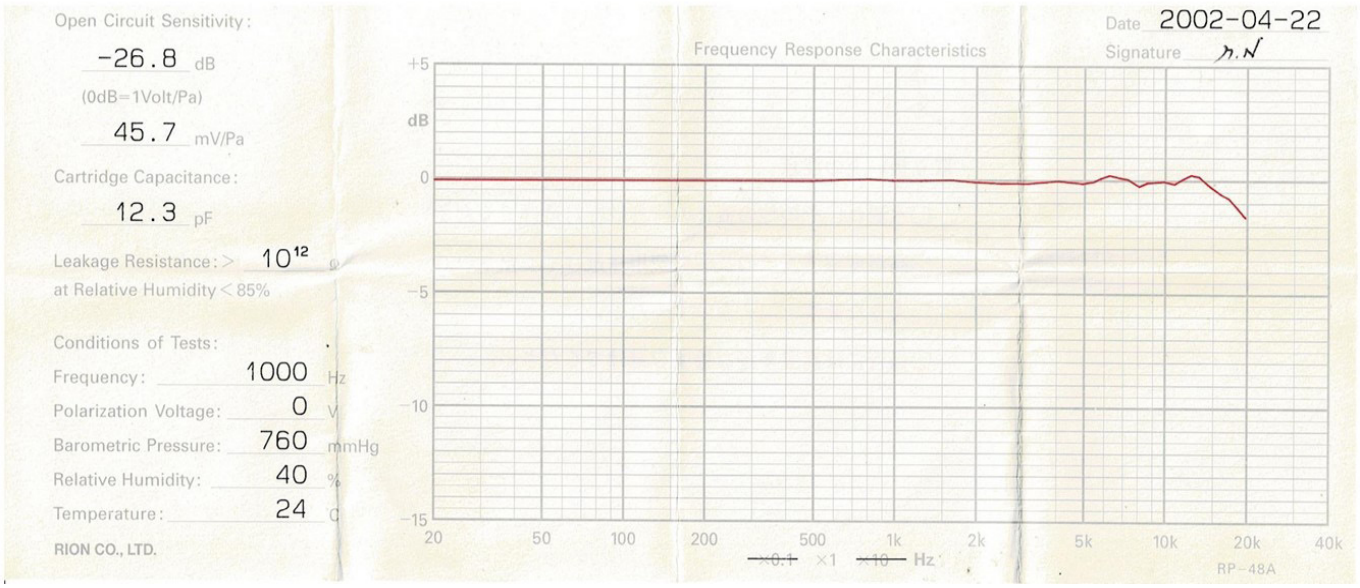
A microphone is distinguishable by the voltage value produced when a known, constant root mean square sound pressure is applied. This is known as microphone open-circuit sensitivity.

The sensitivity of a microphone is defined as the amplitude (in mV) of the output signal for an incident sound pressure of amplitude 1 Pa (94,0dB) at 1 000 Hz.

The SLM manual will indicate the precise nominal sensitivity the microphone shall have for that specific SLM.

Please see below an example of the microphone's manufacture calibration chart:

With each purchase of "New" microphone or SLM Kit, the manufacturer shall supply the unique manufacturer calibration certificate for the microphone.



Each microphone's manufacturer's calibration certificate shall be filed, not just for comparison evaluation for the calibration laboratory testing the open-circuit sensitivity of the microphone but also for the purpose of history and drift of the microphone.

When a sound level meter is calibrated by a calibration laboratory the microphone and the sound level meter are calibrated as a unit and should therefore only be used in that manner.

The microphone's frequency range determines the useful frequency range of the sound level meter and vice versa.

Example: *If a microphone was calibrated electro-acoustically with a sound level meter (and complies/ conforms) and the microphone's frequency range (only conformed to the relevant IEC clause form) 500 Hz to 4 kHz. This in effect, limits the use of the sound level meter to within that frequency range. Measurements that are made outside the 500 Hz to 4 kHz frequency range will be null and void.*

The general minimum frequency range over which a type 1 microphone shall be calibrated and tested shall be as follows:

a) for sound level meters complying to IEC 60651: 63 Hz to 8 kHz; and

b) for sound level meters complying to IEC 61672: 125 Hz, 1 kHz, 4 kHz or 8 kHz.

NOTE: *Refer to 11.8 of SANS 61672-3. Frequency points are dependent on available correction data and the choice between 4 kHz or 8 kHz are at the discretion of the testing laboratory.*

When industry specific applications require the frequency range to extend beyond the minimum range, it should be identified and captured in the client contract review process.

Personal Dosimetry

Where a personal sound exposure meter, or such an instrument referred to by any other name, has been specified by the manufacturer according to IEC 60651:2001, IEC 60804:2000 and IEC 61252, then the instrument may be calibrated according to IEC 60651 and IEC 60804:2000 or according to IEC 61252, as relevant.

Should an instrument not display sound exposure, in accordance with IEC 61252, then the manufacturer shall provide an alternative means to obtain the measurement data from the instrument.

For compliance to IEC 61252, tests shall be performed for sound pressure level (dB) as well as sound exposure (Pa^2s).

NOTE: *IEC 61252 specifies acoustical and electrical performance requirements for personal sound exposure meters of only one accuracy grade. This accuracy grade corresponds to that of an integrating sound level meter which complies with the type 2 requirements of SANS 61672-1 and SANS 61672-2 for an A-weighted sound pressure level range from 80 dBA to 130 dBA and a nominal frequency range from 63 Hz to 8 kHz.*

Acoustic Calibrator

Is an instrument that provides a reference noise source that is used to calibrate and check the performance of a SLM, ISLM and Personal Dosimeter.

A calibrator should comply with the requirements prescribed for a type 2 calibrator in SANS 60942.

The sound calibrator needs to be calibrated annually.

A field acoustic calibrator cannot check:

- whether your noise instruments work at a wide range of frequencies.
- acoustic parameters such as exposure, LA_{eq} and LC_{peak}
- That octave band filter are working correctly.
- whether your microphone is working at a range of frequencies also testing of the open circuit sensitivity.

A change in atmospheric pressure can alter the calibration levels slightly. The manufacturer's manual will indicate if any corrections should be applied.

Example of minimum information to be recorded:

Instrument Type Mode	Serial No	Instrument calibration date	ENVIRONMENTAL CONDITIONS				Pre-shift calibration	Post-shift calibration check	Calibration difference	Accept: Yes / No Variance to be less than 1dB(A)
			Temperature pre-shift	Humidity pre-shift	Temperature post-shift	Humidity post-shift				
Type	SN xxx xxx xxx	dd/mm/yy	wb C° db C°	%	wb C° db C°	%	xx dB(A)	xx dB(A)	xx dB(A)	xx dB(A)

RUN-TEST (BATTERY) ON PERSONAL NOISE EXPOSURE METERS

To preserve the life of the internal battery, it is recommended that the dosimeter is turned off when it is stored. It is best not to store the dosimeter for any period in low battery state condition. Generally, the dosimeter should be stored at room temperature, charged to about 40% to 60% capacity. It is best to charge the dosimeter in docking station charger prior to storage for a prolonged period that is longer than 3 months.

If the dosimeter is to be stored for an even longer period, it is best to take the instrument out of storage and re-charge every two to three months. Charge the dosimeter before attempting to turn it on if the dosimeter has not been used for a prolonged period or was stored in a low battery condition.

It is recommended that frequent internal battery tests are performed on noise dosimeters to ensure that the internal battery are healthy and would record a full shift of measurements. A battery health check is necessary for you to determine whether you need to charge your battery or replace it with a new one.

This is done by running the instrument in a controlled environment for a minimum of 18 hours and checking if the instrument battery indicates any diagnostic concerns, for example: “charge temperature too high”; “battery failed”.

PRE- AND POST-CALIBRATION

By means of a sound calibrator, the acoustic sensitivity of the meter immediately before and after each series of sound level measurements should be checked and the results of the sound measurements should be discarded if the two checks do not coincide to within 1,0 dB.

If measurements are conducted over extended time periods for each series, acoustic sensitivity checks should be conducted at regular intervals, i.e., at least once or twice a day.

The level on which the sound level meter/dosimeter has been calibrated will usually be 94,0 dB/114 dB, however, the level will be indicated on the acoustic calibrator.

NOTE: *A record-keeping system should be incorporated, and calibration certificates, as well as pre and post-calibration results should be recorded, kept and readily available.*

NOTE: *The calibrator is a battery-operated sound source and only provides a reference frequency and a reference level to enable the operator to reference his noise-measuring instrument for a reference point in the acoustics field. It DOES NOT calibrate your sound level meter/noise dosimeter according to the prescribed calibration IEC standards designed for each instrument.*

Always calibrate the instrument without the windscreen or windsock.

Use a windscreen of a type specified by the manufacturer as being suitable for the microphone and which does not detectably influence the accuracy of the meter under the ambient conditions of the test.

Be sure to use only the $^1/_2$” Microphone adaptor and $^1/_4$” Microphone adaptor designed specifically for the specific calibrator. Using another adapter may cause incorrect calibration.

Precaution:
The manufacturer will specify in which circumstances the SLM can be used to measure noise within the manufacturer’s specifications, for example:

Warm-up time:	< 5 seconds for 0,5 dB < 10 seconds for 0,1 dB
Effect of humidity:	0,5 dB for humidity higher than 30% and smaller than 90%
Effect of temperature:	0,5 dB for temperature bigger than -10°C to 50°C

If the temperature of the sound level meter is significantly different from the ambient temperature where it will be used, it should be first warmed up before calibration and use.

A change in atmospheric pressure can alter the calibration levels slightly. The manufacturer’s manual will indicate if any corrections must be applied.

The calibration (reference point) must be checked at the end of the session. If the sound level meter is not calibrated anymore, the data might have to be discarded and the reasons for this calibration change should be investigated as this might indicate an important malfunctioning of the sound level meter.

STORAGE, HANDLING AND TRANSPORTATION OF EQUIPMENT

It is obvious that great care must be taken of the instruments. They should not be exposed to extremes of temperature or to direct sunshine. The manufacturer usually defines the limits that the instruments can stand. The operating range of temperature should also be specified: it is usually narrower.

Instruments should also not be exposed to extremes of humidity, and any condensation should be carefully avoided. This means that the instrument should not be taken from a cold environment (a cold car in wintertime for instance) directly to a hot and humid place. If the temperature of the instrument is lower than the dew point of this environment, condensation might occur, provoking short-circuits or general malfunctioning that might be unnoticed.

The problem is of greater importance for microphones. Condensation on the membrane might in the short term induce erroneous measurement; in the long term however, oxidation of the membrane develops, and small holes might appear in this case, the microphone must be replaced.

Before going from a cold to a hot environment, the instrument, in its tight box, should be progressively brought to a temperature near that of the new environment and certainly well above its dew point.

This means also that the equipment should not be left in the cold overnight or transported in the trunk of a car. The equipment should also be stored in a normal temperature (10 to 25°C) and dry (30 to 70% relative humidity) environment. Microphones should be taken care of by surrounding them with desiccating capsules.

Measuring instruments should not be exposed to vibration for obvious reasons. This implies that they should always be stored, handled, and transported in their original box with damping materials such as plastic foam around them. This is also a further reason for not transporting them in the trunk of a car.

Batteries should be removed from the instrument when it is not used for a prolonged period. Non rechargeable batteries should be checked regularly and replaced as soon as they are flat, otherwise they might leak which might corrode and completely wreck the instrument. Rechargeable batteries must be kept fully charged as far as possible.

The batteries of an instrument make a single set which must be charged together. Individual batteries should not be interchanged between sets and the whole set needs replacement when worn.

The manufacturer should be consulted regarding how to charge the set, with what adaptor, at what rate, and how many times this can be done. For instruments powered by mains, the voltage must be kept in the range indicated by the manufacturer. A stabilised supply might be needed if the voltage fluctuates too much.

Care must also be taken with microphone threads while screwing it onto sound level meters.

Finally, the manual of each instrument might give special instructions concerning its handling, the storage, and the maintenance. This must not be overlooked but must be practiced during the entire life of the instrument.

UNCERTAINTY OF MEASUREMENT – NOISE SURVEY

The following environmental conditions can affect the accuracy of noise data and should be taken into consideration:

1. Temperature
2. Humidity
3. Atmospheric pressure
4. Wind and dust
5. Reflecting surfaces
6. Electromagnetic field
7. Vibration
8. Background noise

Around the world, the GUM method is used to estimate measurement uncertainty.

You can download it here:
https://www.bipm.org/en/publications/guides/

ISO 9612 Acoustics – Determination of occupational noise exposure – Methodology is also a standard which addresses uncertainty of measurement complete with different examples.

CALIBRATION OF EQUIPMENT

When calibrating your SLM or noise dosimeter using an acoustic calibrator, only one level and one frequency are checked, whereas when you are undertaking a real noise measurement, your instrument will be recording a wide range of frequencies, functions and levels which are combined to provide the noise parameters that you need.

Therefore, regular recalibration also known as Periodic Verification is essential to ensure that all the features and functions of your noise equipment are working as intended by the manufacturer. Calibration (or recalibration) carried by a calibration laboratory "periodically" is to check if the instruments is performing as expected and complying to the relevant standards.

Ensure that all items of sound measuring equipment used are calibrated against the requirements of IEC 60942, IEC 61672, IEC 61252 (by an accredited facility as prescribed standards as indicated on the back of the instrument), at intervals not exceeding one year for the sound calibrator, and two years for the rest of the equipment.

When the instruments are received for calibration at the calibration laboratory, an initial visual inspection of the instruments should be performed to ascertain if the instruments have been damaged. During this inspection, the protection grid and diaphragm of the microphone should also be inspected for any dents, deformities, tears etc.

Should any defects be present, it is recommended to replace the microphone with another suitable (equivalent) microphone, as the microphone is precision engineered to have a certain calculated effect on the sound field to which it is subjected.

Any deviation in the deviation of the microphone's physical dimensions may result in undesirable effects caused within the sound field it is subjected to and ergo unreliable measurements.

NOTE: *The microphone's diaphragm may not appear as being damaged, but it can still be less sensitive due to shocks incurred or of being subjected to extreme environmental conditions or abuse, causing the diaphragm to stretch.*

NOTE: *If equipment were repaired, it should not be taken out into service before a comprehensive calibration had been undertaken in accordance with the set standards, and a calibration certificate should be produced.*

CALIBRATION LABORATORY

Accreditation provides assurance that a third party independently verified the laboratories processes.

The scope of accreditation for the calibration laboratory should:

- Provide traceability in accordance with the relevant national legislation
- Implement and maintain a quality management system in accordance with SANS 17025
- Be accredited by a recognised accreditor

The calibration laboratory must be compliant with regards to having implemented a quality management system according to IEC 17025, this however does not indicate the laboratory compliant to calibrate acoustical instruments.

An accredited calibration is a calibration that is within an ISO/IEC 17025 accredited laboratory approved scope of accreditation which demonstrates the lab's technical competence to perform those measurements.

A laboratory must have the specific measurement standard on their Scope of Accreditation to be able to state accredited compliance.

NOTE: *In all instances when reference is made to a calibration laboratory in this guidance note, it is implied that the laboratory has proven via the formal structures available to be competent.*

ORIGINAL EQUIPMENT MANUFACTURER CERTIFICATE/FACTORY CALIBRATION DATA SHEET "ISO 9001 CERTIFIED"

ISO 9001 is defined as the internationally recognised standard for Quality Management Systems (QMS). It is the most widely used QMS standard in the world. ISO 9001 provides a framework and set of principles that ensure a common-sense approach to the management of your organisation to consistently satisfy customers and other stakeholders. In simple terms, ISO 9001 certification provides the basis for effective processes and effective people to deliver an effective product or service time after time.

A non-accredited calibration (obtained from the manufacturer), also referred to as a "commercial calibration" has the following attributes:

- A certificate of calibration will be issued. The certificate will however not have an accreditation logo or a statement of traceability.
- Basic information that identifies the instrument, calibration/due dates, a statement of conformance either being in or out of tolerance, laboratory and technician performing the calibration.
- Laboratory assets used and the environmental conditions.
- May or may not contain the actual data report depending on if this was specified at the time of service.
- ISO 9001 is not an accredited standard for noise instruments, but a QMS.

VERIFICATION CERTIFICATE

- Verification is an activity that is technology specific and usually involves examination, inspection, testing and reviewing a product to establish that it meets the fit for the purpose for which it was designed.
- Tests are normally conducted with a standard acoustic calibrator at the reference sound pressure level of 94,0 dB/114,0 dB at 1 000 Hz.
- No compliance to an IEC standard will be reported and the uncertainty of measurement will not be within the uncertainty of measurement tolerances indicated in the IEC standards. Compliance to the standard will be on the onus of the client.

SANAS CALIBRATION CERTIFICATE OF COMPLIANCE

The main differences for an accredited calibration are:

- The parameter is on the laboratory's scope of accreditation.
- An accreditation logo will be present on the calibration documents.
- The calibration will be traceable to SI units through NIST or other National Metrology Institutes (NMI).
- Most importantly, the data report includes the measurement data and measurement uncertainties.

The guideline for the compilation of a mandatory Code of Practice for an Occupational Health Programme for Noise states that an accredited laboratory must be used, and it requires an accredited calibration.

ISSUED/REPORTING OF RESULTS ON CALIBRATION CERTIFICATE

Calibration certificate shall be issued according to R-79 "REQUIREMENTS FOR THE ISSUE OF SANAS CALIBRATION CERTIFICATES." Where limitations are applicable it should be clearly stated and reported on the certificate.

The wording of certificates should be clear and unambiguous regarding the statement of conformance or non-conformance.

Conformance to a performance specification is demonstrated when the following criteria are both satisfied:

1. Goal does not exceed the applicable acceptance limit, and
2. The corresponding uncertainty of measurement does not exceed the corresponding maximum-permitted uncertainty of measurement given in the IEC standard for the same coverage probability of 95%.

STATEMENT OF UNCERTAINTY OF MEASUREMENT

A laboratory may, at its own discretion, state an uncertainty for each measurement or state a global uncertainty for a group of measurement(s) or parameter(s).

The measurand plus the uncertainty of measurement shall be within the stated tolerances given in IEC 60942, IEC 61672-1, and IEC 61672-3; IEC 61252 as applicable.

For laboratories performing periodic tests, the uncertainties associated with all measurements shall be determined in accordance with the procedures of ISO/IEC Guide 98-3.

Actual measurement uncertainties shall be calculated for a coverage factor of 95%.

Laboratories performing pattern evaluation tests or periodic tests shall demonstrate that the uncertainties of measurements do not exceed the corresponding maximum-permitted uncertainties given in the appropriate international standards.

Conformance to a performance specification is demonstrated when a measured deviation from a design goal equals or does not exceed the corresponding acceptance limits and the laboratory demonstrated that the associated uncertainty of measurements equals or does not exceed the maximum permitted uncertainty.

Where no uncertainty tolerances are indicated by the IEC standards, the calibration laboratory shall ensure that its uncertainties will not result in a statement where no conformance or non-conformance cannot be stated because of the calibration laboratory's expanded uncertainty being too large.

See Annexure attached for explanation/example.

REFERENCES:

- SABS STANDARDS DIVISION: ARP 0109:2014
- SABS STANDARDS DIVISION: SANS 10083
- SABS STANDARDS DIVISION: SANS/IEC 17025
- SABS STANDARDS DIVISION: SANS/IEC 60942
- SABS STANDARDS DIVISION: SANS/IEC 61672-1
- SABS STANDARDS DIVISION: SANS/IEC 61672-3
- SABS STANDARDS DIVISION: SANS/IEC 61252

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Calibration Laboratory
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Details of the laboratory conducting the calibrations

CERTIFICATE OF CALIBRATION

Certificate number	*(Unique certification number according to R79-04)*
Organisation	*(Name of client/company according to R79-04)*
Organisation address	*(Physical address of client/company according to R79-04)*
Calibration of	*(Description of the equipment calibrated according to R79-04)*
Manufacturers	*(Details of equipment certified)*
Model numbers	*(Details of equipment certified)*
Serial numbers	*(Details of equipment certified)*
Software version	**SANS 10083:2021 indicated in Clause 8.2:** **Note:** If the equipment is repaired, any part replaced, or the firmware updated it should not be put into service before a comprehensive calibration is undertaken in accordance with this clause.
Date of calibration	12 – 17 August 2022 *(Date of Calibration performed)*
Recommended due date	August 2024 (see **remarks** 4.7)
Page number	Page 1 of 6 *(Number of pages according to R79-04)*

This certificate is issued in accordance with the conditions of approval granted by the South African National Accreditation System (SANAS). This Certificate may not be reproduced without the written approval of SANAS and SANAS Accredited Laboratory.

The measurement results recorded in this certificate were correct at the time of calibration. The subsequent accuracy will depend on factors such as care, handling, frequency of use and the number of different users. It is recommended that re-calibration should be performed at an interval, which will ensure that the instrument remains within the desired limits and/or manufacturer's specifications.

The South African National Accreditation System (SANAS) is member of the International Laboratory Accreditation Cooperation (ILAC) Mutual Recognition Arrangement (MRA). This arrangement allows for mutual recognition of technical test and calibration data by member accreditation bodies worldwide. For more information on the arrangement please consult **www.ilac.org**.

Calibrated by Calibration Technician:	*(Technician performing the calibration)*	
Authorised/Checked by SANAS Technical Signatory:	*(Accredited Signatory authorised by SANAS)*	Date of Issue: *(Issue date of Certificate)*

PROCEDURE

A brief description to explain which procedures and IEC standards were used as calibration method – the IEC standard will correspond to the IEC standard indicated by the Manufacturer for the specific equipment calibrated.

NOTE: *If your equipment consists of Octave filters, the octave filters shall be calibrated against IEC 61260.*

Calibration against IEC 61672 is only calibration on the Sound Level Meter section.

MEASURING EQUIPMENT

JFW	50BR-022	50 Ohm Step attenuator	7343951614
Agilent	335522A	Function generator	MY 50005443
Onset	UX100-011	Environmental logger	20477474
Agilent	34461A	Digital multimeter	MY 53223905
Gems	PD6000-6RO	Pressure sensor	1606-0204475
B&K	4226	Multi-functional calibrator	2912645

Calibrations performed by this laboratory are in terms of standards, the accuracies of which are traceable to national measuring standards as maintained by NMISA.

Statement of traceability is mandatory according to:

SANS R79-04 clause 5.18 indicates:

Include a statement identifying how the measurement results are metrologically traceable. In addition, it is also recommended that a list of the measurement standards, and their calibration status, used to perform the calibration be listed in the calibration certificate.[1 § 7.8.4.1 c)]

SANS 10083-2021 Clause 8.2.1.2 indicates:

The calibration laboratory should:

a) Prove traceability to the relevant national measurement standards in accordance with the relevant national legislation (see foreword),

b) Implement and maintain a quality management system in accordance with SANS 17025, and

c) Be accredited by the relevant national body (see foreword) for the parameters applicable to sound level meters, sound calibrators and personal sound exposure meters.

Calibrated by Calibration Technician:	*(Technician performing the calibration)*	
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RESULTS – ACCORDING TO THE IEC IEC 61252:2017:

(List of tests performed by the calibration laboratory – these tests are mandatory according to the IEC standard the equipment's designed to by the Manufacturer, more information will be available in the equipment's manufacturer's manual)

The integrating sound level meter was calibrated to the following parameters:

Parameter	Specification	Uncertainty of measurement in dB
Input sensitivity	Manufacturer's specification	± 0,3
Amplitude linearity (at 63 Hz, 1 kHz and 8 kHz from 70,0 dB to 140,0 dB)	IEC 61252: Clause: 8 and Annex B2	± 0,3
Weighting network A (31,5 to 8000) Hz	IEC 61252: Clause: 7 and Annex B3	± 0,3
Integrating (Time averaging and short duration signals)	IEC 61252: Clause: 9 and Annex B4	± 0,3
Unipolar signals – Peak C	IEC 61252: Clause: 10 and Annex B5	± 0,3
Overload indication	IEC 61252: Clause: 11 and Annex B6	± 0,3

Conclusion: The Noise Dosimeter compiled with the relevant clauses of the IEC 61252:2017 specifications, recommended tests and requirements according to ARP 0109:2014.

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The following parameter of the 1/2" MEMS microphone was calibrated electroacoustically on A-weighted sound pressure level – fast, and the results were corrected to the environmental conditions of 1013,25 mBar and 20'C, free-friend corrections were taken into consideration:

Frequency (Hz)	Calculated expected value (dB)	Measured value (dB)	Deviation (dB)
1 000 (Ref)	114.0	114.0	0.0
31,5	74.4	75.9	+ 1.5
63	87.8	89.0	+ 1.2
125	97.8	98.9	+ 1.1
250	105.3	106.1	+ 0.8
500	110.6	111.1	+ 0.5
1 000	114.0	114.0	0.0
2 000	114.7	114.4	- 0.3
4 000	113.7	114.0	+ 0.3
8 000	108.2	109.4	+ 0.3

The uncertainty of measurements was estimated to be: ± 0,3 dB

Conclusion: The 1/2" MEMS microphone, complied with the manufacturer's specification for the frequency range of 31,5 Hz to 8000 Hz, Class 2.

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REMARKS

The reported expanded uncertainties of measurements are based on a standard uncertainty multiplied by a coverage factor of k = 2, providing a level of confidence of approximately 95.45%, the uncertainties of measurements have been estimated in accordance with the principles defined in the GUM (Guide to Uncertainty of Measurement) ISO, Geneva, 1993.

Calibration labels bearing calibration date, due date (if requested), certificate number and serial number have been affixed to the instrument.

The above statement of conformance is based on the measurement values obtained, extended by the estimated uncertainty of measurement, being within the appropriate specification limits.

The above specified noise dosimeter and 1/2" MEMS microphone's frequency range determines the useful frequency range of the noise dosimeter and vice versa.

No specific setup file was loaded on the instrument.

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THE END OF CERTIFICATE