INAB Policy Statement on Scope Format for Calibration Laboratories

PS27

1. INTRODUCTION

1.1. The definitive statement of the accreditation status of a calibration laboratory is the accreditation certificate and the associated scope of accreditation. The scope of accreditation defines the measurement capabilities, ranges and boundaries of the calibration activities for which the organisation holds accreditation. It is therefore important that the scope of accreditation is presented in a manner that is scientifically meaningful and presents unambiguous information in a manner that will be readily understood by the target audience.

1.2. This policy provides guidance on the format, presentation and content of INAB Accredited scopes for calibration laboratories. Use of this guidance will assist in ensuring consistency of scopes for any potential users of the service.

2. CALIBRATION SCOPES

2.1 The first page of a scope of accreditation for permanent laboratories normally contains the following details:

a) Name of the accredited organisation.
b) Contact details, including name, telephone and email address and web site details.
c) Statements to the effect that the organisation is accredited to ISO/IEC 17025 and that calibration is performed at the given address only.
d) The INAB accreditation symbol and the organisation's accreditation number.

3. CALIBRATION AND MEASUREMENT CAPABILITIES

The Calibration and Measurement Capability (CMC), which expresses the lowest uncertainty of measurement that can be achieved during a calibration, describe the capabilities provided by accredited calibration laboratories.

The CMC is normally used to describe the uncertainty that appears in an accredited calibration laboratory's schedule of accreditation and is the uncertainty for which the laboratory has been accredited using the procedure that was the subject of assessment. The CMC should normally be quoted as an expanded uncertainty at a coverage probability of 95 %, which usually requires the use of a coverage factor of k = 2.

The CMC may be described using various methods in the scope of accreditation:

a) As a single value that is valid throughout the range.

Example:

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)
Gas pressure (Gauge)	0 Pa to 500 Pa	0.10 Pa

b) As an explicit function of the measurand or of a parameter.

Example:

Measured quantity Instrument or Guage	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)
Gas pressure (differential)	0 kPa to 1 MPa (line pressure 0 MPa to 40 MPa)	0.80 ppm/MPa of line pressure + 40 ppm of differential pressure + 10 Pa

c) As a range of values. In such cases, the laboratory shall have procedures for determining the uncertainty at any given point within the range. Furthermore, the range should be sufficiently restricted that the customer could make a reasonable estimate of the likely uncertainty at any point within the range. Where a continuous range has been broken down into sub-ranges for this purpose, the CMCs should match at the break points.

Example:

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Comments
AC power factor	0.5 to 0.9 *At 50 Hz*	0.0075 to 0.0036	Maximum voltage 500 V Maximum current 25 A

d) As a matrix or table where the CMCs depend on the values of the measurand and a further parameter.

Example:

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (*k* = 2)	Comments	
Voltage range	Calibration and Measurement Capability in % of value for AC voltages over the frequency ranges shown			
	10 Hz to 100 Hz	*100 Hz to 30 kHz*	*30 kHz to 200 kHz*	*200 kHz to 500 kHz*	*500 kHz to 1 MHz*
1 mV to 3.3 mV	0.15	0.13	0.19	0.35	0.70
3.3 mV to 10 mV	0.048	0.030	0.069	0.20	0.47
10 mV to 33 mV	0.038	0.023	0.050	0.15	0.36
33 mV to 100 mV	0.029	0.014	0.027	0.080	0.21

e) Open intervals (e.g. “>x”) are **not** permitted in the expression of CMCs.

f) It is sometimes the case that a laboratory may wish to be accredited for a CMC that is larger than it can actually achieve. If this is the case then the contributions to the uncertainty budget should be reviewed and consideration given to making more conservative allowances as necessary.

g) In cases where specific conditions are required in order to obtain the CMC, these conditions should be described in the scope of accreditation, normally as footnotes.

Example:

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (*k* = 2)	Comments
RF Attenuation	*0.3 MHz to 3 GHz*	0.047 dB 0.092 dB 0.90 dB	7 mm 50 Ω coaxial line fitted with GPC 7 or Type N connectors. The uncertainty is for devices with input and output VRC not exceeding 0.2.

h) The CMC should always be stated numerically and not exclusively by reference to a standard or other document that describes the measurements undertaken.

Example (incorrect):

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Comments
Non automatic weighing machines	Up to 1000 kg	Uncertainties quoted will depend on the performance of the weighing machine under calibration, and will not be less than the uncertainty of calibration of the weights used for the calibration.	Weights are available in OIML Class E2 from 10 mg to 200 g, Class F1 from 10 mg to 10 kg and class M1 from 1 kg to 20 kg, 2 x 200 kg and 2 x 500 kg, to a total of 1000 kg

Example(Correct):

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Comments
Non automatic weighing machines	10 mg to 10 g 10 g to 50 g 50 g to 30 kg 30 kg to 1000 kg	0.025mg 2.0×10^{-6} 1.0×10^{-5} 1.0×10^{-4}	Weights are available in OIML Class E2 from 10 mg to 200 g, Class F1 from 10 mg to 10 kg and class M1 from 1 kg to 20 kg, 2 x 200 kg and 2 x 500 kg, to a total of 1000 kg

i) It should be particularly noted that relative expressions, such as percentages or parts per million, are not admissible when the range of the quantity values include, or is close to, zero. Under such conditions, an absolute term must also be present; either on its own or in conjunction with the relative term.

Example:

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Comments
DC Voltage	0 V to 1 V	25 ppm	Incorrect
DC Voltage	0 V to 1 V	25 ppm + 5.0 µV	Correct
DC Current	0 mA to 20 mA	2.5 µA	Correct

j) Particular care should be taken when the unit itself is normally expressed in percentage terms; examples are relative humidity (%rh) and amplitude modulation (% AM). For example,
50 %rh ± 10 %rh means the boundaries are 40 %rh and 60 %rh,
50 %rh ± 10 % means the boundaries are 45 %rh and 55 %rh.

k) Under circumstances of this nature the presentation of the CMCs must be such that there is no ambiguity in interpretation.

l) Mathematical functions should not be used when the measurand is a single, specific value, rather than a range of values. Rather, the expression should be evaluated and a single value of CMC stated

Example:

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Comments
DC Resistance (specific value)	100 Ω	25 ppm + 3.0 mΩ	Incorrect
DC Resistance (specific value)	100 Ω	39 mΩ	Correct

m) ***The CMC should therefore be stated to two significant figures***, using the normal rules of rounding, unless there are valid technical reasons for doing otherwise. It is seldom justified to present more than two significant figures. Using less than two significant figures can, however, introduce unacceptably large rounding errors.

n) It is frequently the case that a measurement capability is broken down into ranges corresponding to those available on the measuring instrument upon which the capability is based. Under such circumstances, the ranges described in the Scope of Accreditation should correspond to the nominal range change points.

Correct		Incorrect	
Measured Quantity Instrument or Gauge	Range	Measured Quantity Instrument or Gauge	Range
DC Voltage	0 mV to 200 mV 200 mV to 2 V 2 V to 20 V 20 V to 200 V 200 V to 1000 V	DC Voltage	0 mV to 200 mV > 200 mV to 2 V > 2 V to 20 V > 20 V to 200 V > 200 V to 1000 V 0 mV to 200 mV 201 mV to 2 V 2 .01V to 20 V 20.1 V to 200 V 201 V to 1000 V

4 SYMBOLS AND UNITS

I) It is recommended that only units of the SI and those units recognised for use with the SI should be used to express the values of quantities and of the associated CMCs. Nevertheless, other commonly used units may be used where considered necessary for the intended audience. For example, the term “ppm” (part per million) is frequently used by manufacturers of test and measurement equipment to specify the performance of their products. Terms like this may be used where they are in common use and understood by the users of such equipment, providing their use does not introduce any ambiguity in the capability that is being described.

II) One specific unit that is not mentioned in the SI system is that of relative humidity. It is recommended that the expression “%rh” be for this quantity.
Other commonly encountered units that are not defined in the SI system relate to units of time, in particular days, hours and minutes.
Abbreviations such as sec, cc, or mps are to be avoided and only standard unit symbols, prefix symbols, unit names, and prefix names should be used. Examples:
Correct: s or second; cm3 or cubic centimetre; m/s or metre per second
Incorrect: sec; cc; mps

III) Unit symbols are unaltered in the plural. Example:
Correct: l = 75 cm
Incorrect: l = 75 cms

IV) Unit symbols (or names) are not modified by the addition of subscripts or other information. The following form, for example, is used instead.
Correct: Vmax = 1000 V
Incorrect: V = 1000 Vmax

V) The dash (-) should not be used to indicate a range of values, due to ambiguity with the negative operator (minus sign). The word “to” should be used instead. Example:
Correct: 0.8 g/ml to 1.0 g/ml
Incorrect: 0.8 g/ml - 1.0 g/ml

VI) The unit should be repeated for each quantity value, either explicitly or by the use of parentheses. Example:
Correct: 20 ˚C to 30 ˚C or (20 to 30) ˚C
Incorrect: 20 to 30 ˚C

VII) There is a space between the numerical value and unit symbol, even when the value is used in an adjectival sense, except in the case of superscript units for plane angle. Examples:
Correct: a 25 kg mass, Incorrect: a 25-kg mass
Correct: 100 mV, Incorrect: 100mV
Correct: an angle of 2˚ 3’ 4”, Incorrect: an angle of 2 ˚ 3’ 4”
Correct: 100 ˚C, Incorrect: 100˚C
Correct: 0.25 %, Incorrect: 0.25%

VIII) In cases where a number is not used as part of an expression, there is no space between mathematical operators (such as “+” or “-” signs) and the associated number.
Examples:
Correct: -20 ˚C , Incorrect: - 20 ˚C
Correct: -100 mV to +100 mV, Incorrect: - 100 mV to + 100 mV
NOTE: the absence of a “+” or “-” sign implies that the value is positive, however the use of the “+” sign is encouraged where negative values are also included, as in the second example above.
However, if the number and symbol are part of an expression (e.g. a + b), then spaces should be used.