NABL 121

National Accreditation Board for Testing and Calibration Laboratories (NABL)

Specific Criteria for Calibration Laboratories in Electro–Technical Discipline

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AMENDMENT SHEET

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INTRODUCTION

This document specifies additional requirements for the calibration laboratories in the Electro-Technical field and seeking NABL accreditation in accordance with ISO/ IEC 17025: 2005.

The specific requirements given in this document does not cover all the requirements of ISO/IEC 17025: 2005 but only those clauses which need amplification and are stated as additional requirements. These requirements should be read in conjunction with the relevant requirements of ISO/IEC 17025:2005.

This criteria can be used by laboratories and those who are associated with the programme of accreditation of calibration laboratories e.g. experts, assessors, officials engaged with day-to-day activities of accreditation.

1.0 SCOPE

1.1 Calibration laboratories are accredited by NABL after it is demonstrated that a laboratory complies with the requirements of international standard ISO/IEC 17025: 2005. In view of generic nature of the standard the requirements stated there in, need to be further redefined in specific fields of calibration. This specific criteria lays down those specific requirements in the field of Electro-technical calibration. This part of the document thus amplifies the generic requirements for Electro-technical calibration and supplement the requirements of ISO/IEC 17025:2005. Laboratories seeking NABL accreditation in the field of Electro-technical calibration must also comply with the requirements stated in this part.

1.2 Calibration and Measurement Capability (CMC) is one the parameters that is used by NABL to define the scope of an accredited calibration laboratory, the others being parameter/quantity measured, standard/master used, calibration method used and measurement range. The CMC is expressed as "the smallest uncertainty that a laboratory can achieve when calibrating the best existing device". It is an expanded uncertainty estimated at a confidence level of approximately 95% corresponding to a coverage factor k=2.

Note: Refer NABL 143 for NABL policy on Calibration and Measurement Capability (CMC) and uncertainty in calibration

The laboratory's ability to achieve their claimed CMC shall be evaluated based on its performance during the on-site assessment and by review of proficiency testing results, wherein the laboratory has participated.

1.3 The definition of CMC implies that within its accreditation a laboratory is not permitted to report a smaller uncertainty of measurement than the CMC endorsed on its scope of accreditation. This means that the laboratory shall be required to state a uncertainty not better than that corresponding to the CMC whenever it is established that the actual calibration process adds significantly to the uncertainty of measurement. The CMC is applicable only to the results for which the laboratory claims its status as accredited laboratory. It is therefore a realistic means for customers to select and compare accredited laboratories' capabilities.

The scope of accreditation of calibration laboratory shall be identified as **source** and **measure**. Source shall define the sourcing capability of a laboratory where as measure shall define the measuring capability of a laboratory.

1.4 All the parameters for which accreditation is sought must be expressed in S.I. Units, wherever applicable.

2.0 CRITERIA FOR ACCREDITATION

Accreditation of an Electro-technical calibration laboratory will require assessment of the laboratory for compliance to ISO/ IEC 17025: 2005 (General Requirements for the Competence of Testing and Calibration Laboratories) and NABL 121 (Specific Criteria for Calibration Laboratories in Electro-Technical Discipline).

3.0 SCOPE OF ACCREDITATION

3.1 The scope of accreditation of an accredited laboratory in the field of Electro-Technical calibration shall be defined in terms of its capability to calibrate sources and/or of measuring equipments for various parameters. Therefore, a scope should be identified as “Source” and “Measure” because it provides more information to users of calibration laboratories. “Source” as appearing in the accredited scope of the laboratory reflects the sourcing capability of the laboratory (e.g. calibrators, discrete resistances, inductance, capacitance, frequency generator etc). “Measure” as appearing in the accredited scope of the laboratory reflects the measuring capability of the laboratory (high end multimeters (5½ and above), frequency counters etc).

Laboratories can apply for accreditation for only source or only measure or both.

3.2 A calibration laboratory seeking accreditation to offer calibration services in the field of Electro-Technical measurements will generally carry out calibration in:

a) ALTERNATING CURRENT (< 1 GHz)

Attenuation, Capacitance, Current, Dielectric loss angle, Energy, Distortion, Dissipation factor, Inductance, Impedance, FM Modulation, AM Modulation, Phase angle, Power, Power factor, Resistance, Reflection Coefficient, Voltage, High Voltage (1 kV and above), Voltage & current ratio and Others

b) DIRECT CURRENT

Current, Power, Resistance, Voltage, High Voltage (1 kV and above), Voltage & current ratio and Others

c) RF/Microwave (1 GHz and Above)

Attenuation, Impedance, FM Modulation, AM Modulation, Power, VSWR and Others

d) TIME & FREQUENCY

Frequency (LF & HF), RF (Microwave) & Time interval

e) EMI/ EMC

Antenna Factor, Attenuation, Automotive Transient Generator, Coupling Factor/ Coupling Loss Directivity, Conducted RF, Combination Wave Surge, Damped Oscillatory Wave Generator, Decoupling of Common Mode Disturbance, Electrostatic Discharge, Electrical Fast Transients, EMI Test Receiver, Isolation, Impulse Voltage, Impulse/ Immunity Generator, Insertion Loss/ RF Attenuation, Impedance, Longitudinal conversion Loss, Preamplifier Gain, Phase angle, RF Power Amplifier, Ring Wave Generator, Telecom Surge Test System, Return loss (VSWR), Voltage Dips/ Interruptions, Voltage Division Factor.

f) ELECTRICAL EQUIPMENT

Current Transformers, Voltage Transformers, Oscilloscopes, Bridges, CT-VT Comparator

g) TEMPERATURE SIMULATION

4.0 ORGANISATION (clause 4.1 of ISO/IEC 17025:2005)

4.1 The calibration laboratory shall be organized in such a way that all staff members are aware of both the extent and the limitations of their area of responsibility. This organization shall specify and document the responsibility and authority of the Head of the calibration laboratory, Technical Manager and Quality Manager who will have direct access to the top management. All personnel will perform or verify work affecting the quality of calibrations as per general guidelines and specific criteria laid down for the accredited parameters. The calibration laboratory shall be organized in such a way so as to ensure the integrity of its staff. The training of its employees and operations of the laboratory shall be conducted for ensuring unbiased calibration.

4.2 The laboratory shall clearly nominate Authorized Signatory for authorizing calibration certificates/ reports issued by the laboratory. Authorized signatories shall be approved by NABL.

5.0 MANAGEMENT SYSTEM (clause 4.2 of ISO/IEC 17025:2005)

5.1 The calibration laboratory shall have a Quality Manual which shall be maintained up-to-date and shall be in compliance with ISO/ IEC 17025: 2005 and NABL requirements, with emphasis on following information:

a) A quality policy statement, including objectives as evidence of commitment by the top management.

b) A statement on the organization of the calibration laboratory.

c) Names, qualifications and experience of the persons responsible for managerial, and scientific/ technical activities.

d) A clearly defined charter of responsibility showing the relationship between technical management, quality management and support services.

e) Scope and operation of the laboratory along with information on measurement capability and traceability of calibration results of measuring instruments including reference and working standards to national measurement standards, which are realization of SI system of units.

f) The reference of document number on detailed calibration procedures adopted in the laboratory, which should be compiled in the form of a manual for the use of calibration staff.

g) The reference list of all specification/standards being referred to or used in the performance of calibration work (copies of such specifications/standard specifications should be available in the laboratory for the use of calibration staff.)

h) All amendments made in any of the documents must be updated and listed in the relevant document.

5.2 The calibration facilities established in accordance with the general guidelines and specific criteria shall be audited periodically and reviewed by or on behalf of the management to ensure the continued effectiveness of the system.

5.3 The calibration laboratory shall clearly specify, document and make known to the customers, the administrative and other procedures to be followed for getting calibration done from the laboratory. The procedure for redressal of complaints should also be clearly specified and documented.

5.4 The laboratory shall have authorized signatories for approving and issuing calibration certificates for each calibration parameter as mentioned in the scope of accreditation. Any officer competent to evaluate calibration results critically and occupying a position involving responsibility for the adequacy of calibration results is eligible for approval by NABL as an authorized signatory of endorsed calibration documents. Approved authorized signatories must demonstrate understanding of NABL requirements, and must be competent in the relevant area of calibration.

6.0 PERSONNEL (clause 5.2 of ISO/IEC 17025:2005)

6.1 Technical Personnel

6.1.1 Qualification required for carrying out calibration activity:

The following are the specific requirements. However, qualification and experience will not be the only criteria for the required activity. They have to prove their skill, knowledge and competency in their specific field of calibration activity.

a) B.E / B.Tech or M.Sc. (degree with 3 months experience in Basics of Electro-Technical Calibration.

b) B.Sc or Diploma with 6 months experience in Basics of Electro-Technical Calibration.

c) ITI with 1 year of experience in Basics of Electro-Technical Calibration.

6.1.2 Training and experience required:

a) Training may be external / internal depending on the expertise available in the field. Effectiveness of training action needs to be ensured.

b) Competence of the trainer in case of internal training needs to be ensured.

c) Training in Electro-Technical Calibration and in Uncertainty Measurements.

d) For Technical Manager, Training in Electro-Technical Calibration and in Uncertainty Measurements, CMC including statistical analysis is mandatory.

e) Experience and competence in Electro-Technical Calibration.

f) Sufficient knowledge about handling of reference equipment, maintenance, traceability, calibration procedure and effect of environmental conditions on the results of calibration.

g) During training calibration activity should be done under supervision.

6.2 Authorized Signatory:

6.2.1 Qualification required for interpretation of results and signing the calibration certificates:

The following are only guidelines. However, qualification and experience will not be the only criteria for the required activity. They have to prove their skill, knowledge and competency in analysis and interpretation of calibration results.

a) B.E / B.Tech or M.Sc. degree with 6 months experience in Electro-Technical Calibration.

b) B.Sc. or Diploma with 1 year experience in Electro-Technical Calibration.

6.2.2 Training and experience required:

a) Training may be external / internal depending on the expertise available in the field. Effectiveness of training needs to be ensured.

b) Competence of the trainer in case of internal training needs to be ensured.

7.0 ACCOMMODATION AND ENVIRONMENTAL CONDITIONS (clause 5.3 of ISO/IEC 17025:2005)

7.1 GENERAL

7.1.1 The environmental conditions maintained in the laboratory shall be such that it does not adversely affect the required accuracy of measurement. Facilities should be provided for recording environmental parameters such as temperature, humidity etc. prevailing during calibration. The environmental conditions maintained in the laboratory during calibration should be reported in the calibration report/ certificate.

Wherever applicable, laboratory is required to maintain appropriate environmental conditions related to Line regulation, Harmonic content in supply voltage, EMI/EMC, Stray magnetic fields , Vibration, Dust level, Acoustic noise level, Illumination level etc and keep a record of the same.

Standard Environmental Condition for the Electro-Technical Calibration Laboratory shall be as follows:

a) Temperature 25°C± 2°C; and
b) RH 45% to 75%

7.1.2 The laboratory shall specify limits on the environmental conditions to be achieved in the laboratory. The condition shall be appropriate to the level of its capability required for the calibration undertaken by the laboratory.

7.1.3 The environmental conditions shall be monitored at appropriate intervals and calibrations stopped when the environmental conditions are observed to be outside the specified limits.

7.1.4 As far as possible, only the staff engaged in the calibration activity shall be permitted entry inside the calibration area. Access of other persons shall be controlled and defined.

7.2 SPECIAL ENVIRONMENTAL REQUIREMENTS OF LABORATORY

7.2.1 The calibration laboratory shall make arrangements for regulated and uninterrupted power supply. The recommended regulation level is ± 1% or better on the calibration bench.

7.2.2 It is recommended that relevant IS specifications (IS:1248, IS:13875, IS: 4722) regarding total harmonic content and variation in supply frequency should be followed. Voltage stabilizers of low harmonic content and variation in supply frequency should be used to comply with these requirements.

7.2.3 For Inductance (low frequency) and DC Resistance, the temperature variation must be controlled such that the calibration uncertainty does not exceed 10% due to temperature variation.

7.2.4 For High Voltage Capacitors/ Transformers, the temperature variation should be < 1° during calibration period. The inductive voltage divider should be protected against the effects of AC magnetic fields.

7.2.5 For High voltage calibration, temperature and humidity shall be recorded by the laboratory and correction shall be applied wherever required.

7.2.6 The laboratory shall use, if necessary, isolation transformers and filters etc. to ensure minimization of ground current and effects of mains hum interference.

7.2.7 The power supply to the calibration laboratory shall be directly obtained from the substation as far as possible and shall not be on the same feeder line which is supplying power to workshops and other production areas which require operation of heavy duty machines.

7.2.8 The calibration area shall be adequately free from vibrations generated by central air-conditioning plants, vehicular traffic and other sources to ensure consistent and uniform operational conditions. The laboratory shall take all special/ protective precautions like mounting of sensitive apparatus on vibration free tables and pillars etc., isolated from the floor, if necessary.

7.2.9 Acoustic noise level in the laboratory shall be maintained to facilitate proper performance of calibration work. A threshold noise level of 60 dBA is recommended unless otherwise stated.

7.2.10 The calibration area shall have adequate level of illumination. Where permissible, fluorescent lighting is preferred to avoid localized heating and temperature drift. The recommended level of illumination is 450-700 lux on the working table with glare index of 19 for the laboratory.

7.2.11 Effective earthing shall be provided for mains in accordance with relevant specification IS:3043. Laboratories are required to maintain earth resistance to less than 1 ohm and earth to neutral voltage to less than 1 volt. This shall be periodically checked and stray couplings minimized.

7.2.12 Special care shall be taken about the location of magnetic field sources like, transformers, looped wires, ferrous materials etc., in order to minimize magnetic interference in the measurements.

7.2.13 Adequate screening of the laboratory against electromagnetic interference may be done if necessary. By pass filters should also be provided to minimize conducted interference effect on the electronic equipment. Special shielding chambers should be provided in the laboratory for measurements, particularly when signal to noise ratio is a disturbing factor for accurate measurements.

7.2.14 The reference standards shall be maintained at temperatures specified for their maintenance in order to ensure their conformance to the required level of operation. The laboratory should have specific facilities required for carrying out the calibration of parameters chosen.

7.2.15 The laboratory shall be sealed against dust and external air pressure. Positive air pressure, if necessary shall be maintained inside the laboratory.

7.2.16 Adequate protective measures, like use of transient suppressors etc, shall be taken by the laboratory to ward off high current spikes and transients emanating from switching on and off, of heavy machines, surges in power lines and other such reasons, from reaching the electronics equipment in general and computer based systems involving data storage facilities in particular.

7.3 SAFETY PRECAUTIONS

7.3.1 Relevant fire extinguishing equipment for possible fire hazards should be available in the corridors or convenient places in the laboratory. Adequate safety measures against electrical, chemical fire hazards must be available at the work place. Laboratory rooms/ areas where highly inflammable materials are used/ stored should be identified. Access to relevant fire equipment should be assured near these rooms/ areas.

7.3.2 Specification SP.31-1986, a special publication in the form of a wall chart, giving the method of treatment in case of electric shock, should be followed. The chart should be placed near the power supply switchgear and at other prominent places as prescribed under Indian Electricity Rules 1956.

8.0 CALIBRATION METHODS AND UNCERTAINTY OF MEASUREMENT (clause 5.4 of ISO/IEC 17025:2005)

8.1 COMPARISON METHOD OF CALIBRATION

The laboratory while using the comparison method of calibration (using a nominal source of good short term stability and a measurement standard/master) shall devise methods to evaluate the short term stability of the sources/supply. Records of the short term stability shall be available with the laboratory for verification by NABL.

For comparison method of calibration, it is not mandatory to calibrate the source/supply. However, the laboratory is required to demonstrate the short term stability of the source/supply during the assessment.

The suitability of the comparison method (especially in case of low voltage, low/high current, low/high resistance, high frequency voltage measurements) shall be established by the laboratory by studying the effects of factors like capacitive / inductive / resistive loading, allowable current, compliance voltage etc. on measurement. Assessor shall verify the same during assessments.

The stability data generated by the laboratory for the source/supply needs to be used as a Type-B contribution towards uncertainty of calibration. Other possible contributions towards Type-B, depending on the type of comparison method used, shall have to be identified by the laboratory and included in the uncertainty budget. This shall be verified by the assessor during assessment.

8.2 VALIDATION OF SOFTWARE

Any software used by laboratories for performing automated calibration shall be validated so that all parameters and ranges intended to be calibrated using the software are taken care of. Records for the same shall be available with the laboratory during assessment. Such software needs to be verified by the user laboratory periodically. Periodicity of these verifications may be decided by the user laboratory. Re-validation of software is required whenever there is a change in the version of the software used.

8.3 MINIMUM TYPE 'B' COMPONENTS FOR UNCERTAINTY CALCULATIONS

The following Type B components shall be necessarily considered as a minimum for estimation of measurement uncertainty:

- U1: Uncertainty reported in the calibration certificate of the standard(s) / master(s)
- U2: Uncertainty arising from stability data of the measurement standard(s) / master(s) used for calibration (Detailed explanation for this component is provided below)
- U3: Uncertainty from the resolution of the Device/Unit under Calibration
- U4: Uncertainty due to accuracy of the Device/Unit under Calibration
- U5: Uncertainty due to other influential factors such as temperature, humidity variation etc affecting the measurements.

Clarifications pertaining to U2 component:

Stability data shall be generated by laboratories by preparation of control /trend charts based on successive calibration of their standard(s)/master(s) (preferably without adjustments)*. This shall be established by laboratories within two years from the date on which laboratories apply for NABL accreditation. For the accredited laboratories, this shall be established within a period of two years w.e.f. the date of this issue.

The laboratories may need to get their standard(s)/master(s) calibrated more frequently to generate the stability data within the above stipulated time.

Till such time, the stability data provided by the manufacturer of the standard(s)/master(s) can be utilized for estimation of uncertainty. In case the stability data from the manufacturer is also not available, the accuracy specification as provided by the manufacturer can be used. However, manufacturer's data will not be acceptable after the two year period as mentioned above since the laboratories are expected to establish their own stability data by that period.

** In cases where the standard(s)/master(s) are adjusted during its calibration, pre-adjustment data needs to be used for preparation of control/trend charts.*

9.0 EQUIPMENT (clause 5.5 of ISO/IEC 17025:2005)

9.1 The calibration laboratory shall have measurement standards and equipment of required accuracy in respect of each parameter covered by it in order to be able to realize and to substantiate the corresponding measurement capability claimed. Stability of the standards, accuracy of the values realized through them and repeatability, should be regularly monitored.

9.2 Any bias resulting from ageing of standards should be precisely determined. Instructions for operating each standard and equipment/ instrument should be readily available for use by the laboratory staff members.

9.3 The standards/ measuring equipment of the laboratory should be calibrated at regular intervals, with higher accuracy standards. The calibration certificates, performance history sheets in respect of the reference secondary/ working standards and measuring equipment should be held safely by the laboratory.

9.4 Proper record shall be maintained for each standard and equipment with the following information:

a) Name of the equipment
b) Manufacturers name and address
c) Type, range, identification and serial number
d) Date of procurement and commissioning
e) Details of Calibration
f) Details of maintenance and repairs
g) Performance history with dates
h) Availability of service manual

9.5 Details of periodic calibration schedule of new and old standards and measuring equipment should be worked out in consultation with higher capability laboratory and this schedule should be observed.

9.6 Details of re-calibration of used, serviced and repaired equipment should also be available and proper precautions shall be observed to identify equipment, which are not in service.

9.7 Any alterations in the observations/ data shall be signed by the calibration staff and duly authenticated. Instructions to this effect should be printed on data sheet used for writing observations/ data in the laboratory.

9.8 REPAIR AND MAINTENANCE

9.8.1 A separate repair and maintenance facility, adequately equipped with repair facilities and qualified and experienced manpower, shall be available in-house or by any other means effectively accessible to the calibration laboratory. This facility shall also assist in identifying the preventive maintenance measures, which should be brought to the attention of the personnel engaged in calibration work for taking necessary actions. The repair facility should cover digital and programmable instruments also.

9.8.2 Every repaired equipment shall invariably be re-calibrated through in-house facility or by higher capabilities laboratory before being used for further calibration work.

10.0 MEASUREMENT TRACEABILITY (clause 5.6 of ISO/IEC 17025:2005)

10.1 All calibration laboratories shall follow NABL 142 (Policy on Calibration and Traceability of Measurements) to achieve traceability. For this (irrespective of manual and software calibrations), standard(s)/master(s) used by laboratories need to be calibrated for all parameters and ranges under its scope of accreditation. For each range, standard(s)/master(s) are required to be calibrated at least at two points (preferably minimum and maximum points) of the range assuming ranges to be linear.

10.2 When same standard(s)/master(s) are used both for a parameter and its derived parameter (e.g. reciprocal counter for measurement of Time and Frequency), traceability achieved for the main parameter automatically ensures traceability for the derived parameter. However, the derived parameter(s) needs to be separately demonstrated identifying the appropriate uncertainty contributions and subsequently included in the scope of accreditation.

11.0 HANDLING OF CALIBRATION ITEMS (clause 5.8 of ISO/IEC 17025:2005)

11.1 The standards/ measuring instruments/ equipment received by the laboratory for calibration shall be safely stored in proper environmental conditions according to the instructions given by the customer/manufacturer.

11.2 The laboratory shall have adequate arrangements for packaging of calibrated instruments and may assist the user, if necessary, about the procedure and precautions to be taken by the organization for packaging and transportation of the equipment to the calibration laboratory.

12.0 PROFICIENCY TESTING (clause 5.9 of ISO/IEC 17025:2005)

12.1 Laboratories shall follow NABL 163 (Policy for Participation in Proficiency Testing Activities) and NABL 164 (Guidelines for inter-laboratory comparison for calibration laboratories where formal PT programmes are not available) for participation in PT/ILC programmes.

12.2 In order to assure validity of calibrations undertaken and demonstrate its technical competence, a laboratory will be required to participate, from time to time, in Proficiency Testing Programmes. The laboratory shall remain prepared to participate in the Proficiency Testing Programme through inter-laboratory, inter-comparison schemes wherever it is technically feasible. In case any abnormalities, in terms of En number are detected through these inter-comparisons, appropriate corrective action will be taken, the standards/ equipment shall be replaced/ repaired and re-calibrated with a higher accuracy standard. Reports on such inter-comparisons should be documented with reference.

13.0 CALIBRATION CERTIFICATE/ REPORT (clause 5.10 of ISO/IEC 17025:2005)

13.1 The result of calibration carried out by the calibration laboratory, shall be presented in a comprehensive manner, using a standard format which shall unambiguously and objectively present the measurement results and all relevant information in order to facilitate easy comprehension and usage.

13.2 The calibration report/ certificate shall include the following additional information:

a) Date of receipt of the item and date of completion of the calibration work.

b) Environmental conditions maintained during the measurements.

c) Signature and title of authorized person (authorized signatory) accepting responsibility for the report and date of issue.

d) A statement of the accreditation measurement capability relevant to the job under calibration.

e) NABL Symbol identifying the scope of accreditation of the laboratory.

f) The Uncertainty of measurement.

g) An evidence that the measurements are traceable to National/ International Standards through unbroken chain of Accredited Laboratories.

13.3 The calibration report/ certificate shall not contain any recommendation on the calibration interval except where this has been agreed with the client. This requirement may be superseded by legal regulations.

13.4 Laboratories accredited for main parameters are not allowed to use NABL symbol for parameters derived from these parameters since the associated uncertainty of the derived parameter is not known and the same is not verified by NABL.

13.5 All laboratories are required to retain a replica (either hard copy or soft copy) of the certificates issued to their customers. Laboratory may decide on the appropriate retention period.

14.0 GUIDANCE FOR ASSESSMENTS AND SCOPE RECOMMENDATION

14.1 For initial assessment, the calibration for each parameter, as applied by the laboratory, shall be witnessed. For all ranges under a parameter, atleast the minimum and maximum point of a range, shall be witnessed. The witnessing may be reduced if proper records are available with the laboratory. This needs to be examined by the assessor. The assessor may select additional appropriate critical points for evaluating the laboratory's competence.

14.2 Recommendation of scope shall be in the order- source and / or measure wise, parameter-wise and range wise, as shown as an example in Form 73 (Recommended Scope of Accreditation) in the next page. In special cases, e.g. calibration of oscilloscopes, electrostatic discharge etc, the scope shall be recommended instrument-wise, keeping in mind the uniqueness of calibration or the customer requirement.

14.3 AC parameters to be recommended as frequency ranges followed by voltage/current ranges. Resistance parameter should be clearly recommended as AC or DC. For Oscilloscope calibration, minimum parameters that need to be calibrated are amplitude, time base and bandwidth.

14.4 The recommended ranges shall be split on the basis of capability of the standard(s)/master(s) used and different methods/procedures adopted by the laboratory. It is advisable to split ranges to keep less variation in Calibration and Measurement Capability (CMC) and shall be split in such a manner that linearity is ensured for each range. Wherever linearity is not possible in a range, single value shall be recommended. When single value standard(s) /master(s) are used, recommendation shall also be a single value.

14.5 Laboratories are expected to report measurement uncertainty in SI units in the calibration certificates issued by them. It is desirable that NABL assessor recommends CMC in SI units (wherever possible). The assessor shall recommend the CMC of each range giving due consideration to factors like laboratory's claim and demonstrated uncertainty and shall be rounded off to two significant digits.

14.6 In Form 73, “Remarks/Methods” column will mention the specific calibration method used by the laboratory e.g. comparison method, null method etc.

Wherever required, foot notes may be added to the scope of accreditation for the purpose of clarity and/or completeness.

Form 73

RECOMMENDED SCOPE OF ACCREDITATION
(For Calibration Laboratories)

Laboratory:	**Date(s) of visit:**
Facility:	**Discipline(s):**

Sl	Parameter / Quantity measured (equipment wise)	Standards / Masters Used	Range(s)*	Calibration and measurement capability**			Remark / Method used
				Claimed by Laboratory	Observed by Assessor	Recommended by Assessor	
	Measure						
1	AC Voltage	Fluke 8508A DMM	**10Hz to 10kHz** 1mV to 100mV 100mV to 100V 100V to 1000V	0.002mV to 0.006mV 0.006mV to 0.017V 0.017V to 0.022V	0.004mV to 0.016mV 0.016mV to 0.013V 0.013V to 0.018V	0.004mV to 0.016mV 0.016mV to 0.017V 0.017V to 0.022V	
			10kHz to 100kHz 1mV to 100mV 100mV to 100V 100V to 1000V	0.0069mV to 0.03mV 0.03mV to 0.14V 0.14V to 0.91V	0.0069mV to 0.43mV 0.43mV to 0.1V 0.1V to 0.81V	0.0069mV to 0.43mV 0.43mV to 0.14V 0.14V to 0.91V	
2	DC Voltage	Fluke 8508A DMM	100µV to 10mV 10mV to 100mV	0.012 µV to 0.0042mV 0.0042mV to 0.0005mV	0.012 µV to 0.0042mV 0.0042mV to 0.0004mV	0.012 µV to 0.0042mV 0.0042mV to 0.0005mV	
	Source						
1	DC Resistance	Wavetek 4808 Calibrator	1mΩ to 10Ω 10Ω to 100kΩ 100kΩ to 100MΩ	0.0004mΩ to 0.012Ω 0.012Ω to 0.0011kΩ 0.011kΩ to 0.019MΩ	0.0004mΩ to 0.042Ω 0.042Ω to 0.0021kΩ 0.021kΩ to 0.026MΩ	0.0004mΩ to 0.042Ω 0.042Ω to 0.0021kΩ 0.021kΩ to 0.026MΩ	
2	DC Current	Wavetek 4808 Calibrator	100µA to 100mA 100mA to 1A 1A to 10 A	0.004µA to 0.005mA 0.005mA to 0.00011A 0.00011A to 0.001A	0.014µA to 0.006mA 0.006mA to 0.00014A 0.00014A to 0.0029A	0.014µA to 0.006mA 0.006mA to 0.00014A 0.00014A to 0.0029A	

* For Electro-technical Discipline, wherever applicable, the ranges may be mentioned frequency wise
** Calibration and measurement capability is expressed as measurement uncertainty at a confidence level of 95%

Signature & Name of Lab Representative	**Signature & Name of Assessor(s)**	**Signature & Name of Lead Assessor**

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