

## Policy on Measurement Traceability

PS5

### 1) Purpose

This Statement outlines INAB policy on traceability of measurement.

### 2) Definition of Traceability

The formal definition of **Traceability** is given in the “International Vocabulary of Basic and General Terms in Metrology” (see VIM:1993, 6.4) as the *“property of the result of a measurement or the value of a standard whereby it can be related to stated references, usually national or international standards, through an unbroken chain of comparisons all having stated uncertainties”*.

Traceability is further characterised as:

- 2.1) **An unbroken chain of comparison** going back to a stated references acceptable to the parties, usually a national or international standard.
- 2.2) **Uncertainty of measurement**; the uncertainty of measurement for each step in the traceability chain must be calculated or estimated according to agreed methods and must be stated so that an overall uncertainty for the whole chain may be calculated or estimated.
- 2.3) **Documentation**; each step in the chain must be performed according to documented and generally acknowledged procedures the results must be recorded.
- 2.4) **Competence**; the laboratories or bodies performing one or more steps in the chain must supply evidence for their technical competence, e.g. by demonstrating that they are accredited.
- 2.5) **Reference to SI units**; the chain of comparisons must, where possible, end at primary standards for the realisation of the SI units.
- 2.6) **Calibration interval**; calibrations must be repeated at appropriate intervals; the length of these intervals will depend on a number of variables, e.g. uncertainty required, frequency of use, way of use, stability of the equipment.

### 3) Background

Because measurement results form the basis for many critical decisions in testing and inspection, it is crucial that all measurements are made with the appropriate assurance of accuracy and traceability.

Proper calibration of instrumentation traceable to international measurement standards is an essential first step to ensuring the required accuracy.

Accuracy is defined as the closeness of the agreement between the result of a measurement and the (conventional) true value of the measured quantity. The quantitative expression of this concept should be in terms of uncertainty. The accuracy of measurement achieved is influenced by a number of factors, including:

- The nature of the measuring instrument used;
- The calibration status of the measuring instrument;
- The environment in which the measurement is carried out;
- The procedure followed in performing the measurement.

The responsibility for specifying the level of uncertainty to be achieved in tests lies with the laboratories/inspection bodies themselves. Therefore the organisation's testing / inspection arrangements (including supporting calibration) have to be sufficient (and have to be shown to be sufficient) to achieve the level of uncertainty claimed. The verification that these arrangements are indeed adequate to ensure the level of uncertainty claimed will form a central part of the INAB assessment procedure. INAB will also wish to establish that the claimed uncertainty is compatible with limits stated or implied in technical specifications for the tests / inspections for which the laboratory holds or seeks accreditation, and that it is consistent with generally accepted technical considerations in the area of testing / inspection concerned.

Traceability of measurement is essential if the results of various measurements are to be mutually comparable, and if uncertainty of measurement is to be meaningfully assigned. INAB requires that all measurements necessary for the proper performance of a test/inspection be traceable, where the concept is applicable. This applies not only to the principal measurements involved in the test / inspection, but also to any subsidiary measurements that may significantly affect the results of the test / inspection or its validity. Thus for electrical impedance tests at a specified frequency, the measurements of frequency as well as impedance should be traceable back to national standards. Likewise, in the testing of concrete cubes to BS 1881, not only should the load calibration of the compression testing machine be traceable to national force standards, but measurements to establish cube weight should also be traceable back to national standards of mass.

If traceability is to achieve its purpose, not only must an unbroken chain of calibrations exist, but every calibration in the traceability chain must be carried out in a technically sound manner: the staff, equipment, environment and procedures involved in the calibration must be adequate for the task involved. The precise technical requirements that are appropriate, for any given calibration, depend on a number of features, including the accuracy sought in the calibration, the nature of the equipment involved, and the use to which the calibrated equipment is to be put.

For most types of test / inspection, it is necessary for the calibrations to be carried out in accordance with quite stringent technical requirements, at all stages of the calibration chain; thus the calibration of a concrete cube testing machine against a load cell has to be carried out according to an established protocol, by suitably trained and experienced operators. For more straightforward types of test measurement on the other hand (or for subsidiary measurements whose accuracy does not significantly affect the test result or its validity), the technical requirements at the lower end of the traceability chain may well be less stringent: thus in spread-of flame tests, the stopwatch used to measure time interval (which is the principal measurement involved in this case) may reasonably be calibrated against broadcast time signals.

The criteria to be used for such decisions are that the overall uncertainty of the measurement shall not be jeopardized by inaccuracies in subsidiary measurements.

Intervals between calibrations of measuring standards and measuring equipment shall be established by the laboratory or inspection body on the basis of stability, purpose and usage. Intervals shall be established so that recalibration occurs prior to any probable change in accuracy that is of significance to the use of the equipment. Depending on the results of preceding calibrations, intervals of calibration shall be shortened, if necessary, to ensure continued accuracy.

The selection of a conservatively short initial calibration interval and documented reviews of these intervals in the light of calibration results are features of a good calibration system which will be sought by the INAB assessors. A guide to the selection of calibration intervals is given in OIML (International Organisation of Legal Metrology) International Document No. 10.

#### 4) INAB policy on Traceability of Measurement Results

- 4.1) Organisations accredited by INAB shall be able to demonstrate that calibration of critical equipment, and hence the calibration, inspection or test result generated by that equipment, relevant to their scopes of accreditation, is traceable to the International System of Units (SI units).

“Critical” equipment used by testing and calibration laboratories and inspection bodies is considered by INAB to be those items of equipment necessary to perform a test, calibration or inspection from the scope of accreditation and which have a significant effect on the uncertainty of measurement of test, calibration or inspection result.

INAB recognises that, due to the nature of some tests, it is not possible, realistic or relevant to expect traceability of measurement results.

4.2) **Accredited calibration laboratories;** for equipment and calibrations relevant to their scopes of accreditation, shall in all cases, where possible, derive their traceability either:

directly from an appropriate national metrology institute or

from a calibration laboratory that can demonstrate competence, measurement capability and traceability with appropriate measurement uncertainty, e.g. an accredited calibration laboratory.

INAB considers an “appropriate” national metrology institute to be one that participates regularly and successfully in relevant inter-laboratory comparisons.

4.3) **Accredited testing laboratories and inspection bodies** shall be required by INAB to ensure the traceability of their in-house calibrations and / or accredited test and inspection results to an external calibration provider that is accredited for suitable small uncertainties or that can otherwise demonstrate its competence, or to a national metrology institute or national reference laboratory or to a certified reference material or mutual consent standard or agreed method.

Where the calibration of equipment concerned is technically straightforward, it will be acceptable for testing laboratories and inspection bodies to calibrate their own equipment, in a competent manner, against suitable reference standards that have been calibrated by INAB accredited calibration laboratories or against the National Measurement Standards. In this case, INAB assessors will seek assurance of the laboratory's internal traceability by examining the laboratory's / inspection body's calibration system in the course of a normal assessment. As well as examining the laboratory's competence to carry out the appropriate measurements, the assessors will be concerned with the suitability of any reference standards the laboratory / inspection body may hold, and with the organisation's capability to calibrate its working instruments against such reference standards.

It is emphasised that calibration certificates issued by equipment manufacturers or agents are not acceptable evidence of external traceability, unless these are clearly identified as having been issued by an acceptably accredited calibration laboratory.

## 5) Contact

For further information about this statement please contact an INAB officer at **The Irish National Accreditation Board**.

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