Jordanian Accreditation System

نظام الاعتماد الأردني

Accreditation Unit

AIR QUALITY MEASUREMENTS POLICY

Purpose

The purpose of this JAS-AU policy is to stipulate additional technical requirements to ISO/IEC 17025:2017 for accreditation of air quality testing laboratories performing various testing.

Scope

This policy addresses technical requirements for work in Air Quality Testing laboratories performing testing of ambient air, work environment (indoor and outdoor) and from stationary sources.

Authorship

This publication has been written by the technical committee, and approved by the accreditation director.

Official language

The text may be translated into other languages as required. The English language version remains the definitive version.

Copyright

Further information

This policy is mandatory for Air Quality Testing Laboratories, and shall be implemented within four months from its issuance date. For further information about this publication, kindly contact JAS-AU.

This document is also available at JAS-AU website where you can update directly.

Contents

1.0 Introduction

This document includes additional accreditation requirements for Laboratories performing Air Quality Testing and it provides a reference for JAS-AU assessors in the assessments of Air Quality Testing Laboratories.

2.0 Personnel

Air quality measurements shall be performed or supervised by competent personnel who are experienced and qualified to degree level in the relevant field. Each laboratory shall set the required minimum years of experience in air quality measurements before being allowed to supervise the training of new personnel.

If the work includes interpretations of monitoring results in the test and/or technical reports, this shall be done by authorized personnel with experience and knowledge in specific application, including, for example, legislative and technological requirements and acceptability criteria. Also, the competent personnel shall be aware of the following:

- Air quality standards and legislations;
- Air quality monitoring;
- Equipment operation and maintenance provided by equipment manufacturers;
- Conducting of in-house calibrations where applicable;
- ISO/IEC 17025:2017 requirements;
- Internal auditing of the management system and technical activities of the facility.

2.1 Responsibilities:

Air quality measurements personnel may be required to perform the following general functions and activities for data quality:

- Purchasing equipment, consumables and spare parts.
- Determining the appropriate monitoring site or sampling points.
- Setting up monitoring equipment, electricity, communication.
- Downloading the data from monitoring equipment.
- Developing work instructions and/or standard operating procedures.
- Preparing/assessing test or technical reports.

The following table summarizes a number of important functions and activities that each person shall be aware of according to the scope of measurements:

Scope	Functions and Activities
Ambient air quality measurements	• Selecting monitoring sites according to the purpose of monitoring. • Installing and operating of the monitoring equipment. • Calibrating equipment, performing quality assurance and control. • Equipment preventive maintenance. • Keep the equipment in a consistent collection conditions. • Monitor the minimum stock of spare parts and consumables and request them when required. • Downloading of the monitoring results. • Keep the monitoring station/caravan/mobile laboratory in appropriate conditions. • Any other responsibilities according to the job description.
Stack emission measurements	• Selecting sampling points. • Conditioning of samples before and after conducting the measurements. • Equipment operation, calibration and maintenance. • Monitor the minimum stock of spare parts and consumables and request them when required. • Documentation of results. • Operation conditions that could affect the performance of the equipment. • Any other responsibilities according to the job description.
Work environment air quality measurements	• Selecting sampling locations. • Equipment operation, calibration and maintenance. • Monitor the minimum stock of spare parts and consumables and request them when required. • Documentation of results. • Operation conditions that could affect the performance of the equipment. • Any other responsibilities according to the job description.

An on-going evaluation of personnel competency shall be done at least once a year and each division head/manager/laboratory supervisor shall be able to judge on both theoretical and practical levels whether personnel meet their jobs' responsibilities and whether improvements are required. The evaluation shall include the evaluation method and the acceptance criteria. There are several methods that could be used to evaluate personnel competency such as proficiency test sample, quality assurance sample, test witness, etc.

3.0 Environmental Conditions

Environmental conditions of the laboratory and/or monitoring site are important to the performance and effectiveness of personnel and equipment. The equipment performance may be affected by several conditions (such as temperature, humidity, vibration, lighting, voltage and dust).

Ambient air quality analyzers under operation shall be placed in a conditioned environment according to the equipment manual. Moreover, the monitoring site shall be free of dust; since ambient air quality analyzer is composed of very sensitive boards and sensors.

Filter samples may be contaminated during preparation leading to incorrect results. So, it is important to prepare them in a separate area.

4.0 Selection, Verification and Validation of Test Methods

4.1 Selection and Verification of Test Methods

Appropriate methods shall be selected for air quality measurements; whether they are standard methods, non-standard methods, laboratory-developed methods or standard methods used outside their intended scope or otherwise modified. The customer shall be informed about any deviation from the test method or principle of measurement.

Quality control requirements set in clause (8) are used for verification of test methods.

4.2 Validation of Test Methods

Most of air quality measurements are conducted using automated equipment, no preparation of solutions and sample is required. So, measurements results are affected by only the personnel and equipment performance.

Validation of test method is very important to show the qualification and competency of the laboratory. Validation of automated air quality analyzer is carried out once or at relatively infrequent intervals during the working life of the analyzer, the validation shall include at least one of the following:

- Detection limit, sometimes the detection limit of the equipment will be determined by the manufacturer and in this case there is no need to recalculate the detection limit.
- Linearity, the acceptable linearity error shall be determined in the equipment manual and it is the responsibility of the monitoring laboratory to ensure the linearity of the equipment.
- Accuracy and precision, the combined uncertainty of the result given by an equipment or measurement method is the estimate of the range of values that the true value can be expected to fall within. It combines in a single value both the precision; the degree of agreement between the successive measurements; and accuracy; how close the measurement is to the true value. The repeatability for any single result is given by the standard deviation multiplied by the value of the mathematical function known as Student`s t (obtained from t-tables) appropriate for that large number of repeats at 95% confidence limits (to be included in the combined uncertainty). While, the bias is the difference between the mean of the results and the accepted true value of the reference gas. The overall uncertainty is the combination of the random (bias) and systematic (repeatability) errors.
- Interlaboratory comparison.

Validation method and results shall be documented and retained in a good manner.

5.0 Sampling

Most of air quality measurements especially gaseous pollutants are monitored using automated analyzers, in which sampling and analysis are conducted inside the equipment. However, in some cases gaseous air pollutants are collected in special solvents (such as deionized water, alkaline solution, acidic solution, etc), in which a solvent preparation is required. Therefore, each laboratory shall set a procedure to address the following:

- Solvent’s preparation
- Sampling procedure
- Sample preservation
- The required information that should be documented during the sampling in order to calculate the final results.

The Technical Guidance Note (M1) published by the Environment Agency can be used as guidance for sampling requirements for monitoring stack emissions to air. For ambient air sampling, the operating procedure (SESDPROC-303) published by U.S. Environmental Protection Agency can be used

6.0 Equipment

Air quality equipment shall be operated in accordance with the operator's written Work Instruction (WI) or Standard Operating Procedure (SOP). WI or SOP shall be derived from the manufacturer's instruction manual and in some cases according to the operator's experience.

Calibration certificates (if available) that are received with the equipment shall be kept properly and be available when they are required. Equipment manufacturers include maintenance and calibration requirements in the operating manuals. The role of the monitoring laboratory is to develop WI or SOP and maintain records of calibration, corrective and preventive maintenance, consumables and spare parts, transferring the equipment from the monitoring laboratory to the monitoring site and vice versa, etc.

To ensure traceability of measurements, requirements of JAS-P04 shall be fulfilled.

7.0 Evaluation of Uncertainty of Measurement

An uncertainty budget for each test shall be prepared. The way of recording uncertainty result and statement shall be mentioned clearly in the uncertainty budget.

For instrumental gas analyzers, the following is a typical list of sources of uncertainty:
- Span and zero noise.
- Span and zero drift.
- Minimum detectable limit.
- Resolution.
- Uncertainty of reference material.
- And any other sources of errors

On the other hand, some air quality measurements depend on calculations (such as particulate measurements in the ambient air using High Volume Air Samplers, particulate emissions from stationary sources, etc). Requirements of JAS-P03 shall be fulfilled.

When reporting a measurement and its uncertainty, the two numbers' significant digits must agree. That is, the uncertainty should reflect the level of precision in the estimate of the quantity. Moreover, the expanded uncertainty shall be reported by using a certain coverage factor (k), to give a level of certain confidence. The commonly used coverage factors are:
k = 1 for a confidence level of approximately 68%
k = 2 for a confidence level of approximately 95%
k = 2.58 for a confidence level of 99%
k = 3 for a confidence level of 99.7%

8.0 Ensuring the Validity of Test Results

Air quality measurements shall be maintained frequently to ensure that the monitoring equipment is working properly and the monitoring results are valid and accurate. The following table summarizes quality control requirements, frequency and criteria of evaluation for air quality analyzers:

Scope	Quality Control Requirements	Frequency of Actions	Evaluation of Actions	Required Tools
Gaseous pollutants in the ambient air	Conducting preventive maintenance according to the equipment's operation manual	In accordance with the equipment's operation manual. However, the frequency could be changed according to the operator justified technical reasons.	The actual diagnostic parameters shall be within the minimum and maximum limits set by the manufacturer.	Spare parts and consumables mentioned in the equipment's operation manual.
	Zero and span check. Span check value is preferred to be within the actual measurements of gaseous pollutants in the	In accordance with the equipment's manufacturer. If the frequency is not mentioned, stationary equipment shall	A criterion (control chart, validation limits,..) for accepting calibration results shall be set.	Nitrogen/zero air generator/multi-gas calibrator/reference material with specific concentration.

Scope	Quality Control Requirements	Frequency of Actions	Evaluation of Actions	Required Tools
	ambient air. However, a reference value within the measurement range of the equipment can be used.	be calibrated on monthly basis, and Removable equipment shall be calibrated after each movement prior to measurement.		
Gaseous pollutants emissions from stationary sources	Conducting preventive maintenance according to the equipment's operation manual	In accordance with the equipment's operation manual. However, the frequency could be changed according to the operator justified technical reasons.	Alarms appeared on the equipment.	Consumables and spare parts mentioned in the equipment's operation manual
	One point span check. The value of span check shall be within the measurement range of the equipment.	The equipment shall be calibrated on monthly basis if it is used frequently. Otherwise, the calibration frequency could be changed depending on the usage.	A criterion (control chart, validation limits,..) for accepting calibration results shall be set.	Zero air generator/multi-gas calibrator/reference material with specific concentration.
Gaseous pollutants inside work environment	Conducting preventive maintenance according to the equipment's	In accordance with the equipment's operation manual. However, the	Alarms appeared on the equipment.	Spare parts and consumables mentioned in the equipment's operation manual.

Scope	Quality Control Requirements	Frequency of Actions	Evaluation of Actions	Required Tools
	operation manual	frequency could be changed according to the operator justified technical reasons.		
	One point span check. The value of span check shall be within the measurement range of the equipment.	The equipment shall be according to the frequency mentioned in the equipment's operation manual.	A criterion (control chart, validation limits,..) for accepting calibration results shall be set.	Zero air generator/multi-gas calibrator/reference material with specific concentration.
Continuous measurements of particulate in the ambient air	Conducting preventive maintenance according to the equipment's operation manual	In accordance with the equipment's operation manual. However, the frequency could be changed according to the operator justified technical reasons.	Alarms appeared on the equipment.	Spare parts and consumables mentioned in the equipment's operation manual.
	Calibration of Beta-counter	In accordance with the equipment's operation manual.	In accordance with the equipment's operation manual or any other criteria.	Membrane span foil
Particulate measurements using High Volume Air Samplers	Conducting preventive maintenance according to the sampler's	In accordance with the sampler's operation manual. However, the frequency could	Sampler performance	Spare parts and consumables mentioned in the sampler's operation manual.

Scope	Quality Control Requirements	Frequency of Actions	Evaluation of Actions	Required Tools
	operation manual	be changed according to the operator justified technical reasons.		
	One-point flow rate verification[1]	In accordance to the sampler's operation manual.	The actual flow rate shall be within the acceptable flow limits of 1.1-1.70 m^3/min for TSP and 1.02-1.24 m^3/min for PM_{10} and $PM_{2.5}$.	Manometer, temperature and atmospheric pressure data logger and orifice meter.
	Multi-point flow calibration	In accordance with the sampler's operation manual.	The correlation coefficient should never be less than 0.90 after a five point calibration.	Manometer and orifice meter.
Particulate measurements inside work environment	Conduct regular preventive maintenance and calibration	In accordance with the equipment's operation manual. However, the frequency could be changed according to the operator justified technical reasons.	Depends on the equipment's operation manual and/or the monitoring laboratory.	Depends on the equipment's operation manual.
Weather conditions (wind	Conduct regular preventive	In accordance with the	Adjustment of the sensors'	Calibrated sensors, compass, etc.

[1]Sometimes seasonal set point can be used for the whole season based on the assumption that the average ambient temperature and pressure would be valid for the whole season and could be taken from the results of the previous years.

Scope	Quality Control Requirements	Frequency of Actions	Evaluation of Actions	Required Tools
speed and direction, temperature and relative humidity)	maintenance and calibration	equipment's operation manual. However, the frequency could be changed according to the operator justified technical reasons.	response based on the calibration results.	

8.1 Proficiency Testing and Interlaboratory Comparison

Proficiency testing determines the performance of individual laboratories for specific tests or measurements and is used to monitor laboratories' continuing performance. Also, it is considered as an interlaboratory comparison as the testing results or measurements will be compared with the testing results or measurements obtained by different laboratories.

Requirements of JAS-P02 shall be fulfilled regarding the frequency of participation in proficiency testing schemes and the competence of providers. In case there is a difficulty to obtain PT provider, other sources to check the performance of the test and individuals could be used.

Interlaboratory comparison is one of many quality assurance tools used to assess data quality and evaluate laboratory practices. Participation shall be annual with two accredited laboratories. Evaluation of results is done as per Annex (1) to this policy.

9.0 Reporting the Results

Test report communicates to the customer the results, opinions and interpretations made during the monitoring. Monitoring results shall be reported accurately, unambiguously and objectively. Also, the principle of measurements shall be mentioned in the test report.

Information required by ISO/IEC 17025 shall be included in each test report, in addition but not limited to the following information:

- Test report number.
- Date and time of measurements.
- Principle of measurement.

- Scope of measurements (ambient, stack, working area,…).

10.0 Safety Requirements

The laboratory shall fulfill JAS-P13 requirements.

References

[1] ISO/IEC 17025:2017, General requirements for the competence of testing and calibration laboratories

[2] The Technical Guidance Note (M1), Sampling requirements for stack emissions monitoring

[3] SESDPROC-303, Ambient Air Sampling

[4] JAS-P02, Policy of proficiency testing

[5] JAS-P03, Policy of measurements uncertainty

[6] JAS-P04, Policy on measurement traceability

[7] JAS-P13, Policy for labs performing environmental and water testing, good laboratory practice

Annex 1 Interlaboratory Comparison

Interlaboratory comparison is one of many quality assurance tools used to assess data quality and evaluate laboratory practices. It may contain real-time samples or ambient level concentrations. The following steps could be used to evaluate the results of interlaboratory comparison:

a) Tabulate all responses above the laboratories lower limit of detection.
b) Calculate total average and standard deviation for each compound.
c) Establish critical values (Lower Critical Value = St Dev x 1.28 – mean and Upper Critical Value= St Dev x 1.28 + mean).
d) All values that fall within the critical value limits will be included in the adjusted mean and standard deviation calculations.
e) Graphs are formed comparing all laboratory responses against the adjusted mean and standard deviation response.
f) Each laboratory is notified of its performance, comparing their individual response to the adjusted mean response, for each of the compounds it had reported.