National Accreditation Board for Testing and Calibration Laboratories (NABL)

Specific Criteria for Air Quality Monitoring Equipment Calibration Laboratories

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AMENDMENT SHEET

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1.	01	4 to 7, 9 to 13	--	06.0R.2025	As Highlighted	Internal review	-Sd-	-Sd-
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Introduction

This specific criteria specifies the requirement that shall be followed by the calibration laboratories seeking accreditation for the calibration of “Air Quality Monitoring Equipment”.

The requirements in this document are based on the International Standard i.e. ISO/IEC 17025: 2017- “General requirements for the competence of testing and calibration laboratories”. This document must be used in conjunction with ISO/IEC 17025: 2017. It provides an interpretation of the latter document and describes specific requirements. Further, the laboratory shall follow national, regional, local laws and regulations as applicable.

Intend of this document is to ensure that the data collected overtime through the Air Monitoring Equipment is accurate, reliable, and valid for regulatory compliance, public health protection, and effective environmental management. Calibration is crucial for maintaining the integrity of air quality measurements and for supporting informed decisions based on trustworthy data.

Terms & Definitions

Gas mixture: Gas mixture whose composition is sufficiently well established and stable to be used as a working standard of composition.

Reference Gas Mixture: Gas mixture whose composition is sufficiently well established and stable to be used as a reference standard of composition and prepared as per ISO 17034.

Gas analyzer: A device which can determine a gas component in required range of concentration present in the gas mixture with sufficient precision and accuracy and worked on based on spectroscopic principle.

Zero gas: A zero gas is normally a pure gas that does not contain the component to be measured, and it should be as similar to the matrix of the measured sample as possible.

Impactor and cyclone: Both are Mechanical devices used for segregation of airborne particle based on their inertia.

Orifice flow rate check device: One type of flow rate calibration or check device (transfer standard), often used in the field, based on the established relationship between flow rate and pressure drop across the orifice plate. An orifice’s operating characteristics are determined in the laboratory using a flow rate standard such as soap film flow meter. Orifice devices generally require temperature and pressure corrections.

$PM_{2.5}$: Particulate matter (suspended in the atmosphere) having an aerodynamic diameter less than equal to a nominal 2.5 micrometer as measured by a reference method on 40CFR part 50, appendix L, and designated in accordance with 40 CFR part 53.

$PM_{2.5}$ Sampler: A Sampler used for monitoring $PM_{2.5}$ in the atmosphere that collects a sample of particulate matter from the air based on principles of inertial separation and reposition of on filter. The sampler also maintains a constant sample flow rate and may record the actual flow rate and the total volume sampled. $PM_{2.5}$ mass concentration is calculated as the mass of the filter catch divided by the sampled volume. A sampler cannot calculate $PM_{2.5}$ concentration directly.

$PM_{2.5}$ Separator: A Class of approved devices for removing particles less than 10µm in aerodynamic diameter (but greater than 2.5 µm in diameter), but allows particles of nominally less than 2.5 µm in diameter to pass and collect on Teflon Filter surface.

Certified Reference Material (CRM): Reference material characterized by a metrologically valid procedure for one or more specified properties, accompanied by a reference material certificate that provides the value of the specified property, its associated uncertainty, and a statement of metrological traceability.

Reference Material: RM material, sufficiently homogeneous and stable with respect to one or more specified properties, which has been established to be fit for its intended use in a measurement process.

1. SCOPE

This specific criteria lays down the specific requirements for Air Quality Monitoring Equipment calibration laboratories under Chemical metrology discipline of Calibration field. This part of the document thus amplifies the specific requirements for Air Quality Monitoring Equipment Calibration Laboratories and supplements the requirements of ISO/IEC 17025: 2017. The purpose of this document is to

a) Specify requirements with which a laboratory has to operate and demonstrate its competency to carry out calibration in accordance with ISO/IEC 17025:2017,
b) Achieve uniformity between the laboratories, assessors and assessment process in terms of maximum permissible error, Calibration and Measurement Capability (CMC), measurement uncertainty etc. in line with National/International standards, and
c) Achieve uniformity in selection of equipment's, calibration methods, maintaining required environmental conditions, personnel with relevant qualifications and experience.

2. PERSONNEL, QUALIFICATION AND TRAINING

2.1. The proposed personnel for report, review and authorization of results shall meet the minimum qualification and experience requirements as per NABL 152.

2.2. Accommodation and Environmental Conditions

The laboratories shall ensure and follow the requirements of accommodation and environment depending on the types of services provided as recommended:

a) By the manufacturers of the reference equipment
b) By the manufacturers of the Device under calibration (DUC)
c) As specified in the National/ International Standards or guidelines followed for the calibration.
d) The environmental monitoring equipment used should also meet the requirement of manufacturers' recommendations and specifications as per the relevant standards followed.
e) Environment condition should remain the same for permanent facility, site facility and mobile facility.

2.2.1. Vibration

The calibration area shall be 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.

2.2.2. Acoustic Noise

Acoustic noise level in the laboratory shall be maintained to facilitate proper performance of calibration work. Noise level shall be maintained less than 60 dBA, wherever it affects adversely the required accuracy of measurement.

2.2.3. Illumination

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 250- 500 lux on the working table.

2.3. Special Requirements of Laboratory

2.3.1. The calibration laboratory shall make arrangements for regulated and uninterrupted power supply of proper rating. The recommended voltage regulation level is ± 2 % or better, and Frequency variation ± 2.5 Hz or better on the calibration bench.

2.3.2. The temperature shall be 25 °C ± 2 °C.

2.3.3. Relative humidity shall be maintained 50 %rh ± 15 %rh and at atmospheric pressure.

2.3.4. Temperature, Relative Humidity and barometric pressure parameters are to be recorded using data logger at suitable interval.

2.3.5. The laboratory shall take adequate measures against dust and external air pressure to avoid adverse effect on result.

2.3.6. Laboratory shall have a provision for keeping span gas and standard gas mixture cylinder in controlled environmental condition to have better stability and life of gas in the cylinder. For, Span gas and reference gas mixture intermediate checks shall be done at least quarterly. Cylinder pressure should be more than 10 bar. Cylinder to be place vertically and rigidly.

2.3.7. Teflon/Steel/Glass tubing must be used in transferring gas from the cylinder to the device under calibration. Silicon coated valve must be used for maintaining flow rate. Separate regulator must be used for different cylinder. Multipoint calibrator for gas mixture to be used at laboratory and site.

2.3.8. Data acquisition software or suitable arrangement may be a part of calibration setup to generate evidences of the calibration.

2.3.9. Requirement of flow rate must be known before taking up analyzer for calibration. Desired flow rate must be maintained for the calibration mixture.

2.3.10. Flow measurement of zero air and span gas must be done using calibrated flow meter along with measurement of temperature and line pressure to know the exact flow rate at defined temperature and pressure.

2.3.11. Effective venting out system is needed to avoid the built-up of concentration of gases in the laboratory. CO detector/ sensor and O_2 detector/ sensor are required to measure the CO level and O_2 level in the calibration laboratory to avoid health hazards.

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

2.3.13. Effective mains earthing shall be provided in accordance with relevant specification IS: 3043. This shall be periodically checked to ensure proper contact with earth rod. Earth resistance shall be less than 1 Ω.

2.3.14. Entry to the Calibration Area: Only the staff engaged in the calibration activity shall be permitted entry inside the calibration area.

2.3.15. Space in Calibration Area: The calibration Laboratory shall ensure adequate space for calibration activity without adversely affecting the results.

3. SPECIFIC REQUIREMENTS FOR CALIBRATION OF AIR QUALITY MONITORING EQUIPMENT

3.1. Pre-requisite for calibration

Reference Gas Mixture

a) Ultra-Pure grade Zero Air/ Dilution Gas CRM
b) Air - Gas mixing system (Diluter/ Multipoint Calibrator) to obtain variable flow gas concentration shall be meeting the requirement of NABL 142.
c) Competency of the personnel involved in the mixture preparation.
d) Recommended environmental monitoring equipment:
e) Temperature with a resolution of 0.1°C
f) Humidity with a resolution of 1% RH
g) Pressure measuring device with resolution of 0.001 bar

3.2. Recommended facility of scope

		S. No.	Equipment	PermanentFacility	On SiteFacility	MobileFacility
Monitoring Equipment	Group I Gas	1	NO_x Analyzer	✓	☒	✓
		2	CO Analyzer	✓	☒	✓
		3	SO_2 Analyzer	✓	☒	✓
		4	O_3 Analyzer	✓	☒	✓
		5	Ammonia Analyzer	✓	☒	✓
		6	Benzene Analyzer	✓	☒	✓
	Group II	7	$PM_{2.5}$ Analyzer	✓	✓	✓
		8	PM_{10} Analyzer	✓	✓	✓

3.3. Selection of Reference Standards

3.3.1. Environment monitoring Instruments

a) Gas Analyzer:

1) Certified span gas or span gas mixture from accredited Reference Material Producer/ NMI can be used for calibration of analyzer.
2) Diluter should have metrological traceability as per NABL 142.
3) Competence of Dilution process to be verified during the assessment.

b) $PM_{2.5}$ /PM_{10} Analyzer:

Calibration of beta attenuation method for PM 2.5/PM 10 followings are the requirement.

1) Traceable DISC (minimum Three traceable Disc) for calibration of attenuation coefficient or beta attenuation calibration system.
2) Reference flow Meter
3) Temperature and Pressure sensor (wherever practically possible).

3.3.2. Reference Standard/Equipment

S. No.	Equipment/ DUC	Recommended Relevant Standards/ Guidelines	Parameters to be measured	Master/ Reference equipment used for calibration
1	NOx Analyzer	AS 3580.5.1, ISO 7996, AS/NZS 60079.29.2 :2008, ISO 7996 :1985	NO, NO_2, NOx	Certified Reference Gas (NO)
2	CO Analyzer	AS 3580.7.1, ISO 4224, AS/NZS 60079.29.2: 2008, ISO 4224: 2000	CO	Certified Reference Gas (CO)
3	SO2 Analyzer	AS 3580.4.1-1990; ISO 10498, AS/NZS 60079.29.2 :2008	SO_2	Independent Span Gas Cylinders with regulator and flow meter Certified Reference Gas (SO_2)
4	O3 Analyzer	AS 3580.6.1, AS/NZS 60079.29.2 :2008	O_3	Reference Ozone Photometer
5	Ammonia Analyzer (NH_3)	AS/NZS 60079.29.2 :2008	NH3	Certified Reference Gas (NH3/NO)
6.	Benzene Analyzer	AS/NZS 60079.29.2 :2008	Benzene	Certified Reference Gas (Benzene)
7.	$PM_{2.5}$ Analyzer	40 CFR Appendix A to part 58	2.5 micron particulate	Certified DISC/Beta Attenuation method calibration system
8.	PM_{10} Analyzer	40 CFR Appendix A to part 58	10 micron particulate	Certified DISC/Beta Attenuation method calibration system

The reference gas shall have of uncertainty three times better than the accuracy of DUC.
Laboratory may apply for other DUC(s) with appropriate reference standard.

3.4. Measurement Uncertainty

3.4.1. Repeatability (Type A) Minimum 10 readings

3.4.2. Type B Components (For Gas Analyzer except O_3 Analyzer)

3.4.2.1. Uncertainty of CRM

3.4.2.2. Uncertainty of Diluter

3.4.2.3. Uncertainty due to accuracy/ Drift of Diluter

3.4.2.4. Effect of Temperature: Uncertainty of temperature monitoring Equipment

3.4.2.5. Effect of Relative Humidity: uncertainty due to relative humidity monitoring equipment

3.4.2.6. Uncertainty due to Resolution of DUC.

3.4.2.7. Any other significant contributing factor(s)

3.4.3. Type B Components (For O_3 Analyzer)

3.4.3.1. Uncertainty of the reference photometer

3.4.3.2. Uncertainty due to accuracy of photometer

3.4.3.3. Effect of temperature: uncertainty due to temperature monitoring equipment

3.4.3.4. Effect of Relative Humidity: uncertainty due to Relative Humidity monitoring equipment

3.4.3.5. Uncertainty due to Resolution of DUC.

3.4.3.6. Any other significant contributing factor(s)

Annexure A

Sample Scope

S.No	Discipline / Group	Measurand or Reference Material/Type of instrument or material to be calibrated or measured / Quantity Measured /Instrument	Calibration or Measurement Method or procedure	Measurement range and additional parameters where applicable (Range and Frequency)	* Calibration and Measurement Capability (CMC)(±)
Permanent Facility					
1	CHEMICAL METROLOGY-AIR QUALITY ENVIRONMENT MONITORING EQUIPMENT	NO_2 Analyzer	Using Certified Reference NO_2 gas, Zero Gas Generator and Diluter by Direct Method	0 to 20526.5 µg/m^3	61.6 µg/m^3
2	CHEMICAL METROLOGY-AIR QUALITY ENVIRONMENT MONITORING EQUIPMENT	SO_2 Analyzer	Using Certified Reference SO_2 gas, Zero Gas Generator and Diluter by Direct Method	0 to 28558.7 µg/m^3	42.8 µg/m^3

Bibliography

- AS 3580.5.1-1993- NOx Analyzer
- AS 3580.7.1-1992- CO Infrared Analyzer
- AS 3580.4.1-1990-SO2 direct instrumental method
- AS 3580.6.1-1990-O3 Direct Reading
- ANSI/ASTM F649-01, Practice for Secondary Calibration of Airborne Particle Counter Using Comparison Procedures
- ISO 12039: 2001, Stationary source emissions - Determination of carbon monoxide, carbon dioxide and oxygen – Performance, characteristics and calibration of automated measuring systems
- ISO 6145-2: Gas analysis - Preparation of calibration gas mixtures using dynamic volumetric methods - Part 2: Volumetric pumps
- ISO 6142: Gas analysis — Preparation of calibration gas mixtures Part 1: Gravimetric method for Class I mixtures
- ISO 6143: Gas analysis — Comparison methods for determining and checking the composition of calibration gas mixtures
- ISO 7504: Gas analysis – Vocabulary
- ISO 17034: General requirements for the competence of reference material producers
- IS 15660: Refillable transportable seamless aluminum alloy gas cylinders
- IS 4379: Identification of contents of industrial gas cylinders.
- IS 13490: Code of practice for handling specialty gases”
- IS 5182 (Part 2/Sec 2): 2017 & ISO 10498: 2004 methods for measurement of air pollution part 2 Sulphur dioxide
- ISO 10498: Air “Determination of sulfur dioxide - Ultraviolet fluorescence method.”
- ISO 7996: Air - Determination of the mass concentration of nitrogen oxides - Chemiluminescence method.

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