Approval and Authorization

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Periodic Review Approval and Authorization

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1 OVERVIEW CONTENT

1.1 Process Overview

Calibration laboratories accredited by KENAS must demonstrate that they have complied with the requirements of the international standard ISO/IEC 17025:2005. In addition, this specific criterion lays down those specific requirements in the field of Temperature Metrology.

Calibration laboratories seeking KENAS accreditation in the field of Temperature calibration must comply with the requirements stated in this criteria guideline, KENAS Terms and condition documents and applicable government regulations and any other applicable statutory requirements.

1.2 Purpose

The purpose of this document is to define the specific environmental, general and technical requirements to be met by laboratories to be accredited in the field of Temperature calibration and includes those laboratories which perform electrical simulations of temperature instrumentation.

1.3 Scope

This document covers the application of the ISO/ IEC 17025 for accreditation of Temperature laboratories. This document should be read in conjunction with the Rules and Procedures of KENAS.

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1.4 Role(s) and Responsibility

Role	Responsibility
Testing and Calibration Team	• Development of draft for Technical Committee Review. • Administration of Periodic review
Testing and Calibration Technical Committee	• Technical Draft Review and approval

Assessors and Technical Experts	• Ensure that Accredited labs comply with the requirements in this guidance document

2 DEFINITIONS / ABBREVIATIONS

The table below defines new or changed terms that are included in or associated with this process.

Term	Definition
KENAS	Kenya Accreditation Service
CEO	Chief Executive Officer
MR	Management Representative
KEBS	Kenya Bureau of Standards
NMI	National Metrology Institute
NSB	National Standards Body
TC	Technical Committee
ISO	International organization for standardization.
CMC:	Calibration and Measurement Capability
CJC:	Cold Junction Compensation
K:	Kelvin
LIG:	Liquid in Glass
UUT:	Unit under Test
RTD:	Resistance Temperature Devices
UoM	Uncertainty of Measurement
Reference Junction or Cold Junction:	That junction of a thermocouple which is at a known temperature.
Liquid-in-glass Thermometer:	A temperature measuring instrument whose indications are based on the temperature coefficient of expansion of a liquid relative to that of its containing glass bulb.
Blackbody:	A blackbody is an entity that absorbs all electromagnetic radiation falling upon it. As a perfect absorber, it neither reflects nor transmits, and has an emissivity of 1.
Ice point:	The temperature realized at the equilibrium between ice and water (0 °C). This temperature can be realized, using suitable procedures (Techniques for approximating the International Temperature Scale of 1990 -BIPM - 1990) to within ±5 mK.
Kelvin, K:	Base unit of the temperature in the International System of Units.

Temperature Block Calibrator:	Temperature block calibrators comprise a solid block, with a temperature controller and indicator. The block has borings intended for the calibration of thermometers.
Zone of Homogeneity:	With reference to Temperature Block Calibrators the 'zone of homogeneity' is that zone of at least 40mm in length, normally located at the lower end of the boring into which the thermometer to be calibrated is inserted.
Uncertainty:	The amount by which a true value may differ from a measured value, at a given confidence level.
Repeatability:	The ability of a measuring instrument to provide closely similar indications for repeated applications of the same measurands under the same conditions of measurement.

3 PROCESS INSTRUCTIONS

3.1 Personnel requirements:

3.1.1 The calibration laboratory shall engage staff possessing the technical and professional expertise necessary to perform the calibration. The staff may be full-time, part-time or contracted personnel. The personnel performing the calibration shall satisfy all the requirements defined in clause 5.2 of ISO/IEC 17025:2005.

3.1.2 KENAS accredited and applicant laboratories are required to provide training to their calibration technicians and to their authorized signatories to comply with the requirements of ISO/IEC 17025:2005. The calibration laboratory shall evaluate and appraise the calibration technicians to be competent before allowing them to perform calibration work independently. Effectiveness of trainings undertaken shall be evaluated.

3.2 Environmental and Accommodation Requirements:

3.2.1 To be deemed capable of making adequate measurements, calibration laboratories shall provide an environment with adequate environmental controls appropriate for the level of measurements to be made as required by clause 5.3 of ISO/IEC 17025:2005.

3.2.2 The laboratory shall be maintained at a temperature of 23°C ± 5°C. Where measurements are performed outside this specified limit, the laboratory shall produce documented evidence that the results have been validated, for example when measurements are performed on-site.

3.2.3 Rates of change and gradients of the ambient temperature must be kept to below 2 °C per hour.

3.2.4 Reference temperature measuring devices shall be kept secured in a suitable environment.

3.2.5 Lighting within the laboratory shall be adequate to facilitate the correct performance of the calibration work undertaken. Cognizance shall be taken of the minimum levels of lighting as specified in clause 50 of the Occupational, health and Safety bill (OSHA Act 2007).

3.2.6 Housekeeping: Calibration laboratory shall have adequate space, be free from dust and fumes, free from vibration and acoustic noise and free from any contamination especially in locations where calibration items are calibrated.

3.2.7 The extent to which these environmental factors apply will vary according to the uncertainty to which calibrations are performed.

3.2.8 Where necessary the laboratory shall maintain appropriate records to demonstrate and confirm the environmental conditions within the laboratory.

3.3 Safety Requirements:

All Metrology and Calibration laboratories are expected to comply with the Occupational Safety, health Act 2007 and any other health and safety requirements which shall apply.

3.4 General Requirements:

3.4.1 All in-house calibrations and checks shall be carried out to a documented procedure, and the results, together with the estimate of the uncertainty of the measurement, shall be recorded and retained.

3.4.2 The laboratory shall measure the output of the UUT in the units applicable. Generally, the units will be °C, with certain exceptions such as thermocouples, the output being measured in μVolts or millivolts, resistance thermometers, the output being measured in ohms, temperature transducers the output in mA. In the case of temperature calibrators, the units may be °C, or the applicable electrical units.

3.4.3 The laboratory shall be required to have MSDS for all standards fluids, and chemicals and hazardous cleaning materials used within the laboratory, for example, but not limited to acids, organic solvents, salts, temperature bath fluids, etc.

3.4.4 If the laboratory either uses or calibrates Liquid-in-Glass thermometers they shall have an MSDS for Mercury, and a procedure describing how mercury spills are to be cleaned up.

3.4.5 Laboratories shall have a policy and procedure/s that addresses how Thermometers, both their own references and those belonging to its customers are to be handled, cleaned and stored in order to ensure their ongoing integrity.

3.4.6 The laboratory shall be equipped with suitable isothermal heat sources such as stirred liquid baths, furnaces, and/or block calibrators for the calibration of temperature sensors.

3.4.7 Where digital multimeters are used to measure the output of thermocouples, transmitters, and RTD's, the specification of the digital multimeter shall be used in the estimation of the UoM, unless it can be shown that sufficient measurements over the applicable measurement range (mV, mA, Ω) have been made by the calibrating laboratory, allowing for interpolation and correction where applicable, and subsequently the use of the UoM specified by the calibrating laboratory

3.4.8 Raw data shall be recorded in a non-erasable ink.

3.5 Technical Requirements:

3.5.1 **Traceability of Measurement:**

Traceability of a measurement result is ensured when the result can be related to a stated reference through a documented unbroken chain of calibrations, each contributing to the measurement uncertainty. The stated reference at the end of the chain is expected to be one or more CMCs held by national metrology institutes (NMIs) and based on practical realizations of the International System of Units. Calibrations recognized by KENAS as traceable to national standards shall be evidenced by appropriate calibration certificates, and can be provided:

(a) By the National Metrology Institute or the National Standards Laboratory of another country that is covered by a mutual recognition agreement under ILAC or,

(b) By a KENAS accredited calibration laboratory or,

(c) By an accredited calibration laboratory accredited by an overseas body that is party to the international multilateral agreements for accreditation bodies or,

(d) In-house using documented procedures that have been assessed as appropriate by KENAS. This might be through the use of reference standard thermometers owned by the laboratory.

3.5.2 Uncertainty of measurement:

3.5.2.1 The calibration laboratory shall perform a measurement or series of measurements on the thermometer using the same calibration method, apparatus, and personnel that it uses to calibrate its customers' equipment. The laboratory shall be able to identify and quantify all sources of uncertainty that affect the measurement. The laboratory shall attach an overall uncertainty to the measurement by combining all uncertainty contributions, in their type A and type B components.

3.5.2.2 The Laboratories shall supply (and have available) for evaluation all relevant data of the Thermometer, such as specification sheets, used in the determination of the CMC, along with copies of the Uncertainty of Measurement estimation. All relevant factors shall be considered, and only after confirmation that the contribution is insignificant may they be omitted from the estimation. This process shall be documented.

3.5.3 **Calibration and check intervals:**

3.5.3.1 The frequency of calibration shall depend on the type of Thermometer and its use. The Thermometer shall be calibrated fully at least once a year, unless sufficient evidence has been obtained to show that the thermometer has remained well within acceptance limits and that the interval can be extended.

3.5.3.2 Regular checks (intermediate checks) may be required between full calibrations, dependent upon use and intervals between full calibrations. Results of intermediate checks shall be recorded.

3.5.3.3 Full calibrations shall be performed after a significant change In the laboratory’s environmental conditions or a change in the properties of the thermometer. Intermediate checks, or full calibrations, shall also be performed when there is any reason to believe that any other change has occurred which may affect the accuracy of the thermometer.

3.5.4 Calibration of Liquid in Glass Thermometer:

3.5.4.1 Reference thermometers shall be selected having regard to the precision and range of measurement required of the working thermometer(s) to be calibrated.

3.5.4.2 Where the accuracy of temperature measurement has a significant effect on the test result (or on its uncertainty or validity), a valid calibration certificate shall be held for the working thermometer. Alternatively, it shall be calibrated in-house against a reference thermometer (or thermometers) held by the laboratory.

3.5.4.3 Working thermometers shall be monitored by periodic checks at the reference point. Calibration shall be carried out after a determined period by the laboratory, or sooner if the checks at the reference point indicate that a change, significant in terms of the uncertainty of the original calibration, or in excess of a documented permitted change since the previous calibration, has taken place.

3.5.4.4 New thermometers may be subject to changes due to stabilization of the bulb volume. These are likely to be greatest during the first year of use, and reference point checks shall be carried out at smaller intervals during this period

3.5.4.5 The procedure/s for calibration of LIG thermometers shall describe complete, partial or/and total-immersion of the thermometer, and shall include the method for the calculation of emergent liquid column corrections where appropriate.

3.5.4.6 The calibration procedure shall include a visual inspection of the thermometer for gross defects such as missing graduations, broken column, and separations in the thermometric liquid or if the thermometer had been stored or used improperly, exposed at some length to sunlight or heat, or if its accuracy is otherwise in question.

3.5.4.7 The calibration procedure shall include the method for handling, storage and transportation of LIG thermometers.

3.5.4.8 The Calibration procedure shall describe how during calibration, the thermometer shall be immersed in the calibration bath to ensure accurate measurements and to avoid a systematic error linked to the height of the emergent column above the surface of the bath.

3.5.4.9 A magnifying eyepiece and suitable light source may be used to reduce parallax errors and increase readability.

3.5.4.10 It must be noted that block calibrators, may not be suitable for the calibration of total immersion liquid-in-glass thermometers, since, in most cases, these cannot be immersed to the appropriate depth required over the full temperature range.

3.5.4.11 For any on-site calibration, working thermometer standards shall be checked or calibrated against reference standard before and after onsite measurements to ensure metrological properties. Working thermometers shall be handled with care to avoid generation of mechanical stress.

3.5.4.12 No laboratory shall be accredited to perform on site calibration of LIG thermometers unless they also have the capability to perform the calibration in their own laboratory, and their measurement capability is based on the equipment which they have in their own laboratory. This equipment shall include but is not limited to standard working thermometers and reference thermometers.

3.5.5 **Calibration of Thermocouples**:

3.5.5.1 The thermocouple shall be inspected (temperature sensor, digital display, wires or leads, and plugs) for signs of wear or damage; the batteries shall be checked if they are at full voltage.

3.5.5.2 Calibration shall ensure that the effects due to the influences listed below are minimised. These influences shall be taken into account when calculating the uncertainty of measurement stated in the calibration certificate. The influences are:

- Poor contact or heat conduction along the thermocouple (lack of immersion)
- Variation of temperature with time and spatial temperature distribution in the thermal source
- Temperature variation in the cold (reference) junction
- Parasitic thermo voltages, e.g. arising in connectors or from the use of a scanner or selector switch
- Effects due to the use of extension or compensating cables
- Electromagnetic interference
- Mechanical stresses or deformations
- Inhomogeneity
- Oxidation or other chemical contamination
- Changes in alloy composition, physical condition or crystal structure
- Breakdown of insulation resistance.

3.5.5.3 Every thermocouple which shall be calibrated shall be homogeneous.

Thermocouple to be calibrated shall first be annealed at maximum immersion at the highest temperature of intended use for several hours. Type K thermocouples, which are subject to calibration changes on temperature cycling to 500 °C or above, shall be calibrated at increasing temperatures, and the first calibration point repeated at the end as a check. The same considerations shall apply to a lesser extent to other base-metal thermocouples.

3.5.5.4 Thermocouples shall be calibrated by measurement either at a series of fixed point temperatures, e.g. melting/freezing points or, by comparison with reference or standard thermometers, in thermally stabilized baths or furnaces suitable for the calibration, or by a combination of techniques, e.g. comparisons and fixed-point temperatures.

3.5.6 **Compensation and Extension Thermocouple Calibration**:

3.5.6.1 If, for practical reasons, the length of a thermocouple has to be increased this shall be made by the use of the correct extension or compensating cable. The calibration of compensation or extension thermocouple cable shall take place over a limited range, typically not exceeding 0°C to 70°C. The cables are manufactured to match emf/temperature characteristic of the thermocouple itself but over a restricted temperature range, no wider than -40 °C to +200 °C. Manufacturing tolerances are specified in EN IEC 60584-3.

3.5.6.2 These cables shall be preferably be connected permanently to the thermocouple. Alternatively, connections thermocouple wires are often made using special plugs and sockets (also made of compensating alloys).

3.5.6.3 When a sample of TC cable or TC compensating or extension cable is calibrated and taken to be representative of a reel or length of cable, the laboratory shall address the requirements for sampling as specified in Clause 5.7 of ISO/IEC 17025:2005.

3.5.7 **Reference (cold) junction**:

3.5.7.1 The laboratory shall have procedure for the preparation of the ice point reference which shall include the method of preparation, the type and grade of water to be used, appearance, and expected uncertainty.

3.5.7.2 An Ice point prepared with reasonable care should reproduce 0°C ± 0,05°C or better.

3.5.7.3 If a reference temperature other than 0 °C is used with a thermocouple having a calibration referenced to 0 °C, the emf corresponding to the reference temperature chose shall be added to the measured emf output of the thermocouple. It is not possible to use the temperature of the reference junction as a correction.

3.6 Resistance Thermometer Calibration

3.6.1 The laboratory shall have and apply procedure for the calibration of resistance thermometers and shall address the following as a minimum:

- Depth of immersion;
- Temperature variation of the thermal source;
- Time and spatial temperature distribution of the thermal source;
- Annealing;
- Connection configuration and color coding;
- Self-heating;
- Initial inspection (obvious defects, contamination, etc.)
- Calibration of digital multimeters or direct reading temperature indicators;

- Possible loading effects when using a digital multimeter.

3.6.2 The annealing of a resistance thermometer shall take place with the consent of the customer and shall be recorded as part of the contract review process.

3.6.3 Where no other requirement has been specified by the customer the thermometer shall be allowed to cool by:

- For thermometers used only up to approximately 450°C, they may be removed from the heat source and allowed to cool down to ambient conditions;
- For thermometers used above that temperature, after annealing the thermometer should be allowed to cool down to 450 ° in the heat source, where-after it may be removed and allowed to cool down to ambient.

3.7 **Digital Thermometer Calibration**:

3.7.1 The laboratory shall have procedure for the calibration of digital thermometers and shall address the following as a minimum:

- Depth of immersion;
- Temperature variation of the thermal source;
- Time and spatial temperature distribution of the thermal source;
- Temperature variation of the cold (reference) junction;
- Electromagnetic interference;
- Initial inspection (obvious defects, contamination, etc.).

3.7.2 Typically hand held digital thermometers use either TC type K, RTD Pt 100, or thermistor temperature sensors. Subsequently range, stability and accuracy will differ between all of these types, and cognisance of these differences shall be considered when the UoM is estimated.

3.7.3 When a digital thermometer is calibrated with a temperature probe, both the thermometer and probe shall be uniquely identified. If the probe is detachable, or interchangeable the certificate shall include a disclaimer that the calibration is only valid when the digital thermometer is used with the specified temperature probe.

3.7.4 Digital thermometers that include an externally accessible ‘zero’ adjustment, shall have the adjustment screw sealed with a tamper proof sticker, after the calibration has been completed.

3.8 **Mechanical Dial Thermometer Calibration**:

3.8.1 Mechanical dial thermometers can be separated into two distinctive types, those operating with a filled liquid capillary system, and those incorporating a bi-metallic strip, or bi-metallic helical coil.

3.8.2 Mechanical effects due to friction in the transmission and indication may result in a difference in rising and falling temperatures (hysteresis) and this shall be considered during the estimation of the UoM.

3.8.3 The laboratory shall procedure for the calibration of the mechanical dial thermometer and shall address among other things the immersion depth.

3.8.4 In instances where the thermometer is provided with an external means of adjustment to offset changes in the calibration, such as an adjustable dial, or pointer, this adjustment shall be sealed with a tamper proof sticker after the calibration has been completed.

3.9 Calibration of temperature indicators and simulators by Electrical Simulation:

3.9.1 A temperature indicator operates by converting the electrical signal received from a sensor into an equivalent readout in temperature units. The calibration principle is based on the verification of this conversion process by simulation/replacement of the sensor's output by appropriate electrical stimuli.

3.9.2 The laboratory shall have and apply procedures for the calibration of temperature indicators and controllers by electrical simulation.

3.9.3 In the calibration procedure for the temperature indicator, a calibrated electrical source shall be substituted for the temperature sensor. Using reference tables, the electrical output of the temperature sensor at the required calibration point shall be determined and the output of the electrical source set to this level. This electrical signal shall be applied to the temperature indicator and the indicator's reading compared with the simulated input temperature and the error of indication of the temperature indicator determined.

3.9.4 In the calibration procedure of the temperature simulator, the simulator shall be set at the required calibration point. The electrical output produced by the simulator at this setting shall be measured using a calibrated electrical measuring instrument. The measured value shall be converted into the equivalent temperature using reference tables and the deviation of the simulator setting determined.

3.9.5 Procedures shall address the interconnections for calibration purposes of the standard and the UUT. For RTD devices this shall include 2, 3 or 4 wire connections. For TC devices the procedure shall address the use of compensating leads, including their polarity, and the use of reference junctions.

3.9.6 The laboratory shall have copies of all reference tables for all thermocouple types, and resistance thermometers that they are accredited to calibrate. The laboratory shall also have TC color charts available.

3.9.7 The temperature scale used to express temperature values in the calibration certificate shall be clearly stated. Unless requested by the customer the International Temperature Scale of 1990 (ITS-90) shall be used.

3.9.8 The standard reference tables used to convert the electrical signals to temperature values together with their reference/identification numbers shall be stated on the calibration certificate.

3.9.9 For calibrators or simulators capable of measuring and simulating several different type of temperature sensor, the calibration certificate shall clearly indicate the sensor types, and range covered by the calibration, and this should have been agreed with the customer.

3.9.10 Certain temperature calibrators or simulators have a selectable CJC feature, allowing the CJC to be enabled or disabled, or manually set to a temperature such as 0°C or ambient. These instruments may be calibrated using either method. The calibration certificate shall clearly indicate if the results were obtained with the CJC enabled, disabled or manually set.

3.10 Cold Junction Compensation Calibration

3.10.1 Indicator or simulator conversion is compared with temperature-emf or temperature-resistance reference tables. Reference tables for standard thermocouple types are referred to a reference junction temperature of 0°C, usually referred to as the cold junction temperature. Indicators and simulators are often equipped with cold junction compensation (CJC) in order to take account of this. A reference cold junction and thermocouple wires are used, in addition to electrical instrumentation, to calibrate indicators or simulators equipped with a CJC feature.

3.10.2 The laboratory shall have and apply procedures for the calibration of the CJC when this is performed separately to the TC output or input function of the UUT.

3.10.3 The procedure shall take cognizance of the fact that the CJC temperature is measured, usually with a sensor bonded to one of the terminals, and therefore the temperature stability of the UUT is as critical as the stability of an Ice point that may be used as part of the calibration.

3.10.4 The reference standards used in the calibrations shall be calibrated and characterized for the effects of influence quantities over the applicable measuring range.

3.11 **Radiation Thermometer Calibration**.

3.11.1 The laboratory shall have and apply procedure for the calibration of Radiation Thermometers and shall address:

- Spectral emissivity,
- Alignment with the target,
- Size of the source.

3.11.2 Calibration of the reference radiation thermometers (Pyrometers) and reference radiation sources shall be carried out at intervals depending upon the period of use at temperature, but in any case at least every 1 year.

3.11.3 A valid certificate of calibration shall be held for all working radiation thermometers. Alternatively, they shall be calibrated in-house against reference radiation sources, or by comparison with a reference radiation thermometer, operating at the same effective wavelength and measuring a similar effective wavelength and measuring a similar effective area of the radiation source. The interval between calibrations shall depend on the period and temperature range of use but shall not normally exceed 3 months.

3.12 Temperature Block Calibrator Calibration

3.12.1 A temperature block calibrator comprises at least the solid-state block, a temperature-regulating device for the block, a temperature sensor with indicator (the built-in controlling thermometer) to determine the block temperature. These components shall either combined to form a compact unit, or an unambiguous assignment of these components to each other shall be possible.

3.12.2 This Guideline shall only applicable to temperature block calibrators that meet the following requirements:

- The temperature sensor and indicator used to determine block temperature shall meet the requirements which would be necessary, if they were calibrated separately from the block.

- The borings used for calibrations shall have a zone of sufficient temperature homogeneity of at least 40 mm in length (in the following referred to as measurement zone), whose position is exactly specified. The homogeneous zone shall in general be at the lower end of the boring. If the homogeneous zone is situated at another place, this shall explicitly be stated.
- In the temperature range from –80 °C to +660 °C, the inside diameter of the boring or bushing used may be at most 0,5 mm larger than the outside diameter of the thermometer to be calibrated; in the temperature range from +660 °C to +1300 °C, this value may be at most 1,0 mm. As an alternative, an equally good or better thermal contact may be established by suitable heat-conveying means.
- The immersion depth of the thermometer shall at least be equal to fifteen times the outer diameter of the thermometer. Some thermometer constructions may require a larger immersion depth.

3.12.3 The laboratory shall have a calibration procedure that shall cover the following measurements as a minimum:

- ▪ An evaluation of the zone of homogeneity, in the central boring or a specifically identified marked boring;
- The greatest temperature difference between the borings at a specified temperature;
- ▪ Stability over a 30 minute period, after stability has been reached;
- ▪ Calibration against the indicated temperature at a minimum of 3 different temperatures, distributed uniformly over the temperature range excluding ambient. If one of the desired temperatures is near ambient the temperature shall be increased or decreased by approximately 20ºC from ambient

3.12.4 Where any of the above measurements have not been performed this shall be specified on the calibration certificate.

3.12.5 In addition the calibration procedure shall address:

- The outside diameter of the thermometer used to perform the calibration relative to the inside diameter of the boring or bushing;
- The minimum immersion length;
- The use of insulation materials on the top of the block;
- The location of the thermometer in the zone of homogeneity during calibration;
- Heat conduction when using a standard thermometer with a diameter ≥ 6mm.

3.13 Isothermal Evaluation – Autoclaves

3.13.1 The calibration / performance evaluation of a sterilizing autoclave shall be conducted in accordance with the requirements as agreed during the contract review. However, these requirements shall be superseded by regulatory requirements.

3.13.2 It is recommended that a multipoint calibration / evaluation be performed.

3.13.3 Care shall be taken to ensure that the pressure seal of the lid of the autoclave is not damaged, should it be necessary for temperature sensor wires be fed into the chamber via the lid. Individual temperature loggers shall be used instead of conventional temperature sensors (TCs or RTDs) to overcome the problem of gaining access to the chamber.

3.13.4 Since the evaluation of autoclaves is done over elapsed time, the laboratory shall have and maintain a suitable time standard to calibrate the timer of the autoclave. Similarly, a calibrated pressure gauge with manifold and pressure pump can be used for the calibration of the pressure gauge of the autoclave.

3.13.5 A temperature laboratory may apply for limited Time Interval and Pressure accreditation for the calibration of autoclaves only. This accreditation may not be used for any other purpose.

3.13.6 The certificate / report shall include a disclaimer that the calibration / evaluation does not cover the inspection of the autoclave as a pressure vessel that may be required in terms of legislation.

3.14 Isothermal Evaluation – Sterilizers

3.14.1 The evaluation of non-pressurized sterilizers shall be achieved by temperature mapping alone.

3.15 Environmental Chamber Evaluation

3.15.1 The calibration of environmental chambers necessitates the following measurements:

- Variations in space for temperature and % relative humidity
- Variations in time for temperature and % relative humidity.

3.15.2 It is recommended that the humidity is measured at the same point in the chamber where the temperature is measured. Applying humidity calculations to humidity measured in the center of the chamber, based on the spatial temperature measurements, may provide incorrect humidity spatial values.

3.16 Temperature Installations:

3.16.1 Laboratories performing the calibration of temperature indicators, controllers and recorders excluding the temperature probes shall be accredited for electrical simulation.

3.16.2 The calibration may include temperature mapping for large volumes.

3.17 Temperature Recorder Calibration

3.17.1 Laboratories performing the calibration of temperature recorders such as thermo hygrographs or data loggers shall be equipped with a suitable chamber.

3.18 Hotplate Calibration

3.18.1 The laboratory shall have suitable reference surface temperature thermometers in order to perform these calibrations.

3.18.2 The laboratory shall have and apply procedures that describe how the thermocouple measuring tip is to make contact with the measuring surface of the hotplate, and the applicable settling time, necessary to produce repeatable measurements

3.19 On-Site Calibration

3.19.1 Laboratories wishing to be accredited for on-site work shall have procedures that describe how equipment including standards are to be transported, how measurement standards are validated (intermediate checks performed) to ensure the on-going integrity and accuracy of the measurement standards.

4 REFERENCE AND RELATED DOCUMENTS

Ref	Document Identifier	Document Title
1.	ISO/IEC 17011	Conformity Assessment-General requirements for accreditation bodies accrediting conformity assessment bodies
2.	ISO/IEC 17025	Conformity Assessment – General requirements for Testing and Calibration Laboratories
3.	KENAS-TS-F-004	Confidentiality Form
4.	KENAS-POL-036-02	KENAS Policy on traceability of measurements

5.	ASTM E 344-00	Terminology relating to Thermometry and Hygrometry.
6.	EA-10/11	EA Guidelines on the Calibration of Temperature Indicators and Simulators by Electrical Simulation and Measurement.
7.	IEC-584-1	International Electro-technical Commission Thermocouples – Part 1 Reference Tables.
8.	IEC-584-2	International Electro-technical Commission Thermocouples – Part 2 Tolerances.
9.	EA 10/08 Ed 1	European co-operation for Accreditation Calibration of Thermocouples Edition 1 Oct 1997 (EAL-G31).
10.	EA 10/13	European co-operation for Accreditation EA Guidelines on the calibration of Temperature Block Calibrators, Nov 1999.
11.	OIML R133	International Organization of Legal Metrology Liquid-in-glass thermometers, Ed. 2002(E).
12.	AS TG 3	IANZ Technical Guide Working Thermometers Calibration Procedures, March 2002.
13.	WIKA	Handbook Pressure and Temperature Measurement, 1995
14.	VIM 1993	International Vocabulary of Basic and General Terms in Metrology, 2nd Edition, 1993, Issued by BIPM, IEC, ISO, and OIML.
15.	NPL Guide 4	Introductory Guide to emissivity, NPL Http://www.npl.co.uk/thermal/stuff/guide4.html

5 TRAINING

Notification to CABs and awareness by Assessors.

6 REVISION HISTORY

Date	Ver	Revised By	Reason For Revision
16/03/2013	01	ADTC	• Initial
14/03/2017	02	ADTC	• Align guideline to the right template. • Incorporate references, and terms and definitions in the appropriate sections.