Guidelines for Forensic Science Laboratories

ILAC-G19:2002

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PREAMBLE

The general requirements for the competence of testing and calibration laboratories are described in ISO/IEC 17025. These requirements are designed to apply to all types of calibration and objective testing and therefore need to be interpreted with respect to the type of calibration and testing concerned and the techniques involved.

This document does not re-state all the provisions of ISO/IEC 17025 and laboratories are reminded of the need to comply with all of the relevant criteria detailed in ISO/IEC 17025. The clause numbers in this document follow those of ISO/IEC 17025 but since not all clauses require interpretation, the numbering may not be continuous.

This document may also be used by accreditation bodies to provide appropriate criteria for the assessment and accreditation of laboratories providing forensic services.

Laboratories are also reminded of the need to comply with any relevant statutory or legislative requirements.

PURPOSE

This document is intended to provide guidance for laboratories involved in forensic analysis and examination by providing application of ISO/IEC 17025.

AUTHORSHIP

This document has been produced in consultation with Working Group 4 of the ILAC Technical Accreditation Issues Committee, and approved for publication by the ILAC General Assembly in 2001.

1. SCOPE

Forensic science refers to the examination of scenes of crime, recovery of evidence, laboratory examinations, interpretation of findings and presentation of the conclusions reached for intelligence purposes or for use in court. The activities range from instrumental analysis with unequivocal results, such as blood alcohol determination and glass refractive index measurement, to the investigation of suspicious fires and vehicle accidents, to comparison work such as handwriting and toolmark examination, which is largely subjective in nature but which, with training, can produce consistent outcomes between different forensic scientists.

1.1 Forensic science work involves the examination of a wide range of items and substances. The following list describes the activities that may be encountered in a forensic laboratory. This does not, however, preclude other activities being undertaken in a forensic laboratory.

Controlled Substances

- Controlled pharmaceutical and illicit drugs
- Related chemicals and paraphernalia
- Botanical material

Toxicology

- Pharmaceutical products
- Poisons
- Alcohol

Hairs, Blood, Body Fluids and Tissues

- Serology
- DNA profiling

Trace Evidence

- Fire debris
- Pyrotechnic devices
- Glass
- Paint
- Metals and alloys
- Fibres and hairs
- Adhesives
- Oils and greases
- Lachrymatory chemicals
- Fertilisers
- Acids
- Food
- Feedingstuffs and ancillary items
- Components of technical or household appliances
- Botanical material (excluding controlled substances)
- Hydrocarbon fuels
- Explosives and explosion debris
- Light filaments
- Vehicle components
- Firearm discharge residues
- Clothing / garments
- Dyes and pigments
- Cosmetics
- Soils
- Corrosives
- Alkalis
- Lubricants and spermicidal agents
- Electrical devices and components
- Manufacturers marks (incl serial number restoration)

Firearms and ballistics

- Firearms
- Bullets and cartridges

Handwriting and Document Examination

- Handwriting
- Paper
- Rubber stamps
- Security marks
- Printers and other printed objects
- Inks and printing materials
- Copiers and copied material
- Indentations
- Typewriters and typewritten material
- Embossing and embossed materials

Fingerprints
- Fingerprints
- Footprints
- Palmprints

Marks and Impressions
- Toolmarks
- Shoe prints
- Glove marks
- Toolmarks and impressions
- Tyre prints
- Fabric prints
- Non-friction ridge body prints

Audio, Video and Computer Analysis
- Audiotape recordings
- Language samples
- Image enhancement
- Facial mapping
- Speech samples
- Computers (hardware and software)
- Videogrammetry
- Recovery of information

Accident Investigation
- Tachograph charts
- Component failures
- Speed calculations
- Car immobiliser systems
- Trace evidence
- Unsafe loads
- Electrical failures

Scene Investigation
- Crime scene investigation
- Computer simulations
- Fire investigation
- Evidence recovery
- Photography
- Blood splash pattern interpretation

Forensic pathology, Entomology, Odontology

1.2 The techniques adopted in the analysis and examination of forensic material cover a broad range from visual examination to sophisticated instrumental procedures. Techniques which are employed include but are not limited to:

- Chemical colour tests
- Chemiluminescence
- Chromatography
- Atomic absorption and emission spectrometry
- Ultraviolet, infrared and visible spectrophotometry
- Optical and electron microscopy
- Serology
- Electrophoresis
- Metallurgy
- Autoradiography
- DNA analysis
- Mass spectrometry
- Nuclear magnetic resonance spectroscopy
- Physical measurements eg weight, volume, length, density, refractive index
- X-ray analysis
- Immunoassay
- Visual inspections
- Computer simulations

It is anticipated that the majority of the work carried out in forensic science laboratories will be capable of satisfying the definition of an objective test, although in some instances a different emphasis may be placed on the particular aspect of 'control' required. The level of training and experience for staff involved in the work will be dependent on the nature of the examination or test.

2. REFERENCES

ISO/IEC 17025:1999, *General requirements for the competence of testing and calibration laboratories.*

ISO/IEC Guide 2, *General terms and their definitions concerning standardisation and related activities.*

ISO Guide 30:1992, *Terms and definitions used in connection with reference materials*.

ILAC-P10: 2002, *ILAC Policy on Traceability of Measurement Results*

ILAC-G2: 1994, *Traceability of measurements*

3. TERMS AND DEFINITIONS

For the purposes of the Guide, the relevant terms and definitions given in ISO/IEC Guide 2 apply.

Objective Test

A test which having been documented and validated is under control so that it can be demonstrated that all appropriately trained staff will obtain the same results within defined limits. These defined limits relate to expressions of degrees of probability as well as numerical values.

Objective tests will be controlled by:

- documentation of the test
- validation of the test
- training and authorisation of staff
- maintenance of equipment

and where appropriate by;

- calibration of equipment
- use of appropriate reference materials
- provision of guidance for interpretation
- checking of results
- testing of staff proficiency
- recording of equipment/test performance

Visual inspection, qualitative examinations and computer simulations are included in the definition of objective test.

Reference Collection

A collection of stable materials, substances, objects or artefacts of known properties or origin that may be used in the determination of the properties or origins of unknown items.

Court Statement

A written report of the results and interpretations of forensic tests/examinations submitted to court. Such reports may be in a format prescribed in legislation.

4. MANAGEMENT REQUIREMENTS

4.12 Control of Records

4.12.2.1a) The forensic science laboratory should have documented procedures to ensure that it maintains a coordinated record relating to each case under investigation. The information that is to be included in case records should be documented and may include records of telephone conversations, evidence receipts, descriptions of evidence packaging and seals, subpoenas, records of observations and test/examination results, reference to procedures used, diagrams, print-outs, autoradiographs, photographs, etc. In general, the records required to support conclusions should be such that in the absence of the analyst/examiner, another competent analyst/examiner could evaluate what had been performed and interpret the data.

b) Where instrumental analyses are conducted, operating parameters should be recorded.

c) Where appropriate, observations or test results should be preserved by photography or electronic scanning (eg electrophoretic runs, physical matches). Photocopies, tracings or hand-drawn facsimiles may also be suitable (eg thin-layer chromatography results, questioned documents).

d) When a test result or observation is rejected, the reason(s) should be recorded.

e) Calculations and data transfers which do not form part of a validated electronic process should be checked, preferably by a second person. The case record should include an indication that such checks have been carried out and by whom.

f) Each page of every document in the case record should be traceable to the analyst/examiner and where appropriate, to a uniquely identified case or exhibit. It should be clear from the case record who has performed all stages of the analysis/examination and when each stage of the analysis/examination was performed (eg relevant date(s)).

g) Laboratory generated examination records should be paginated using a page numbering system which indicates the total number of pages.

h) The laboratory should have documented policies and procedures for the review of case records, including test reports.

Where independent checks on critical findings are carried out by other authorised personnel, the records should indicate that each critical finding has been checked and agreed and by whom the checks were performed. This may be indicated in a number of ways including entries against each finding, entry on a summary of findings or a statement to this effect in the records.

5. TECHNICAL REQUIREMENTS

5.2 Personnel

5.2.1 The laboratory should have a defined policy that ensures that all staff working in the laboratory are competent to perform the work required. The term 'competent' implies possessing the requisite knowledge, skills and abilities to perform the job. The laboratory's policy should also include procedures for retraining and maintenance of skills and expertise.

Where test or technique specific training is given, acceptance criteria should be assigned eg observation of the relevant tests or analyses by an experienced officer, satisfactory performance in the analysis of quality control/quality assurance samples, correlation of results with those obtained by other trained staff. Where necessary, training programs should also include training in the presentation of evidence in court.

5.2.5 A laboratory should have clear statements of the competencies required for all jobs and records should be maintained to demonstrate that all staff are competent for the jobs they are asked to carry out.

Each laboratory or section should maintain an up-to-date record of the training that each member of staff has received. These records should include academic and professional qualifications, external or internal courses attended and relevant training (and retraining, where necessary) received whilst working in the laboratory.

Records should be sufficiently detailed to provide evidence that staff performing particular tasks have been properly trained and that their subsequent ability to perform these tests has been formally assessed.

5.3 Accommodation and Environmental Conditions

5.3.3 Special care is needed in forensic testing laboratories involved in the analysis or determination of trace levels of materials, including DNA. Physical separation of high-level and low-level work is required. Where special areas are set aside for this type of work, access to these areas should be restricted and the work undertaken carefully controlled. Appropriate records should be kept to demonstrate this control. It may also be necessary to carry out 'environmental monitoring' of equipment, work areas, clothing and consumables.

5.3.4 a) Access to the operational area of the laboratory should be controllable and limited. Visitors should not have unrestricted access to the operational areas of the laboratory. A record should be retained of all visitors to the operational areas of the laboratory.

b) Evidence storage areas should be secure to prevent theft or interference and there should be limited, controlled

access. The storage conditions should be such as to prevent loss, deterioration and contamination and to maintain the integrity and identity of the evidence. This applies both before and after examinations have been performed.

5.4 Test and calibration methods and method validation

5.4.1 All methods should be fully documented including procedures for quality control, and, where appropriate, the use of reference materials.

5.4.2 a) All technical procedures used by a forensic science laboratory should be fully validated before being used on casework.

b) Where a laboratory introduces a new (validated) method, it should first demonstrate the reliability of the procedure in-house against any documented performance characteristics of that procedure.

Records of performance verification should be maintained for future reference.

c) Laboratories should institute a procedure to identify infrequently performed tests or analyses. For these tests or analyses, there are two methods of demonstrating competence, either of which would be equally valid. These are:

i. regular analysis of control samples and use of control charts even when casework samples are not being analysed; or

ii. reverification before the test or analysis in question is performed on a casework sample involving at least the use of an appropriate reference material, followed by replicate testing or analysis of the real sample.

d) The quality of standard materials and reagents should be adequate for the procedure used. Lot/batch numbers of standard materials and critical reagents should be recorded. All critical reagents should be tested for their reliability.

Standard materials and reagents should be labelled with:

- name;
- concentration, where appropriate,
- preparation date and or expiry date;
- identity of preparer;
- storage conditions, if relevant;
- hazard warning, where necessary.

5.4.5.1 All technical procedures used by a forensic science laboratory must be fully validated before being used on casework.

Methods may be validated by comparison with other established methods using certified reference materials (where available) or materials of known characteristics. In validating test methods, the following issues (among others) may need to be determined, as appropriate:

- matrix effects
- interferences
- sample homogeneity
- concentration ranges
- specificity
- stability of measured compounds
- linearity range
- population distribution
- precision
- measurement uncertainty

Validation studies can be conducted by the scientific community (as in the case of standard or published methods) or by the forensic science laboratory itself (as in the case of methods developed in-house or where significant modifications are made to previously validated methods).

5.5 Equipment

5.5.2 As part of a quality system, all laboratories are required to operate a program for the maintenance and calibration of equipment used in the laboratory. The equipment used in a forensic science laboratory is diverse and will range across a number of different scientific and technical disciplines.

a) General service equipment not directly used for making measurements (e.g. hot plates, stirrers, non-volumetric glassware, cameras, refrigerators, thermal cyclers).

Such equipment will typically be maintained by visual examination, safety checks and cleaning as necessary. Calibrations or performance checks will only be necessary where the equipment setting can significantly affect the test or analytical result (eg temperature of a muffle furnace or constant temperature bath).

b) Microscopes including attachments

Microscopes should be cleaned and serviced periodically. Steps should be taken to ensure that microscopes are properly set up for use and are used only by competent staff. Where microscopes are used for measurement the guidance given in paragraph d) applies.

c) Volumetric equipment

Volumetric equipment will typically be maintained by visual examination and cleaning but calibration and performance checks will need to be carried out before initial use and at intervals depending on the type and frequency of use.

d) Measuring instruments - thermometers, balances, densitometers, chromatographs, spectrometers and spectrophotometers, refractometers, autoanalysers, DNA sequencers

Correct use combined with periodic servicing, cleaning and calibration will not necessarily ensure that a measuring instrument or detection system is performing adequately. Therefore, where appropriate, periodic performance checks shall be carried out and predetermined limits of acceptability shall be assigned. The frequency of such performance checks should be determined by need, type and previous performance of the equipment.

It is often possible to build performance checks or system suitability checks into test methods (eg chromatographic systems, measurement of glass refractive index). These checks should be documented and should be satisfactorily completed before the equipment is used or before results are accepted.

e) Computers and data processors

5.6 Measurement traceability

5.6.1 Individual calibration programs should be established depending on the specific requirements of the testing or analytical work being carried out. It will normally be necessary to check instrument calibration after any shut down, whether deliberate or otherwise, and following service or other substantial maintenance. In general, calibration intervals should not be less stringent than manufacturers' recommendations.

5.6.2.2.2 For many types of analysis, 'calibration' may be carried out using synthetic standards containing the analytes under test, prepared within the laboratory from chemicals of known purity and composition, or matrix matched standards. Alternatively, 'standard' solutions may be purchased. Many chemicals can be purchased with manufacturer's statements or certificates. Wherever possible, laboratories should obtain supplies of chemical standards from competent suppliers.

5.6.3.2 Reference collections of data or items/materials encountered in casework which are maintained for identification, comparison or interpretation purposes (eg mass spectra, motor vehicle paints or headlamp lenses, drug samples, typewriter printstyles, wood fragments, bullets, cartridges, DNA profiles, frequency databases) should be fully documented, uniquely identified and properly controlled.

5.7 Sampling

5.7.1 Selection, recovery, prioritisation and sampling of materials from submitted test items and from scenes of crime are important parts of the forensic process. In the area of forensic science emphasis is placed on the competence of the scientist and the training of staff in these activities is therefore of prime importance. Laboratories should ensure that there are documented procedures and training programs to cover this aspect of their work and that detailed

competency/training records are kept for all staff involved.

5.8 Handling of test and calibration items

5.8.1 For legal purposes, forensic science laboratories should be able to demonstrate that the items/samples examined and reported on were those submitted to the laboratory. A 'chain of custody' record should be maintained from the receipt of items/samples which details each person who takes possession of an item or alternatively the location of that item (eg if in storage).

5.8.4 There should be documented procedures which describe the measures taken to secure exhibits in the process of being examined which must be left unattended.

5.9 Assuring the quality of test and calibration results

5.9.1 a) Analytical performance should be monitored by operating quality control schemes which are appropriate to the type and frequency of testing undertaken by a laboratory. The range of quality control activities available to laboratories includes the use of :

- reference collections;
- certified reference materials and internally generated reference materials;
- statistical tables;
- positive and negative controls;
- control charts;
- replicate testing;
- alternative methods;
- repeat testing;
- spiked samples, standard additions and internal standards;
- independent checks (verification) by other authorised personnel.

Depending on the particular test being performed, the laboratory may make use of one or several of these examples to demonstrate that the test or examination is 'under control'.

The quality control procedures necessary in any particular area of work should be determined by the laboratory responsible for the work, based on best professional practice. The procedures should be documented and records should be retained to show that all appropriate QC measures have been taken, that all QC results are acceptable or, if not, that remedial action has been taken.

b) An effective means for a forensic science laboratory to monitor its performance, both against its own requirements and against the performance of peer laboratories, is to take part in proficiency testing programs. When participating in proficiency testing programs, the laboratory's own documented test procedures should be used. Performance in the programs should be reviewed regularly and where necessary, corrective action should be taken.

Proficiency testing records should include:

- full details of the analyses/examinations undertaken and the results and conclusions obtained;
- an indication that performance has been reviewed;
- details of the corrective action undertaken, where necessary.

c) The laboratory should have and follow a documented procedure whereby the testimony of each examiner is monitored on a regular basis. The evaluation should include appearance, performance and effectiveness of presentation. The monitoring procedure should also prescribe the remedial action that is to be taken should the evaluation be less than satisfactory.

5.10 Reporting the results

5.10.2 It is accepted that forensic science laboratories may not be able to include all of the items in 'Court Statements' that are detailed in sub-clause 5.10 of ISO/IEC 17025 as the format of these documents is prescribed in legislation. Forensic science laboratories may therefore elect to adopt one or more of the following means of meeting these requirements.

- the preparation of a test report which includes all of the information required by ISO/IEC 17025;

- the preparation of an annex to the Court Statement which includes any additional information required by ISO/IEC 17025;
- ensuring that the case record relating to a specific investigation contains all the relevant information required by ISO/IEC 17025.

ANNEX: BIBLIOGRAPHY

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Specific Criteria for Forensic Analysis, Raad voor Accreditatie (RVA), October 1993.

The International Laboratory Accreditation Cooperation (ILAC) is the principal international forum for the exchange of ideas and information on laboratory accreditation.

Established in the late 1970s, ILAC membership has grown rapidly and includes representatives from the world's major laboratory accreditation systems in Europe, Asia, North America, Australia and the Pacific. Countries that are developing their own laboratory accreditation systems are also welcome to participate and contribute.

ILAC operates a series of committees which investigate issues such as the harmonisation of international laboratory accreditation practices, the effectiveness of mutual recognition agreements in facilitating trade and the promotion of the aims and awareness of laboratory accreditation around the world.

There are regular meetings of individual ILAC committees as well as a major plenary meeting of all ILAC members.

The activities of ILAC affect a diverse range of areas including standardisation, accreditation, certification, testing, calibration, and regulation in both the public and private sectors.

ILAC has a comprehensive website at www.ilac.org which contains a wealth of information regarding accreditation, testing, trade related publications and other information of interest to industry, regulators, government, trade bodies, laboratories, accreditation bodies, and users of testing and calibration services.

The following ILAC publications are available free of charge on the ILAC website at www.ilac.org:

Brochures
ILAC Information Brochure
Why Use An Accredited Laboratory?
Why Become An Accredited Laboratory?
How Does Using an Accredited Laboratory Benefit Government & Regulators?
The Advantages of Being An Accredited Laboratory

Information Documents (I Series)

ILAC-I1:1994	Legal Liability in Testing
ILAC-I2:1994	Testing, Quality Assurance, Certification and Accreditation
ILAC-I3:1996	The Role of Testing and Laboratory Accreditation in International Trade
ILAC-I4:1996	Guidance Documents for the Preparation of Laboratory Quality Manuals

Guidance Documents (G Series)

ILAC-G2:1994	Traceability of Measurement
ILAC-G3:1994	Guidelines for Training Courses for Assessors
ILAC-G4:1994	Guidelines on Scopes of Accreditation
ILAC-G7:1996	Accreditation Requirements and Operating Criteria for Horseracing Laboratories
ILAC-G8:1996	Guidelines on Assessment and Reporting of Compliance with Specification
ILAC-G9:1996	Guidelines for the Selection and Use of Certified Reference Materials
ILAC-G10:1996	Harmonised Procedures for Surveillance & Reassessment of Accredited Laboratories
ILAC-G11:1998	Guidelines on Assessor Qualification and Competence
ILAC-G12:2000	Guidelines for the Requirements for the Competence of Reference Material Producers
ILAC-G13:2000	Guidelines for the Requirements for the Competence of Providers of Proficiency Testing Schemes
ILAC-G14:2000	Guidelines for the Use of Accreditation Body Logos and for Claims of Accreditation Status
ILAC-G15:2001	Guidance for Accreditation to ISO/IEC 17025
ILAC-G17:2002	Introducing the Concept of Uncertainty of Measurement in Testing in Association with the Application of the Standard ISO/IEC 17025
ILAC-G18:2002	The Scope of Accreditation and Consideration of Methods and Criteria for the Assessment of the Scope in Testing
ILAC-G19:2002	Guidelines for Forensic Science Laboratories

Secretariat Documents (S Series)

ILAC-S1:2000	Guidelines for the Proposal, Drafting, Approval and Publication of ILAC Documents
ILAC-S2:1998	Rules

Procedural Documents (P Series)

ILAC-P1:2000	ILAC Mutual Recognition Arrangement (Arrangement): Requirements for Evaluation of Accreditation Bodies
ILAC-P2: 2000	ILAC Mutual Recognition Arrangement (Arrangement): Procedures for the Evaluation of Regional Cooperation Bodies for the Purpose of Recognition
ILAC-P3: 2002	ILAC Mutual Recognition Arrangement (Arrangement): Procedures for the Unaffiliated Bodies for the Purpose of Recognition
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