NABL 138

National Accreditation Board for Testing and Calibration Laboratories (NABL)

Specific Criteria for Air Quality Monitoring Equipment Calibration Laboratories

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Terms & Definitions

Gas Mixture: In gas mixtures, each component in the gas phase can be treated separately. Each component of the mixture shares the same temperature and volume. The gases expand to fill the volume of their container; gases in a mixture do that as well. However, each gas component has its own pressure, which is called its partial pressure.

Gas Analyzer: A device for indicating the fuel-air ratio of the fuel mixture of an engine (as of an airplane) that consists of an element sensitive to carbon dioxide placed in the exhaust manifold - called also fuel-mixture indicator, smoke free.

Impactor: An inertial particle size separator. A PM2.5 reference of Class I equivalent method sampler uses a specially shaped inlet followed by an impactor that allows only particulate matter of well-defined size ranges to penetrate to the filter collection portion of collector.

Impactor well: That portion of the sampler inlet where particles larger than 2.5µm impact and are held by a filter soaked with oil (tetramethyl tetraphenyltrisiloxane), such that they are removed from the sample air stream.

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 filtration. 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.

1. INTRODUCTION

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 qualification and experience.

2. SCOPE

This specific criterion 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 and supplements the requirements of ISO/IEC 17025: 2017.

3. PERSONNEL, QUALIFICATION AND TRAINING

3.1. Technical Personnel

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. (having Physics, chemistry as one of the subjects) degree with 6 months experience in calibration of Air Quality Monitoring Equipment.

b) B. Sc (with Physics as one of the subjects) or Diploma with 1-year experience in Basics of Air Quality Monitoring Equipment ITI with 2 year of experience in calibration of Air Quality Monitoring equipment.

Technical personnel should have Training in estimation of Uncertainty of Measurements, CMC including statistical analysis for Basics of Air Quality Monitoring Equipment and relevant area of metrology. Knowledge on operation on analyzer and monitoring equipment is preferable. person declared for authorizing the results shall meet the requirement mentioned in NABL 165.

3.2. Accommodation and Environmental Conditions

The laboratories are advised to follow the requirement 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 Unit under calibration

c. As specified in the National/ International Standards or guidelines followed for the calibration.

The environmental monitoring equipment used should also meet the requirement of manufacturers' recommendations and specifications as per the relevant standards followed.

3.2.1 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.

3.2.2 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.

3.2.3 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.

3.3 Special Requirements of Laboratory

3.3.1 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.

3.3.2 The ambient temperature shall be 25°C ± 2°C.

3.3.3 Relative humidity shall be maintained 50% ± 10% RH and at Atmospheric Pressure.

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

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

3.3.6 Lab shall have provision for keeping span gas and standard gas mixture cylinder in controlled environmental condition to have better stability and life of gas in cylinder. For, Span gas and reference gas mixture intermediate checks shall be done at least quarterly with the help of suitable analyzer maintaining at least Test Uncertainty Ratio 1:1.

3.3.7 Teflon/Steel/Glass tubing must be used in transferring gas from cylinder to mixture tube. Teflon 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 lab and site.

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

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

3.3.10 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.

3.3.11 Effective venting out system needed to avoid built-up of concentration of gases in laboratory.

3.3.12 Relevant fire extinguishing equipment for possible fire hazards, shall 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 shall be identified. Access to the relevant fire equipment shall be assured near these rooms/ areas.

3.3.13 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.

3.3.14 **Entry to the Calibration Area:** As far as possible, only the staff engaged in the calibration activity shall be permitted entry inside the calibration area.

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

4. SPECIFIC REQUIREMENTS FOR CALIBRATION OF AIR QUALITY MONITORING EQUIPMENT

4.1. Prerequisite Requirement for Calibration

Reference Gas Mixture/Permeation Tube System

a) Ultra-Pure grade Zero Air Generating System

b) Air – Gas mixing system to obtained variable flow gas concentration for calibration Reference flow meter to verify the flow

c) Reference Temperature and Pressure measuring device

Traceability of reference standard shall meet the requirement as per NABL 142.

4.2 Scope: Calibration- Monitoring Equipment

		S. No.	Equipment	Permanent Facility	On Site Facility	Mobile Facility
Monitoring Equipment	**Group I** Gas Analyzer	1	NO_2 Analyzer	✓	✓	✓
		2	CO Analyzer	✓	✓	✓
		3	SO_2 Analyzer	✓	✓	✓
		4	O_3 Analyzer	✓	✓	✓
		5	Ammonia Analyzer	✓	✓	✓
		6	Benzene Analyzer	✓	✓	✓
	Group II PM Analyzer	7	$PM_{2.5}$ Analyzer	✓	✓	✓
		8	PM_{10} Analyzer	✓	✓	✓

4.3 Selection of Reference Masters and Standards

4.3.1 Environment monitoring Instruments

a) Certified span gas or span gas mixture/Permeation Tube system from accredited Reference Material Producer/ NMI can be used for calibration of analyzer.

b) Traceable DISC for particulates or co-locating comparative study with reference certified/calibrated $PM_{2.5}$ and PM_{10} Analyzer at same flow rate.

4.3.2 Reference Standard/Equipment

S. No.	Equipment/ DUC	Recommended Relevant Standards/ Guidelines	Parameters to be measured	Master/ Reference equipment used for calibration
1	NO_2 Analyzer	AS 3580.5.1, ISO 7996, AS/NZS 60079.29.2 :2008, ISO 7996 :1985	NO, NO_2, NOx	Certified Reference Gas (NO)/ Permeation Tube System
2	CO Analyzer	AS 3580.7.1, ISO 4224, AS/NZS 60079.29.2 :2008, ISO 4224 :2000	CO	Certified Reference Gas (CO)
3	SO_2 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)/ Permeation Tube System
4	O_3 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	NH_3	Certified Reference Gas (NH3/NO)/ Permeation Tube System
6.	Benzene Analyzer	AS/NZS 60079.29.2 :2008	Benzene	Certified Reference Gas (Benzene)/ Permeation Tube System
7.	$PM_{2.5}$ Analyzer	40 CFR Appendix A to part 58	2.5 micron particulate	Certified DISC for particulates/ Certified with $PM_{2.5}$ Analyzer* * Co-locating Sampling duration should be 24hrs with similar sampling technologies
08.	PM_{10} Analyzer	40 CFR Appendix A to part 58	10 micron particulate	Certified with PM_{10} sampler* / Certified DISC * Co-locating Sampling duration should be 24hrs with similar sampling technologies
09.	Any other related equipment can be considered for accreditation provided method and reference equipment are available.			

- Laboratory may use any other appropriate Reference Standards / Master equipment(s) which shall be capable of measuring above parameters depending on the DUC and its grade/accuracy to meet the requirements of relevant IS/ISO and other standards in totality.
- The reference gas shall have of uncertainty three times better than the accuracy of DUC.

4.4 Measurement Uncertainty

4.4.1 Repeatability (Type A) Minimum 10 readings

4.4.2 Type B Components

4.4.2.1 Uncertainty of master (s) [When error of the Master is not corrected during calibration then it should be added as an additional uncertainty component].

4.4.2.2 Effect of Temperature: Uncertainty of temperature monitoring Equipment (ref. NABL 141)

4.4.2.3 Effect of Pressure: Uncertainty of Pressure monitoring Equipment.

4.4.2.4 Uncertainty due to Resolution of DUC.

4.4.2.5 Uncertainty due to Hysteresis effect.

4.4.2.6 Uncertainty due to Response Time of Analyzer

4.4.2.7 Uncertainty due to Drift of reference standard

4.5 Evaluation of CMC (Refer NABL 143)

4.5.1 CMC value is not the same as expanded uncertainty reported in the calibration Certificate/Report. CMC values exclude the uncertainties which are attributed to the DUC (Device under Calibration).

4.5.2 For the purpose of CMC evaluation, the following components should be considered:

4.5.2.1 Repeatability (Type A) Minimum 10 readings,

4.5.2.2 Uncertainty of master (s) [When error of the Master is not corrected during calibration then it should be added as an additional uncertainty component],

4.5.2.3 Effect of Temperature: Uncertainty of temperature monitoring Equipment (ref. NABL 141)

4.5.2.4 Effect of Pressure: Uncertainty of Pressure monitoring Equipment

4.5.2.5 Uncertainty due to Resolution of DUC.

4.5.2.6 Uncertainty due to Hysteresis effect

4.5.2.7 Uncertainty due to Response Time of Analyzer

4.5.2.8 Uncertainty due to Drift of reference standard

Note: Gas/Analyzer Methodology to be define in calibration certificate issued to the customer.

4.6 Calibration Interval

Calibration interval master/ reference equipment other than reference gas, shall comply with relevant NABL specific criteria.

Sample Scope

Sample Recommended Scope: An illustrative example (by Expert)

Laboratory: XYZ						Date(s) of Visit:	
Discipline: Air Quality Environment Monitoring Instruments							
S. No.	**Parameter* / Device under calibration**	**Master equipment used**	**Range(s) of measurement**	**Calibration and Measurement Capability **(±)**			**Remarks+/ Method used**
				Claimed by Laboratory	**Observed by Assessor**	**Recommended by Assessor**	
Correct presentation of scope of accreditation							
1.	NO_2 Analyzer	Certified Reference NO_2 gas	0 to 20526.5 µg/m^3	20.5 µg/m^3	61.6 µg/m^3	61.6 µg/m^3	AS/ANZS 60079.29.2: 2008 By comparison Method
2.	SO_2 Analyzer	Certified Reference SO_2 gas	0to 28558.7 µg/m^3	22.5 µg/m^3	42.8 µg/m^3	42.8 µg/m^3	AS/ANZS 60079.29.2: 2008 By comparison Method
** Only for Electro-technical discipline; scope shall be recommended parameter wise (where applicable) and the ranges may be mentioned frequency wise.*							
*** NABL 143 shall be referred for the recommendation of CMC*							
+ Remarks shall also include whether the same scope is applicable for site calibration as well. NABL 130 shall be referred while recommending the scope for site calibration.							

Signature, Date & Name of Lab Representative	Signature, Date & Name of Assessor(s)	Signature, Date & Name of Lead Assessor

National/ International Standards, References and Guidelines

- AS 3580.5.1-1993- NOx Analyzer
- AS 3580.7.1-1992- CO Infrared Analyzer
- AS 3580.4.1-1990-SO_2 direct instrumental method
- AS 3580.6.1-1990-O_3 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 6145-2:2001, Gas analysis - Preparation of calibration gas mixtures using dynamic volumetric methods - Part 2: Volumetric pumps
- IS 15660: Refillable transportable seamless aluminum alloy gas cylinders by BIS.
- IS 4379: Identification of contents of industrial gas cylinders by BIS
- 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 10498:2004, Ambient air - Determination of sulfur dioxide - Ultraviolet fluorescence method.
- ISO 7996:1985 Ambient air -- Determination of the mass concentration of nitrogen oxides - Chemiluminescence method.
- ISO 10498.2. 1999 Ambient Air - Determination of Sulphur Dioxide - Ultraviolet Fluorescence

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