Specific Criteria for Accreditation
Electrical Testing

The NZ mark of competence
Tohu Matatau Aotearoa

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AS LAB C3

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Contents

1 Introduction

International Accreditation New Zealand (IANZ) Specific Criteria are an elaboration of the General Criteria for Accreditation for specific fields of test and calibration, test technologies, products or materials. They address items that are essential or most important for the proper conduct of a test or calibration. Specific Criteria provide detail or add extra information to the generally stated requirements of the IANZ General Criteria for Accreditation, which remains the governing document. A list of all published Specific Criteria is available on www.ianz.govt.nz or from IANZ on request.

This criteria document must be read in conjunction with current issues of ISO/IEC 17025 and the IANZ publication *Procedures and Conditions for Accreditation* (AS 1), the latter document describing the organisation and operation of the IANZ Accreditation Programmes (references 1 and 2).

ISO/IEC 17025 is a general document designed to apply to all types of testing and calibration laboratories. This criteria document, on the other hand, provides information and interpretation on classes of test, staff, accommodation, equipment and other aspects of good laboratory management practice which are considered to be minimum standards for electrical testing laboratories being accredited against ISO/IEC 17025.

2 Scope

This criteria schedule sets out the specific requirements an electrical testing laboratory has to meet, in addition to the general requirements of ISO/IEC 17025, if it is to be accredited by IANZ. Additional requirements for laboratories to gain United States Federal Communications Commission (USFCC) and United States Department of Homeland Security (USDHS) recognition are covered in:

1. Supplementary Criteria for Accreditation: *Accreditation of Testing Laboratories for RF Equipment Authorization* (AS LAB C3.1)
2. Supplementary Criteria for Accreditation: *Accreditation of Testing Laboratories for P25 CAP Laboratory Recognition* (AS LAB C3.2)

3 Classes of Test

IANZ Accreditation does not constitute a blanket approval of all of a laboratory's activities. The classes of test are an arbitrary subdivision of the potential range of activities involved in electrical testing on the basis of the type of measurements being made, the scientific disciplines involved and the techniques employed. It is therefore possible for a particular test or technique to be included under several classes of test. However, these classes and subclasses do not necessarily constitute any restriction on the work which a laboratory can perform but provide a convenient means of expressing an accredited laboratory's capabilities.

Accreditation is normally granted only for work which is performed regularly and for which the laboratory is properly equipped and has demonstrated its capability. The extent of a laboratory's scope of accreditation will therefore vary with the range of work performed, the scope and complexity of the tests involved, the competence and organisation of laboratory staff and the level of technology available in the laboratory.

The field of electrical testing covers tests of an essentially electrical nature performed on instruments, equipment, appliances, components, and materials (covered in Appendix 1). The calibration of electrical and electronic measuring instruments and equipment is included in the Metrology and Calibration field (refer to IANZ Specific Criteria for Accreditation: *Metrology and Calibration*, AS LAB C5).

Issued Schedules to the Certificate of Accreditation (Scopes of Accreditation) can be viewed via the IANZ Directory at www.ianz.govt.nz.

3.1 Requested extensions to scope of accreditation

It is relatively common for electrical testing laboratories to expand their testing capabilities for new standards, new clauses of an existing accredited standard, or for an equivalent standard of an existing accredited standard. A laboratory may request an extension of their scope and must provide records of verification (refer to verification of methods in ISO 17025) that include an analysis of the new testing standard highlighting the existing and new capabilities required to perform the testing.

Depending on the reference equipment, environment requirements, level of technical competence and other factors, such an extension may be reviewed and authorised by IANZ without a visit to the laboratory.

However, at the discretion of IANZ, a limited assessment with a technical expert may be required. In any case, time spent by IANZ staff on extensions to scope, where substantial, is chargeable, as is time given by a technical expert.

Please see the *Procedures and Conditions for Accredit*ation (reference 2) for more information.

4 Laboratory Accommodation and Safety

4.1 Accommodation

Accommodation requirements for electrical testing laboratories vary quite widely depending upon the nature of the items to be tested and the uncertainty with which measurements are to be made. A formal laboratory area will be required for precise electrical measurements but many measurements and tests can be satisfactorily performed in production areas or in the field.

Formal laboratory areas must have good lighting (minimum of 400 lux), adequate bench space, freedom from dust and fumes, freedom from vibration and acoustic noise and have appropriate control of temperature and humidity. The extent to which these environmental factors apply will vary according to the type of measurement and precision (uncertainty) with which measurements are made.

When precise measurements are to be made in laboratories, the following factors may assume greater importance:

(a) Isolation from sources of mechanical vibration and shock likely to have a detrimental effect on sensitive instruments, e.g. lifts, plant rooms, busy roads, etc.

(b) Smooth, antistatic finishes for walls, ceilings and floors, and—where necessary—air filtration to facilitate dust control

(c) Wall insulation, double glazing of windows and shading from direct sunlight

(d) Temperature control of the laboratory where relevant but in any case with variation typically less than 2 °C per hour

(e) Humidity control as required (typically in the range 35 %rh to 70 %rh)

(f) Isolation from electromagnetic interference. This is less likely to be necessary for DC and low frequency AC measurements but assumes importance at RF frequencies. Screening may be necessary for some precise electrical measurements (see particular requirements for Open Area Test Sites-OATS below). Radiation from local transmitters and computer equipment may be a hazard to many measurements and its effects may need to be assessed.

(g) Stabilisation or filtering of incoming mains power supply where purity of waveform and constancy of voltage are important

(h) Management of the laboratory environment by regular cleaning

(i) Freedom from fumes that are likely to have an adverse effect on equipment (and staff).

4.1.1 Open Area Test Sites (OATS)

OATS must comply with the requirements of the IEC International Special Committee on Radio Interference (CISPR) 16-1 (see reference 3). For category (d) sites, pre-OATS scanning of the equipment under test (EUT) must be carried out in a screened room and any emissions that could be masked by ambient emissions must be identified in the report.

Note: Use of a screened room for EMC emission measurement is not currently an option under CISPR procedures.

Site attenuation tests must be carried out regularly as required by CISPR 16-1.

Test sites used to make measurements above 1 GHz will need to have the site Voltage Standing Wave Ratio (VSWR) measured and recorded to demonstrate compliance with CISPR 16-1-4:2010 or American National Standards Institute (ANSI) C63.4:2014, depending on customer and/or market regulator requirements. Compliance with alternative editions of these standards may be permitted if required by the regulator.

4.2 Safety

While safety falls outside the scope of accreditation, laboratories are expected to comply with the Electrical Safety Regulations and any other relevant health and safety requirements. AS 2243 is recommended as a guide to safe practices in laboratories.

For laboratories performing electrical testing where there is a higher health and safety risk, for example high voltage, the laboratory should endeavour to have at least two staff members present during the testing.

4.3 Access to Test Areas

Laboratories carrying out type tests on electrical equipment will be expected to control access to test areas to provide security for new client designs and innovative technical solutions, particularly where the laboratory is contained within a production facility and performs tests for the public.

5 Equipment Management and Calibration

Management and calibration requirements for equipment are given in ISO/IEC 17025. Guidelines on calibration intervals for laboratory equipment are given in Appendix 2.

5.1 Metrological Traceability

Traceability of a measurement result is ensured when the result can be related to a stated reference through a documented unbroken chain of calibrations, each contributing to the measurement uncertainty (see reference 4). The IANZ policy on traceability of measurement is set out in the IANZ Technical Policy No.1: *Traceability of Measurement* (reference 5). All IANZ accredited electrical testing laboratories are required to maintain conformity with this policy.

The calibration certificates issued by accredited laboratories must be endorsed in accordance with the requirements of the accreditation bodies concerned. This constitutes proof of traceability to the International System of Units (SI), via national standards. The calibration certificate must include a statement on the traceability to the SI (or appropriate International Reference, such as ITS-90 for temperature), and reference may be made to the national measurement institute if desired. An example of such a statement is: “Measurements reported in this certificate are traceable to the SI via the Measurement Standards Laboratory of New Zealand” or similar.

The endorsement on a calibration certificate does not automatically mean that the calibration is fit for the purpose and meets the requirements of the laboratory. However, a laboratory receiving a calibration certificate will need to consider its contents before placing the reference equipment back into use. If this step is missed and/or if a piece of reference equipment had not been appropriately verified before being put back into service, it can mean that the laboratory may need to recall work which has already been completed and reported in endorsed reports.

For example, some things to consider may be: are all the required ranges and/or parameters reported, is the uncertainty presented in an understandable and appropriate way, are there any non-compliances with specification, or measurements in the window of uncertainty (WOU), is the report suitably (fully) endorsed.

Calibration certificates endorsed with the logo of an ISO 9001 certifying body alone will not be accepted for critical measurements where traceability is required.

5.2 Calibration

Calibration involves controlled comparison of the device under calibration (DUC) against a “known” instrument over the range of values of use of the DUC. The differences between the “known” instrument and the DUC are tabulated as corrections to the DUC for a range of pre-selected calibration points. Calibration does not involve adjustment; that is a separate process which may also be carried out as part of the service offered by the calibration agency. The uncertainty and these differences must be reported for the comparison process. Electrical laboratories must obtain such calibration certificates for all critical measuring equipment. Alternatively, they may perform comparisons in-house where they have appropriate reference equipment and can demonstrate performance to a documented method. Uncertainty of measurement must be determined for internal calibration of critical items.

Where electrical instruments submitted to a calibration laboratory are likely to be adjusted, appropriate "as received" measurements must be requested by the submitting electrical laboratory. The full calibration is then carried out after the adjustment. If this procedure is not followed, then historical stability data is lost along with the electrical testing laboratory's ability to take appropriate corrective action on out-of-calibration equipment. Historical stability data can be used to justify extending calibration intervals.

When the laboratory’s reference equipment contains software adjustments for calibration purposes, these adjustments must be made only by the laboratory carrying out the reference equipment calibration. Once an adjustment has been made, any existing calibration certificate is invalidated.

5.2.1 Thermocouples

The effects of inhomogeneity, compensating leads, cold junction compensation and thermal losses on temperature measurements should be evaluated. It is important to note that the emf in a thermocouple is produced at the temperature gradient and not at the thermocouple tip. Calibrations of thermocouples should include the compensating lead to be used.

Type K thermocouple wire can suffer from large errors arising from its immersion history. Where critical high temperature measurements need to be made, use of a type N wire is advised in place of type K.

Standard uncertainty due to thermocouple inhomogeneity can be evaluated using the following formula:

$u = 0.15 + 0.0003 \cdot t + 0.000004 \cdot t^2$

Where:

u = standard uncertainty for thermocouple inhomogeneity,

t = temperature in degrees Celsius.

5.2.2 Performance Verification

The manufacturer's performance verification against the equipment specification is not considered to be a calibration unless an appropriate range of the instrument’s hardware and software is covered.

5.3 Electronic Instruments

Electronic and software controlled instruments are acceptable as reference devices providing their long term stability and total uncertainty are considered appropriate (see Appendix 2).

6 Computer Controlled Test Equipment

Appropriate quality assurance is needed of all in-house developed software (see ISO/IEC 17025). Automatic test equipment must be calibrated in a similar manner to other equipment being calibrated.

The following comments apply to the use of computers for direct data capture and control of the calibration operation. Where control is by proprietary software such as that supplied with some calibrators, validation will only be required of the individual calibration routines for instruments and not for the programme supplied by the manufacturer.

For in-house developed software, standard packages of raw data can be developed for feeding through the system to check routines on development or modification of the system. Care should be taken to ensure that such packages cover the expected range of values and include combinations of peculiar circumstances to highlight faults in basic logic of the programme or its subroutines. Alternative systems using spreadsheets or other software may also be used.

Reference artefacts may be held to check the operation of the whole system at appropriate intervals. The results of this testing should be recorded and incorporated in the maintenance history. Software maintenance should include a back-up regime and a system recovery plan.

Electronic data must be treated in an equivalent way to hard copy to ensure it is not lost or changed without an audit trail. In most situations this takes the form of version control and change history.

7 Laboratory Staff

ISO/IEC 17025 gives the general requirements for laboratory staff and management. The requirements for laboratory key technical personnel are set out in Appendix 3.

Staff assessing products for conformance with electrical safety requirements will be expected to have a tertiary electrical engineering or related qualification and to have extensive knowledge of the risks against which protection is required e.g. electric shock, fire, burning of skin and of other important aspects of the relevant test specifications.

Staff assessing products for conformance with EMC requirements will be expected to have a tertiary electrical engineering or related qualification and to have extensive knowledge of the risks against which protection is required e.g. the effect of unwanted emissions on other users of the spectrum, the effect of emissions on critical electrical and electronic equipment such as medical equipment for critical care, air traffic control equipment, etc. In addition, staff seeking to be a key technical person would need to be familiar with immunity requirements for equipment under test as specified in the relevant test specifications.

Staff assessing products for conformance with Spark New Zealand, Australian Communications and Media Authority (ACMA) or similar telecommunications requirements will be expected to have a tertiary electrical engineering or related qualification and to have extensive knowledge of the electrical safety risks against which protection is required e.g. the risks associated with any low voltage items which form a part of the telecommunications terminal equipment (TTE), the additional risks to the public switched telephone network (PSTN) posed by the low voltage equipment, the additional risks to the network introduced by the PSTN side of the TTE. Testing staff would be expected to be familiar with relevant test specifications.

Laboratory staff performing electrical safety type tests, tests on TTE and EMC tests within a production facility must be independent of the production management and any influence or direction from that management that could affect the proper outcome of the tests. They would also be expected to have a good knowledge, whether they use it to advise clients or not, of the design types and general component arrangements that provide physical protection to the product, network or user against such risks.

8 Laboratory Test Methods

Where test methods and in-house calibration methods are based on standard test methods or manufacturer's methods, these must be tailored for the laboratory's own test equipment. Calibration procedures must exercise all relevant parts of the hardware and software of the instrument, particularly for in-house calibration purposes.

9 Uncertainty of Measurement

Electrical testing laboratories certifying conformance with specification limits for electrical safety and electromagnetic compatibility tests must define and document a policy on calculation of measurement uncertainties (see references 6, 7 and 8 for guidance; the second is preferred).

The policy must include consideration of all contributions to uncertainty (type A and type B) and must define the method the laboratory will use to combine these effects and the confidence interval within which the test result can be expressed. Where relevant, measurement uncertainties must be reported in test reports.

When test results lie within the uncertainty band about a specification limit, the laboratory must define its policy on reporting conformance and must report the uncertainty.

10 Identification of Items under Test

Items under test must be uniquely and unambiguously identified. This may include circuit diagrams, block diagrams, operating manuals, board layouts, photographs, drawings as well as the version and configuration of any software used in the item. For type testing, in particular, accurate characterisation of the design type that was certified as complying is critical.

The item under test submitted for final approval must be representative of production. Any modifications made to the hardware or software of the item to enable it to comply must also be explicitly identified in the records of the test unless the test is to be completely repeated.

11 Reports and Records

Reports covering electrical safety testing or EMC type tests must cover all relevant clauses of the applicable test method. Where any clause is not applied, the report must clearly show that it is not relevant or the report must refer to another report where those clauses were assessed.

When test methods relating to particular appliances or equipment call up clauses from generic methods such as AS/NZS 3100 or AS/NZS 60335.1, then the report must clearly and unambiguously show that these have been covered in the tests. One way to ensure this is to use the testing report format of the International Electrotechnical Commission System of Conformity Assessment Schemes for Electrotechnical Equipment and Components Certification Body (IECEE CB) Scheme.

Reports covering retests of equipment that had previously failed to comply must clearly show what modifications have been made to the equipment and, where these are partial tests, must make clear reference to the earlier report covering the other compliant clauses. Where complete retests are carried out, detail of modifications is not as important as specifying the new design with drawings, photos, layouts, PCB designs, etc.

Where cords, switches, plugs, etc. are deemed to comply on the basis of test reports supplied by the customer, these must be:

(a) From a laboratory accredited by IANZ or by a national laboratory accreditation authority with which IANZ has a mutual recognition arrangement or from a CB accredited laboratory, and

(b) The applicable report must be referenced as required by accreditation criteria (see ISO/IEC 17025 and the appendix in *Procedures and Conditions for Accreditation*).

11.1 Reporting statements of conformity

ISO/IEC 17025 (clause 7.8.6) requires the Decision Rule to be defined when making a statement of conformity. This usually refers to stating the measurement uncertainty and whether it was applied as a guard band to the acceptance tolerance or not. For many testing standards the Decision Rule is inherent in the standard by stating the accuracy requirements of the testing and measuring equipment to be used. In this case laboratories may report compliance to the limit of the acceptance tolerance. Laboratories must assess equipment calibration records to confirm that equipment meets specified accuracy requirements (including the measurement uncertainty and any unapplied corrections (errors of indication). If specified accuracy requirements cannot be met the laboratory must apply an appropriate guard band to the acceptance tolerance.

For laboratories performing electrical safety testing to IEC based standards it is accepted practice to make a conformance statement on test reports that all equipment met the specified accuracy requirements, such as those specified by the IEC Committee of Testing Laboratories (CTL) in IECEE OD-5014:2019 Instrument Accuracy Limits.

12 Proficiency Testing

The IANZ policy on participation in proficiency testing activities is set out in the IANZ Technical Policy No.2: *Participation in Proficiency Testing Activities* (Reference 9). All IANZ accredited electrical testing laboratories are required to maintain conformity with this policy.

13 References

1. ISO/IEC 17025: *General requirements for the competence of testing and calibration laboratories.*
2. IANZ General Criteria: *IANZ Procedures and Conditions for Accreditation* (AS 1)
3. CISPR 16-1: *Specification for Radio Disturbance and Immunity Measuring Apparatus and Methods, Part 1: Radio Disturbance and Immunity Measuring Apparatus*
4. JCGM 200: *International vocabulary of metrology-Basic and general concepts and associated terms (VIM)*
5. IANZ Technical Policy 1: *IANZ Measurement traceability policy* (AS TP1)
6. UKAS M3003: *The expression of Uncertainty and Confidence in Measurement for Calibration*

7. JCGM 100: (GUM 1995 with minor corrections) - *Evaluation of measurement data — Guide to the expression of uncertainty in measurement*
8. ETSI Report ETR 028: *Radio Equipment and Systems; Uncertainties in the measurement of mobile radio equipment characteristics*, Edition 2, 1994
9. IANZ Technical Policy 2: *IANZ PT participation policy* (AS TP2)

Appendix 1: Classes of Test – Electrical Testing

Laboratories are accredited for classes of test. Individual laboratories may be accredited for the performance of a single class of test, for any combination of the classes of test listed or even for one specific test within a class of test.

Divisions in the list of classes of test are based essentially on the nature of instruments, equipment, components or materials under test. While some exceptions to the general principle have been inevitable, this method of division of the field has been adopted to reduce repetition. As the scope of accreditation of any individual laboratory normally details the range of frequency, current, voltage, etc., in which measurements are made, it is possible for each class of test to cover the work of laboratories with widely differing interests. The list of classes of test is used with flexibility to ensure that the scope of accreditation of each laboratory is fully informative, to the advantage of both the laboratory and its clients.

3.01 Conductors and Resistance Alloys

3.02 Resistors, Resistance Boxes and Potential Dividers

3.03 Insulators and Insulating Materials

- (a) Electric strength tests
- (b) Insulation resistance tests
- (c) Surface and volume resistivity tests
- (d) Loss tangent tests
- (e) Relative permittivity tests
- (f) Direct voltage tests
- (g) Alternating voltage tests
- (h) Tracking
- (i) Dielectric dispersion coefficient
- (j) Moisture absorption
- (k) Insulating oils and oil insulated systems
- (l) Ageing
- (m) Partial discharge tests
- (n) Impulse voltage tests
- (o) Thermal stability tests
- (p) Other tests

3.05 Magnetic Materials and Magnetic Instruments

- (a) Magnetic materials
- (b) Magnets, solenoids and Helmholtz coils
- (c) Magnetic permeameters
- (d) Magnetic frames and squares
- (e) Fluxmeters
- (f) Magnetometers and search coils
- (g) Hibbert magnetic standards and other flux linkage generators
- (h) Flux density meters

3.20 Cells and Batteries

- (a) Primary cells
- (b) Accumulators
- (c) Power conditioners

3.21 Power Supplies and Stabilisers

- (a) Power supplies
- (b) Stabilisers
- (c) Power conditioners

3.23 Power Rectifiers and Switches

- (a) Rotary, vibratory, and other mechanical types
- (b) Silicon controlled rectifiers and allied control devices
- (c) Vacuum tube rectifiers
- (d) Semiconductor rectifiers

3.24 Electronic Components

- (a) Fixed resistors
- (b) Capacitors
- (c) Semi-conductor devices
- (d) Printed circuits
- (e) Connectors
- (f) Relays
- (g) Integrated circuits
- (h) Other components and sub-assemblies

3.25 Communications Equipment

- (a) Line transmission measuring equipment
- (b) Radio transmission measuring equipment
- (c) Field intensity measuring equipment
- (d) Electrical noise and interference measuring equipment

(e) Impedance and reflection measuring equipment

(f) Spectrum analysis measuring equipment

(g) Data transmission equipment

(h) Power measuring equipment

(i) Attenuators and amplifiers

(j) Waveguide and coaxial components

(k) Communication systems

(l) Data acquisition systems

(m) Processor controlled systems

(n) Other equipment

3.30 Electrical Machines and Auxiliary Apparatus

(a) Motors, generators and other rotating machines

(b) Starters, controllers, regulators

(c) Other equipment

3.31 Circuit Switching and Rupturing Devices

(a) Circuit breakers and controllers

(b) Protection and control relays

(c) Switches and isolators

(d) Time switches

(e) Fuses and fuse links

(f) Surge diverters

3.35 Cables and Feeders

(a) Conductor resistance tests

(b) Insulation resistance tests

(c) Capacitance tests

(d) Direct voltage tests

(e) Alternating voltage tests

(f) Spark tests

(g) Partial discharge tests

(h) Dielectric tests

(i) Electric field intensity tests

(j) Magnetic field flux density tests

(k) Sequence impedance tests

(l) Electrical tests on fittings

(m) Mechanical tests on fittings

(n) Other tests

3.36 Power Supply Equipment and Systems

(a) Electrical parameters

(b) Waveform characteristics

(c) Power system disturbances

(d) Temperature rise and thermal rating tests

(e) Other tests

3.40 High Voltage Testing

(a) Direct voltage tests

(b) Alternating voltage tests

(c) Impulse voltage tests

(d) Impulse current tests

(e) Partial discharge tests

(f) Dielectric tests

(g) Switching impulse voltage tests

3.41 Radio communication Equipment

(a) Receiving equipment

(b) Transmitting equipment

3.42 Electromagnetic Compatibility Testing

(a) Radiated emissions

(b) Radiated susceptibility

(c) Conducted emissions

(d) Conducted susceptibility

(e) Transient testing

3.43 United States Federal Communications Commission Recognised Laboratory (47 CFR Part 2.948)

3.44 United States Department of Homeland Security P25 CAP Recognised Laboratory

3.45 High Power and High Current Testing

(a) Short time withstand and peak withstand current tests

(b) Short circuit making and breaking capacities

(c) Making and breaking capacities

(d) Overload performance

(e) Electrical endurance

(f) Arcing fault tests due to internal fault

(g) Determination of cut-off current characteristic

(h) Determination of joule integral characteristic

(i) Temperature rise tests

(j) Other tests

3.50 Optical Fibre Systems

(a) Optical power

(b) Optical attenuation

(c) Optical wavelength

(d) Optical time-domain reflectometry

(e) Optical bandwidth

(f) Optical fibre system components

(g) Fibre and core geometry

(h) Other tests

3.60 Environmental Tests

(a) Cold tests

(b) Dry heat tests

(c) Damp heat tests

(d) Impact tests

(e) Vibration tests

(f) Acceleration tests

(g) Storage tests

(h) Mould growth tests

(i) Corrosion tests

(j) Low air pressure tests

(k) Change of temperature tests

(l) Sealing tests

(m) Solar radiation tests

(n) Soldering tests

(o) Robustness of terminations tests

(p) Combined tests

(q) Other specified tests

3.65 Miscellaneous Electrical Tests

(a) Insulating gloves and tools

(b) High voltage operating equipment

(c) Insulated platform vehicles

(d) Fire extinguishers

(e) Other tests

3.70 Antistatic Materials

(a) Flooring

(b) Other tests

3.75 Performance Tests on Telecommunications Equipment

3.80 Approval Tests on Electrical Appliances

3.85 Performance Tests on Electrical Appliances and Accessories

3.90 Electrical Equipment for Explosive Atmospheres

3.95 Electromedical Equipment

(a) Approval tests

(b) Performance tests

3.96 Medical Treatment Areas

(a) Antistatic flooring

(b) Patient equipotential areas

Appendix 2: Recommended Calibration Intervals

The following table sets out the normal periods between successive calibrations for a number of reference standards and measuring instruments. It must be stressed that each period is generally considered to be the maximum appropriate in each case providing that the other criteria as specified below are met:

(a) The equipment is of good quality and of proven adequate stability, and

(b) The laboratory has both the equipment capability and staff expertise to perform adequate internal checks, and

(c) If any suspicion or indication of overloading or mishandling arises, the equipment will be checked immediately and thereafter at frequent intervals until it can be shown that stability has not been impaired.

Where the above criteria cannot be met, appropriately shorter intervals may be necessary. IANZ is, however, prepared to consider submissions for extension of calibration intervals based on factors such as history of stability, frequency of use, accuracy required, ability of staff to perform regular checks and successful participation in proficiency testing programmes. It is the responsibility of the testing laboratory to provide evidence that its calibration system will ensure that confidence in the equipment is maintained. Application of the requirements of ISO 10012, Parts 1 and 2 need to be considered when seeking an extension of intervals.

Items marked with an asterisk in the table are those which can be calibrated in-house by the staff of a laboratory if it is suitably equipped and the staff are competent to perform such re-calibrations. Inter-comparisons may also be carried out by laboratory staff. Where calibrations have been performed by the staff of a laboratory, adequate records of these measurements must be maintained, which includes the measurement uncertainty estimations.

The second column shows the maximum recommended period between the initial calibration and the first recalibration. The third column shows the maximum period between subsequent recalibrations, where applicable, provided that the two earlier calibrations indicate that the item is stable. These recalibration intervals apply only to equipment of good quality and stability that is used, handled and stored with care. Excessive usage of equipment would lead to a reduction in these periods.

Equipment	**Recommended maximum period (years)between successive calibrations**	
	Initial	**Subsequent**
Attenuators	Three (attenuation and frequency response). Resistance and return loss check annually where appropriate.	Three
Bridges	Three (full calibration). Range check annually.	Three
Capacitors	Three. Inter-compare annually.	Five
Digital meters*	One	Two
Digital calibrators with self-checking	One	Two
Inductors	Three. Inter-compare annually.	Three
Instruments, indicating and recording* (analogue only)	Three. Inter-compare every six months or more frequently as required.	Three

Equipment	Recommended maximum period (years)between successive calibrations	
	Initial	Subsequent
Instrument and ratio transformers	Five	Five
Instrument transformer test sets	Three (full calibration). Annual inter-comparison of transformers to detect major problems.	Five
Potentiometers	Five	Five
Resistors	One, after initial drift rate has been established. Inter-compare annually.	Three
RF noise sources	Two	Two
RF power measuring equipment	One, for power references. Three, for thermistor and diode sensors. Annual check of VSWR.	Three
Signal generators	One (frequency accuracy, output level and attenuator ratio).	Two
Standard cells and electronic references	One. Inter-compare at least three monthly to establish drift rate of a group. One cell in a group needs to be calibrated annually then inter-compare with group as required.	One
Time, time interval, and frequency standards*	One. Note: Calibration interval dependent on equipment frequency type and accuracy required. This may be as frequently as daily if the highest possible performance is required (via TV line six). Audit the data collection system every two years	One
Transfer standards, AC-DC	Five, with annual self-check for a stand-alone passive instrument. Two, for active devices.	Five Two
Volt ratio boxes	Three. Annual resistance checks.	Three
Watt-hour meters (electromechanical)	One. Inter-compare every three months.	Two
Wattmeters and watt-hour meters (electronic)	One, with regular inter-comparisons; intervals to be based on performance history.	Two
	Ancillary Equipment	
Accelerometers	One	One

Equipment	Recommended maximum period (years)between successive calibrations	
	Initial	**Subsequent**
Anemometers	One	One
Environmental chambers*	Three: time and spatial variation (temperature variations, recovery time, rate of ventilation).	Five
Balances and weighing appliances	One year initially. *Additional requirements and considerations in MSL Technical Guide 12.*	Up to three years depending on use.
Force testing machines	Two to five years depending on type (where required by a standard method this period may be less).	Two to five
Hygrometers* (a) Assman and sling type psychrometers (b) mechanical (e.g. hair type) thermohygrometers (c) electrical impedance sensor (d) chilled mirror sensor (e) other	 Six months (compare thermometers at room temperature with wick dry). Five, (complete calibration) Three months. One One One	 Five One One One One
Masses	One to five years depending on use and accuracy required (See AS LAB C5)	One to five
Micrometers, dial gauges, callipers etc.*	See IANZ Technical Guide AS TG 1	
Pressure and vacuum gauges (a) Reference (b) Working*	 One One (with three-to-six monthly internal intermediate checks)	 Two One
Thermocouples (probe only) (a) rare metal	 100 hours use or three years whichever is the sooner.	

Equipment	Recommended maximum period (years)between successive calibrations	
	Initial	**Subsequent**
(b) base metal	Calibration intervals to suit the particular application.	
Thermometers		
(a) reference liquid-in-glass	Five years (full calibration). Check ice point immediately after initial calibration then at least every six months.	Five
(b) working liquid-in-glass*	Five years (full calibration). Check ice point immediately after initial calibration then at least every six months. **or alternatively** Inter-compare with reference thermometer(s) at points in the working range every six months (See IANZ Technical Guide AS TG 3 *Working Thermometers – Calibration Procedures*).	Five
(c) electronic (sensors that are thermocouples, thermistors or other integrated circuit devices)*	One year (full calibration)	One
(d) resistance reference	Five years (full calibration) or when the ice point drift is more than five times the uncertainty of calibration. Check at ice point before use or at least every six months.	Five
(e) resistance working	Working hand-held resistance thermometers can be checked using the alternative procedure for glass thermometers above.	
EMC and Electrical Safety Testing Equipment		
Absorbing Clamps	Annual calibration or verification	One
Antennae	Three years	Three
Artificial networks (EMC and Telecoms) (LISN etc)*	Annual checks of voltage division factor, rf impedance, and mains voltage drop at rated current and no load.	One
Attenuators, cables, couplers and preamplifiers*	Annual calibration or verification	One
Harmonic and voltage fluctuation measuring equipment	Annual calibration. Intermediate checks as appropriate.	One
Immunity field strength meters	Three years	Three

Equipment	Recommended maximum period (years)between successive calibrations	
	Initial	Subsequent
Impact hammers	Five years	Five
Impulse testers	Annual calibration or verification	One
ESD testers	Annual full calibration for two years then three years with intermediate checks on voltage network in house.	Three
Receivers	Annual calibration.	One
Surge generators and other immunity testing equipment	Intermediate checks as appropriate.	

Appendix 3: Key Technical Personnel and Other Staff

Supervisory staff in accredited organisations must be competent and experienced in the technical areas covered by their accreditation. They must be able to oversee the operations and cope with any problems that might arise in their work or that of their colleagues or those who report to them. Such staff members, formally appointed by the senior management of the laboratory, are referred to as Key Technical Personnel.

Key Technical Personnel are the knowledgeable staff members who, where relevant:

(a) Develop and implement new procedures

(b) Design quality control procedures, set action criteria and take corrective actions

(c) Identify and resolve problems

(d) Authorise the release of reports/results

(e) Take responsibility for the validity of test results.

Every accredited organisation must have at least one Key Technical Person covering each class of test activity on its scope of accreditation. Accreditation is automatically suspended for any scope item(s) where there is no Key Technical Person for the item(s) due to Key Technical Personnel leaving the organisation or otherwise losing their approval for that part of the scope.

The qualifications and experience required of Key Technical Personnel and other technical staff members cannot be rigidly specified but must be appropriate to the work in which they are engaged. Key Technical Personnel would normally hold tertiary qualifications or equivalent professional recognition in the relevant discipline. Organisations engaged in a restricted range of repetitive work may have that work controlled by a Key Technical Personnel with appropriate practical experience and specific training in that work but without formal qualifications.

Requirements for Key Technical Personnel

(a) Appointment of Key Technical Personnel will be the responsibility of a designated senior laboratory officer who is a member of the laboratory's senior management team. Laboratories are required to have a documented person/position specification for Key Technical Persons and a documented and formal process for their qualification and appointment.

(b) The laboratory will maintain a list of current Key Technical Personnel, including the technical scope of their areas of responsibility. This list may be included in the laboratory's quality manual or as a separate document, but must be maintained up-to-date at all times. The technical scope for each individual will be described in a manner to suit the laboratory's circumstance and organisational structure, but there must be at least one Key Technical Person appointed for each test or group of testing activities in the laboratory's scope of accreditation. The laboratory may choose to use the Classes of Test detailed in Appendix 1, with additional qualifiers as appropriate, but this is not mandatory.

(c) The list of Key Technical Personnel and their individual scope of responsibility must be notified to IANZ who will maintain this listing for each accreditation. IANZ will request this information in the Application for Accreditation and will review it with laboratories during their assessment.

(d) Changes to Key Technical Personnel listings (including individuals who have left the laboratory, new Key Technical Person appointments, or changes in the technical scope of responsibility) made between annual assessments must also be notified to IANZ. This is the responsibility of the laboratory's Authorised Representative.

(e) In addition to the laboratory's usual training records, each Key Technical Person is required to have a brief CV-type summary of qualifications and experience. This CV information will be requested to be provided to IANZ for each appointed Key Technical Person in the Application for Accreditation/Reassessment documentation. This information is also expected to be provided to IANZ when new Key Technical Personnel are appointed and notified to IANZ outside of annual assessments.

(f) Where a laboratory loses the sole Key Technical Person for all or part of their scope of accreditation, and no new appointment is made by the laboratory management then the laboratory's accreditation (or part thereof) will be suspended until such time as a new appointment is notified to IANZ. Where new Key Technical Personnel appointments are made outside of routine reassessments, and particularly when a new appointment is the sole Key Technical Person for all or part of the accreditation, IANZ reserves the right to conduct an on-site assessment of the laboratory to be assured the laboratory's systems and integrity of the laboratory's test results will continue to be maintained.

(g) All IANZ-endorsed test reports issued by an accredited laboratory must be signed or authorised by a Key Technical Person holding approval in the relevant class(es) of test, who will take full responsibility for the validity of the work. Authorisation can be by signing or by electronic signature with appropriate software safeguards covering release of the report information.

A Key Technical Personnel may be appointed to a person engaged by an accredited organisation as a consultant, with respect to work done within the scope of accreditation of that organisation, provided that there is a written agreement between the parties setting out the extent of the authority and responsibility of the consultant in relation to the services provided. The consultant's position in the organisation must be such that they can perform their role as a technical decision maker, as effectively as if they were an employee.

Staff members of the accredited organisation who are not engaged full time are also eligible as a Key Technical Person, provided that the circumstances in which they are called upon to exercise their function and their access to, and knowledge of, the technical operations are such that they are able to take full responsibility for the results they authorise.

The position and function of a Key Technical Person are quite distinct from that of an Authorised Representative. An organisation will normally have only one Authorised Representative who is appointed by the organisation and is only the contact point for IANZ and need not have any particular professional or technical expertise. However, the organisation may have several Key Technical Personnel approved by IANZ and with their own individual areas of expertise.

An Authorised Representative who is not also a Key Technical Person may not authorise the release of IANZ endorsed reports.