



ACCREDITATION SCHEME FOR LABORATORIES

Technical Notes ENV 001
Specific Requirements for
Environmental Testing Laboratories

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1. INTRODUCTION

- 1.1 This document describes the specific requirements for compliance by environmental testing laboratories.
- 1.2 This document shall be studied in conjunction with ISO/IEC 17025 General Requirements for the Competence of Testing and Calibration Laboratories, SAC-SINGLAS 002 Requirements for the Application of ISO/IEC 17025, Proficiency Testing Technical Note 001 and other ENV Technical Notes published by SAC-SINGLAS. For the use of Reference Materials, refer to ISO Guide 33:2015 Reference materials – Good practice in using reference materials. For undated references, the latest edition of the referenced document (including any amendments) applies.

2. SCOPE

- 2.1 The scope of the Environmental Testing field covers various environmental media, such as air, water/wastewater and solid/semisolid hazardous wastes. SAC-SINGLAS will accredit environmental testing laboratories on an analyte specific basis.

3. SAMPLING

- 3.1 Special consideration shall be given to the procurement, storage and transportation of samples to be analysed. Procedures shall ensure as far as possible that the analyte originally present have not undergone degradation or concentration and that contaminating impurities which might interfere with the analysis have not been added.
- 3.2 Sample containers of appropriate materials shall be used and cleaned by the specified procedures.
- 3.3 Where sampling is not within the control of the laboratory, clients submitting samples for analysis shall be instructed on the correct manner of selecting and cleaning suitable containers and on the procedures for taking representative or grab samples as appropriate.

4. REAGENTS AND CULTURE MEDIA

- 4.1 Laboratory personnel shall be made aware of their responsibilities on the use of suitable reagents, solvents, culture media, reference materials and laboratory ware in terms of the types of analysis they conduct.
- 4.2 Proper storage of reagents and culture media shall be observed according to the requirements set up by the manufacturers.
- 4.3 Chemical reagents, solvents and gases are generally available in various grades and purity. The appropriate grade of materials as specified in the methods or procedures shall be used.
- 4.4 All reagent containers shall be labelled and tightly closed. They shall bear the original label, or as a minimum: reagent name, date of receipt, strength, solvent (if not water), any special precautions or hazards and date of expiry. The person responsible for the preparation of the reagent shall be

identifiable either from the label or from records.

- 4.5 Laboratories shall establish written procedures for preparation of reagent solutions and culture media. Records of such preparation shall be maintained for later reference in case of doubtful test result. Records for reagent solutions shall include measured weights and volume, burette readings, pH readings, calculation of standardisation factor and solution concentration. For culture media, they shall include medium name, batch number, amount prepared, pH before and after autoclaving, autoclave time and pressure.
- 4.6 For substances that are classified as “hazardous substance” under prevailing national regulations, they shall be kept separately from other reagents and held in locked cabinets. These substances shall be handled in accordance to the rules and guidelines set out in the Environmental Pollution Control Act.
- 4.7 All solvents shall be checked for GLC-detectable contaminants before use in extraction and concentration analysis (eg. by concentrating 200 mL down to 1 mL and injecting 4µL aliquots into the GLC system to be used for analysis of the sample extracts).
- 4.8 Where laboratory prepares its own media, the chemicals used for such preparation shall be verified to be of the appropriate quality before use.
- 4.9 Laboratory shall have procedures for verifying the suitability of culture media used. Both positive and negative controls shall be applied simultaneously together with the material to be tested under the same testing condition. The size of the inoculums used in positive controls shall be appropriate to the sensitivity required.

5. PURIFIED WATER

- 5.1 Purified water is one of the most critical but most often neglected reagents used in laboratory operations. Failure to prepare water properly and to use water suitably may account for the poor performance of some analytical methods.
- 5.2 Distillation of water will not always ensure quality. The design of the still, the materials of construction, and the character of the raw water all influence the quality of the distillate. The storage container, too, can significantly influence the purity of the water, especially if the water is stored for extended periods before use.
- 5.3 A high-grade ion-exchange system can produce water of suitable purity for many laboratory purposes, but this method does not remove some impurities.
- 5.4 Stills need periodic cleaning to remove scale. When the feed water is of poor quality because of hardness and/or dissolved organic compounds, it may be necessary to combine water softening (deionising) and an activated-carbon-filtration system before distillation to achieve water of suitable purity.
- 5.5 For metal analysis, it may be necessary to use water distilled from an all-borosilicate glass distillation system. Special clean water systems may be necessary for trace elements, liquid chromatographic and other analysis.
- 5.6 Specific conductance or specific resistance is used as a measure of the

inorganic quality of purified water. Purified water can be defined as water that has been distilled and/or deionized so that it has a specific resistance of more than 500,000 ohms-cm or a conductivity of 2.0 microohms/cm or less.

- 5.7 Purified water used for preparation of culture media and reagents for microbiological tests shall be free from toxic metals, bactericidal or inhibitory compounds. The bacteriological quality of purified water shall be monitored frequently and the bacterial populations shall not be more than 10^3 CFU/mL. (Refer APHA 9020)

6. CERTIFIED REFERENCE MATERIALS AND REFERENCE MATERIALS

6.1 Certified Reference Materials (CRM)

- 6.1.1 Reference material, accompanied by documentation (e.g. COA) issued by an authoritative body* and providing one or more specified property values with associated uncertainties and traceabilities, using valid procedures.

6.1.2 Values associated with CRMs (by definition) are metrologically traceable.

6.1.3 For traceability provided by reference material producers, refer to SAC-SINGLAS 006 Clause 5.2

**Note : Reference materials supplied by other commercial companies have to be accredited by their national accreditation bodies for their competency for preparing and supplying CRMs in accordance with ISO Guide 30/31/32/33/34/35.*

6.2 Reference Materials

6.2.1 Material, sufficiently homogeneous and stable with reference to specified properties, which has been established to be fit for its intended use in measurement or in examination of nominal properties.

6.2.2 Values associated with reference materials may not be metrologically traceable.

6.2.3 For microbiology testing, refer to clause 6.3.

6.3 Reference Microorganisms

6.3.1 The laboratory shall hold reference cultures of microorganisms, where appropriate, from a recognised national/international collection to demonstrate traceability.

6.3.2 Reference cultures may be subcultured preferably once, but not more than five times from the original culture to provide reference stocks. The reference stocks must be used to prepare working stocks for routine work and they must not be re-frozen and re-used once thawed. Working stocks shall not be sub-cultured to replace reference stocks. Records of subculturing shall be kept.

6.3.3 Appropriate technique shall be used to preserve the reference microorganisms so that the desired characteristics of the strains are maintained. The laboratory shall assign suitable staff for maintenance of reference microorganisms. Written protocols for culture maintenance shall be

available in the laboratory.

6.4 The traceability requirements for reference materials in ISO/IEC 17025 are described in Clause 5.6.3.2.

6.5 Standard solutions may be classified as Certified Reference Materials or Reference Materials.

7. VALIDATION OF METHODS

7.1 Methods shall be validated by carrying out analyses of reference standards of known concentration, both in isolation and in the form of spiked samples, and determining the recovery through each stage of the procedure (i.e. extraction, concentration of the extract and clean-up of the extract).

7.2 All reagents for use in validation of methods shall be of an acceptable purity.

7.3 Where applicable, the method of quantification shall be evaluated using solutions of the analyte in a suitable solvent. An internal standard shall be included where possible.

7.4 The detection limits, linearity and reproducibility of analysis shall be evaluated on spiked material containing standards covering the expected concentration range.

7.5 Replicated analyses shall be carried to ascertain the repeatability of analysis. Inclusion of a control sample in subsequent analyses will serve to check for deviations from the established method.

7.6 The stability of the analyte in the sample matrix during storage and throughout the analysis procedure shall be evaluated.

7.7 Method validation may also consist of analysing the same sample material by different methods and comparing the recovery of known amounts of reference standard.

8. RECOVERIES

8.1 Residue recoveries are determined by carrying out the entire analysis procedure on original 'clean' samples and samples of the same material spiked with known concentrations of analyte. It is most important that the spiked bulk material be homogenous and it is recommended that sufficient replicate analyses of the spiked and unspiked sample should be carried out in order to determine the percentage relative standard deviation for each analyte present.

8.2 A record must be kept of spiked sample preparation and should contain all relevant particulars such as the name of the person preparing the spiked materials, date of preparation, identification of the spiking standard solution, concentration of the analyte contained in the spike, a batch or identification number, and a discard date.

8.3 Laboratories making fewer than one routine analysis per week should analyse a corresponding spiked reference sample with each routine sample. When large number of samples are being analysed, one spiked reference

sample should be analysed with every nine routine samples to confirm residue recoveries.

9. CROSS CONTAMINATION

9.1 The laboratory shall be able to demonstrate that the accommodation cannot lead to the contamination of sample or sample extracts. Work areas in which the analysis is done should preferably be separated from all other laboratory operations.

9.2 Separate work areas shall be available for the following operations:-

- a) Cleaning of glasswares, purification of reagents and solvents;
- b) Dismantling of sampling trains following the taking of samples;
- c) Highly contaminated samples must be extracted and clean up in a separate work area from relatively low-level samples;
- d) Analytical instruments must be housed in a separate area provided with adequate air-conditioning;
- e) Adequate and appropriate storage facilities must be available for
 - (i) the storage of sample before, during and following analysis;
 - (ii) the storage of materials used in the course of analysis;
 - (iii) the safe storage of hazardous and non-hazardous wastes prior to disposal
 - (iv) Decontamination of persons and protective clothing.

9.3 Washing-up procedures shall be rigorous enough to ensure no carry-over of residues. All efforts shall be made to prevent possible sources of cross-contamination.

9.4 Reference standards, standard solutions and spiked samples shall be stored in a dedicated refrigerator and away from samples for analysis.

10. LABORATORY PERSONNEL

10.1 The technical manager (however named) shall preferably possess tertiary qualifications from a recognised institution in environment/science discipline and have at least 3 years of laboratory experience.

10.2 Persons in senior technical position shall preferably have tertiary qualifications in a relevant scientific field or relevant working experience in the accredited area. At least one year of laboratory experience or an equivalent in-house training in relevant analysis is required.

10.3 For specialised area eg. *Legionella*, the nominated signatory shall preferably have formalised internal/external training in the area. A scheduled quality control check shall be formalised to ensure that faculty for correct evaluation of result is maintained for all technicians eg. CDC's ELITE Programme for Legionella Testing.

11. QUALITY CONTROL PROCEDURES

11.1 For quality control, each batch shall include one QC sample and a reference

matrix blank (eg. reagent water). QC samples must be either a homogenous sample of the same (or similar) matrix analysed repeatedly with each batch, or duplicate analyses of one or more samples in each batch.

12. QUALITY ASSURANCE

- 12.1 Laboratories shall operate a formal quality assurance programme. The minimum requirements of this programme consist of an initial demonstration of laboratory capability, analysis of spiked samples spiked with labelled compounds to evaluate and document data quality, and analysis of standards and of solvent and/or sample matrix blanks as tests of continuing performance.
- 12.2 The following analytical characteristics must be established by means of the procedures described in the test method:-
- a) Initial precision and accuracy;
 - b) Method performance on the sample matrix, by analysis of spiked recovery samples;
 - c) Recovery of labelled compounds in the labelled compound spiking standard;
 - d) Method blanks, by analysis of reference matrix blanks.

13. PROFICIENCY TESTING

- 13.1 Participation in proficiency testing programmes is rendered mandatory. All environmental testing laboratories are required to participate in proficiency testing programmes at least one per area over the validity of the certificate when available.
- 13.2 The laboratories accredited for the analysis of Legionella testing should participate in a recognised programme at least once a year. The testing method used in the proficiency programme should be that is routinely used for analysis of samples.
- 13.3 The opportunity shall be taken whenever possible to have the samples analysed by two or more analysts.
- 13.4 The results of participation in proficiency trials shall be recorded and, where poor results have been obtained, details of corrective action taken by the laboratory shall also be recorded.

14. RETAINED SAMPLES

- 14.1 A retained sample is a part of the material originating from the same consignment as the analytical sample and preserved at the laboratory for future use in case of a dispute over the findings.
- 14.2 Where applicable, a representative sample with sufficient quantity shall be retained for a specified period. It shall be properly sealed, appropriately identified and stored under appropriate conditions.

15. VOLUMETRIC GLASSWARE

- 15.1 All volumetric equipment shall be suitably maintained and calibrated. Exemption is made for the case of Class A volumetric equipment, with valid calibration certificates. Laboratories shall adhere to the standard method set out in ASTM E 542 or equivalent for the calibration of volumetric ware.

16. SAFETY

- 16.1 Laboratories shall uphold a standard of safety and adhere to safe working practices as outlined in recognised standards such as APHA 1090, ASTM E 50, AS/NZS 2243 or equivalent.
- 16.2 Laboratories shall ensure that its personnel wear protective clothing at all times and safety equipment appropriate to the duties being performed
- 16.3 Laboratories shall also provide fire extinguisher, safety shower and eye bath in close proximity to the laboratory working area.
- 16.4 Many of the compounds and materials used during the extraction, cleanup and analytical stages of environmental analysis are hazardous. Due care shall be taken to recognise the specific hazards presented by each compound and to ensure the safety of analysts involved in testing by:
- a) using a system of labelling that identifies the substance and the hazards involved, and sets out simple precautionary measures to be followed;
 - b) having available material safety data sheets for all substances in use in the laboratory;
 - c) providing all testing staff with appropriate training in safe handling procedures;
 - d) following strict procedures written into analytical methods;
 - e) ensuring that good housekeeping practices are adhered to, that all spillages are cleaned up without delay and apparatus are cleaned up after use;
 - f) providing adequate and safe means of containing and disposing of all waste materials in accordance with waste disposal authorities and statutory requirements.