EESTI AKREDITEERIMISKESKUS
ESTONIAN ACCREDITATION CENTRE

KALIBREERIMISLABORITE AKREDITEERIMISULATUSTE KIRJELDAMISE JA VAATLUSTE PLANEERIMISE JUHIS

INSTRUCTION ON DESCRIPTION AND WITNESSING OF ACCREDITATION SCOPES OF CALIBRATION LABORATORIES

EAK VJ3 - 2017

Translation from Estonian

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Authorship and principles

This guidance document was prepared by the EAK working group including P. Ruzitš, T. Tiivel and V. Krutob. This document to be used together with EAK guide J2 is intended to provide specific guidance for assessment of calibration laboratories. The provisions of the EVS standard 758 and UKAS LAB45 document were considered during preparation of this document.

Official language

If required, the guidance may be translated into other languages. The Estonian version is and must remain like the original.

Additional information

In order to get further information on the document please call upon the EAK, Mäealuse 2/1 12618 Tallinn, www.eak.ee.

Confirmation

This document was confirmed by

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Member of EAK Management Board
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1. Introduction

1.1 This document specifies guidelines of the EAK J2 requirements regarding the format, presentation and content of accreditation scopes for the EAK accredited calibration laboratories. Compliance with this document is mandatory for the EAK personnel, as well as for the technical assessors and experts performing assessment of calibration laboratories. The guidelines given in this document should also be considered by calibration laboratories for description of the accreditation scope they are applying for.

1.2 Accreditation certificates and accreditation scopes described in their annexes serve as the confirmation of the accredited status of calibration laboratories. Description of the accreditation scope of a calibration laboratory is an important document that defines the measurement capability, measurement range and boundaries of accredited calibration activities. Therefore it is important to present the accreditation scope in a manner that is technically accurate and unambiguous to laboratories and their customers to understand.

1.3 The description of the accreditation scope of a calibration laboratory is presented in the annex to the accreditation certificate.

2. Description of the accreditation scope of a calibration laboratory

Description of the accreditation scope of a calibration laboratory is presented by the types of measuring instruments used and calibrated for measuring the values of physical quantities (*see Annex 1*). The first page of the description of accreditation scope (*see Annex 2*) includes at least the following information:

a) Name of the accredited organisation (*laboratory)* as stated in the associated accreditation certificate;

b) The EAK logo and the organisation's (*laboratory's)* accreditation number;

c) Address of the main site of activities;

d) Description of the accreditation scope associated with the main site of activities (*table).*

The addresses of other sites (*if any),* covered by accreditation, are presented in the description of the accreditation scope together with the part of associated scope. When calibrations are not performed in the permanent laboratory (*e.g. at customer's premises*), the site will be considered to be a different location.

The last page of the description of the accreditation scope will include a statement to the effect that the organisation (*laboratory)* is accredited to the requirements of EVS-EN ISO/IEC 17025 and the date of issue of the document. If the annex to the accreditation certificate replaces the annex that was valid before, a note will be added to explain the reason (*basis for change*) why the annex is replaced and the date of issue of the annex that the current annex will replace.

3. Opinions and interpretations

3.1 In cases when the expression of opinions and interpretations is included in the accreditation scope of the calibration laboratory, the following statement is suggested to be included in the scope:

Opinions regarding the results and interpretations of those results may be provided for the measurements indicated.

3.2 Assessment of compliance with specifications does not require opinions and interpretations to be included in the accreditation scope because compliance assessment is based on stated and objective criteria.

4. Calibration and measurement capabilities

4.1 Capabilities of accredited calibration laboratories are described by the calibration and measurement capability *(in English 'CMC')*, which expresses the lowest uncertainty of measurement that can be achieved during calibration. In case a measuring instrument under calibration itself significantly contributes to uncertainty (*e.g. if it has limited resolution or exhibits non-repeatability*), then the uncertainty quoted on a calibration certificate will be increased to account for these factors.

The definition of the calibration and measurement capability is as follows:

A CMC is calibration and measurement capability available to customers under normal conditions:
(a) as published in the CIPM MRA BIPM key comparison database (KCDB); or
(b) as described in the laboratory's accreditation scope, granted by the signatory to the ILAC MRA or EA MLA.

4.2 Calibration and measurement capability CMC is used to describe the uncertainty of the accredited calibration laboratory and it is the uncertainty for which the laboratory has been accredited and based on the measuring procedure subject to assessment. CMC is calculated according to the procedures given in the guide EA-4/02 and is normally stated as an expanded uncertainty at a coverage probability of 95 %, which requires the use of a coverage factor of $k = 2$.

An accredited laboratory is not permitted to quote uncertainty that is smaller than the stated calibration and measurement capability in the description of accreditation scope.

4.3 CMC may be described in several different ways:

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

Example:

Measured quantity calibration object	Nominal value or range	Calibration and measurement capability (CMC) expressed as expanded uncertainty (k = 2)	Brief description of measurement method and remarks
Gas pressure (*gauge*)	(0,1 to 500) Pa	0,10 Pa	Comparison to measurement standard dead-weight piston gauge PPP778

b) As an explicit function of the measurand.

Example:

Measured quantity calibration object	Nominal value or range	Calibration and measurement capability (CMC)*	Brief description of measurement method and remarks
Gas pressure (*differential*)	0,1 kPa to 1 MPa (*line pressure to 40 MPa*)	$0{,}80 \times 10^{-6}$/MPa of line pressure + 40×10^{-6}/Pa of differential pressure + 10 Pa	Comparison to measurement standard manometer PPP779

*Expressed as expanded uncertainty U ($k = 2$)

c) As a range of values. In such a case the laboratory shall have procedures to establish uncertainty at any point within the range. Where a continuous range is broken down into sub-ranges, the CMCs should match at the break points.

Example:

Measured quantity calibration object	Nominal value or range	Calibration and measurement capability (CMC)*	Brief description of measurement method and remarks
AC power factor	0,5 to 0,9 *At 50 Hz*	0,0075 to 0,0036	Comparison method VVV567 Maximum voltage 500 V Maximum current 25 A

*Expressed as expanded uncertainty *U* (*k* = 2)

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

Example:

Measured quantity calibration object	Nominal value or range	Calibration and measurement capability (CMC)*			Brief description of measurement method and remarks
AC voltage					VVP345
Voltage range	Calibration and measurement capability in % of value for AC voltages over the frequency ranges shown				
	(10 to 100) Hz	100 Hz to 30 kHz	(30 to 200) kHz	(200 to 500) kHz	500 kHz to 1 MHz
(1 to 3,3) mV	0,15	0,13	0,19	0,35	0,70
(3,3 to 10) mV	0,048	0,030	0,069	0,20	0,47
(10 to 33) mV	0,038	0,023	0,050	0,15	0,36
(33 to100) mV	0,029	0,014	0,027	0,080	0,21

*Expressed as expanded uncertainty *U* (*k* = 2)

e) In a graphical form, providing there is sufficient resolution on each axis to obtain at least two significant figures for the value of calibration and measurement capability.

4.4 Open intervals *(e.g.* “>*x*”) are not permitted in the expression of the calibration and measurement capabilities.

4.5 In cases where specific conditions are required to obtain the calibration and measurement capability, these conditions should be described in the accreditation scope, normally in the remarks column.

Example:

Measured quantity calibration object	Nominal value or range	Calibration and measurement capability (CMC)*	Brief description of measurement method and remarks
RF Attenuation	*0,3 MHz* to *3 GHz* (0,1 to 40) dB (40 to 62) dB (62 to 80) dB	0,045 dB 0,094 dB 0,95 dB	Comparison method FFS654 7 mm 50 Ω coaxial line with GPC 7 or N type connectors. Uncertainty applies to devices whose input and output VRC does not exceed 0,2

*Expressed as expanded uncertainty *U* (*k* = 2)

4.6 The calibration and measurement capability 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 calibration object	Nominal value or range	Calibration and measurement capability (CMC)*	Brief description of measurement method and remarks
Non-automatic weighing instruments	Up to1000 kg	Uncertainties quoted will depend on the performance of weighing instrument under calibration, and will not be less than the uncertainty of calibration of the weights used for the calibration	Loading of weighing instruments with weights KKK123 Weights are available in OIML class E2 from10 mg to 200 g, class F1 weights from 10 mg to10 kg and class M1 weights from 1 kg to 20 kg, 2 × 200 kg and 2 × 500 kg, to a total of 1000 kg

*Expressed as expanded uncertainty U (k = 2)

Example (*correct*):

Measured quantity calibration object	Nominal value or range	Calibration and measurement capability (CMC) Expressed as expanded uncertainty (k = 2)	Brief description of measurement method and remarks
Non-automatic weighing instruments	10 mg to 10 g 10 g to 50 g 50 g to 30 kg 30 kg to 1000 kg	0,025 mg $2,0 \times 10^{-6}$ g $1,0 \times 10^{-5}$ g $1,0 \times 10^{-4}$ g	Loading of weighing instruments with weights KKK123

4.7 Relative expressions, such as percentages or parts per million, are not permissible when the range of quantity values include, or is close to, zero. Under such conditions, an absolute term should also be present; either on its own or in conjunction with the relative term.

Example:

Measured quantity calibration object	Nominal value or range	Calibration and measurement capability (CMC) Expressed as expanded uncertainty (k = 2)	Short description of method and remarks
DC voltage DC voltage DC current	0 V to 1 V 0 V to 1 V 0 mA to 20 mA	25 ppm 0,0025 % + 5,0 µV 2,5 µA	Incorrect Correct Correct

4.8 Mathematical functions should not be used when the measurand is a single, specific value, rather than a range of values. In such a case the expression should be evaluated and a single value of the calibration and measurement capability stated.

Example:

Measured quantity calibration object	Nominal value or range	Calibration and measurement capability (CMC) Expressed as expanded uncertainty ($k = 2$)	Brief description of measurement method and remarks
DC resistance (*specific value*) DC resistance (*specific value*)	100 Ω 100 Ω	0,0025 % + 3,0 mΩ 39 mΩ	Incorre ct Correct

4.9 The number of figures in a calibration and measurement capability declaration should always reflect practical measurement capability. Considering the process of uncertainty evaluation it is seldom justified to present more than two significant figures. However, using less than two significant figures can introduce unacceptably large rounding errors. Therefore, the calibration and measurement capability should be stated to two significant figures, using the rounding rules provided in ISO 8000-1 standard, unless there are special reasons for doing otherwise.

Examples:

Incorrect: 2 µm; 0,1 MPa; 5 mg; 7,17 nA
Correct: 2,0 µm; 0,098 MPa; 4,7 mg; 7,2 nA

4.10 The measurement capability of a measuring instrument is frequently is broken down by ranges. Under such circumstances the ranges described in the accreditation scope should correspond to nominal range change points, as in the example below.

Correct		Incorrect	
Measured quantity calibration object	Nominal value or range	Measured quantity calibration object	Nominal value or range
DC voltage	0,1 mV to 200 mV 200 mV to 2 V 2 V to 20 V 20 V to 200 V 200 V to1000 V	DC voltage	0,1 mV to 200 mV > 200 mV to 2 V > 2 V to 20 V > 20 V to 200 V > 200 V to 1000 V 0,1 mV to 200 mV 201 mV to 2 V 2,01 V to 20 V 20,1 V to 200 V 201 V to 1000 V

4.11 The column of brief description of method and remarks, in addition to specifying remarks (*e.g. for specific conditions*), normally contains a reference to a documented in-house laboratory method, and if necessary, a short description of the method. Unlike testing laboratories which in most cases conduct their tests against international standards and the associated test scope contains references to these standards, the majority of calibration activities are conducted using documented in-house methods that have been demonstrated to provide the stated calibration and measurement capabilities by means of uncertainty analysis. Consequently, in most cases there is no requirement to list normative references associated to calibration scopes. However, where such standards are used, they should be included in the remarks column, e.g. as in the following example.

Measured quantity/ calibration object	Nominal value or range	Calibration and measurement capability (CMC) expressed as expanded uncertainty (k = 2)	Brief description of measurement method and remarks
Relative magnetic permeability, μ_r For low magnetic permeability materials	(μ_r - 1) 0,001 to1,5 (DC)	0,20 %	According to EVS 6666:2017

4.12 Where the calibration and measurement capability is stated in percentage, it is necessary to add a clarification to explain whether the percentage (i.e. 0,01) means a percentage of measured value or indication. In the latter the CMC means 1,5 % of value: 1,5 × 0,01 × i, where i is the indication of the measuring instrument.

5. Units and symbols

5.1 Only units of the SI and those units recognised for the use with the SI should be used to express the values of quantities and of the associated calibration and measurement capabilities. Other commonly used units which are not mentioned in the SI system may be used in the accreditation scope, providing their use does not introduce any ambiguity in the capability that is being described.

5.2 The more commonly used units that are not defined in the SI system are units of time – day, hour and minute. The following are recommended to consider for describing accreditation scope:

Name	Symbol	Value in SI units
minute	min	1 min = 60 s
hour	h	1 h = 60 min = 3 600 s
day	d	1 d = 24 h = 86 400 s

5.3 Symbols *sec*, *m/sec* and *ppm* (*parts per million*) are to be avoided, and only standard unit symbols and standard prefix symbols and names should be used.
Examples:
Correct: s or second; m/s or meters per second; 10^{-6}
Incorrect: sec; m/sec; ppm

5.4 Unit symbols are not modified by the addition of subscripts or other information. The following form, for example, is used instead:

Correct: V_{max} = 1 000 V
Incorrect: V = 1 000 V_{max}

5.5 The dash ("-" or "–") is not to be used to indicate a range of values to avoid confusion with the negative operator (*minus sign*). Three dots ("…") or the word "to" should be used instead.
Example:
Correct: 0,8 g/ml to 1,0 g/ml; 0,8 g/ml…1,0 g/ml
Incorrect: 0,8 g/ml – 1,0 g/ml

5.6 The unit belongs to each quantity value, either explicitly or by the use of parentheses.
Example:
Correct: 20 °C to 30 °C; (20 to 30) °C; (20…30) °C

Incorrect: 20 to 30 °C

5.7 The unit should be repeated for each quantity value, even when the value is used in an adjectival sense, except in the case of superscript units for plane angle.

Examples:

Correct: 25 kg Incorrect: 25kg
Correct: 100 mV Incorrect: 100mV
Correct: 2° 3' 4" Incorrect: 2 ° 3 ' 4 "
Correct: 100 °C Incorrect: 100°C
Correct: 0,25 % Incorrect: 0,25%

5.8 Where the quantity values are expressed, it is reasonable to use such prefixes in the case of which the quantity value is in the range of 0,1 to 1000.

Examples:

4,76 mm should be used instead of 0,00476 m
21 kN should be used instead of $2{,}1\cdot10^4$ N
1,755 kPa should be used instead of 1755 Pa

6. Planning principles for assessment and witnessing of the accreditation scopes of calibration laboratories

6.1 When planning witnessing of the accreditation scopes of a calibration laboratory the principles of clause 2.3.3 of EAK J2 are to be considered, taking into account the specific issues mentioned below and the classification of the types of measuring instruments given in Annex 1.

6.2 The types of measuring instruments for measuring physical quantities (*hereinafter calibration types*) are broken down into sub-types in cases where different calibration methods, measuring principles and/or equipment of different accuracy class (*e.g. in cases of measurement standards of higher accuracy*) are used.

6.3 Witnessing of calibration activities is conducted for all calibration types, and if required (*at the discretion of assessor*), also for sub-types. One witnessing may cover several calibration types within the same physical quantity (*combined witnessing*), providing that all (*sub-*)types included in witnessing, but not actually witnessed, have been assessed on the basis of documentation.

6.4 Witnessing of calibration activities is linked to a specific location and it may not be automatically extended to other locations (*including on-site*). In case the assessor considers that the results of witnessing could be extended to other locations, it has to be clearly indicated in the assessor's or witnessing report.

6.5 The witnessing plan that covers the whole accreditation scope of the calibration laboratory under assessment is to be prepared by the lead assessor together with assessors before the initial assessment visit. The witnessing plan for the accreditation cycle (*covering the whole accreditation scope under assessment*) is to be prepared after the initial assessment or reassessment, based on the previous plan. The decision on breaking down the calibration types into sub-types and/or combined witnessing activities, is to be made based on the approval of the assessor(s) of the corresponding calibration type.

6.6 Witnessing reports shall clearly point out the calibration (*sub-*)types covered by the particular witnessing, consequent observations and conclusions made as well as references to the documents, the method(s)` assessment was based on.

Annex 1: Types of measuring instruments for physical quantities

(the list is not exhaustive and contains only most common measuring instruments)

1. Length and angle:

- Line measures of length and length measures
- Length measuring instruments (callipers, micrometers, indicators, cable measures, measuring wheels, etc.)
- Measuring machines
- Angle gauges and angle measuring instruments
- Comparators
- Laser distance meters
- Level gauges and inclinometers
- Surface roughness
- Surveying instruments
- GPS meters

2. Mass:

- Non-automatic weighing instruments
- Weighing instruments
- Weights
- Density and magnetic properties of weights
- Comparators

3. Volume and flow:

- Capacity measures
- Automatic pipettes
- Dispensers
- Glass gauges
- Tanks
- Fuel pumps
- Flow meters
- Liquid volume meters
- Water meters
- Flow meters (e.g. gas flow meters)
- Heat-flow gauges

4. Pressure:

- Pressure balances
- Vacuum and pressure gauges
- Micromanometers
- Differential manometers
- Pressure calibrators

5. Temperature:

- Glass thermometers
- Thermocouples
- Resistance thermometers
- Radiation thermometers

- Thermovisors
- Temperature calibrators
- Numerical scale thermometers
- Temperature chambers
- Climate chambers
- Incubators
- Muffle furnaces
- Thermostats
- Comparators

6. Force and torque:

- Force gauges
- Dynamometers
- Force testing machines
- Testers
- Torque measuring devices
- Brake testers
- Torque spanners
- Hardness meters

7. Optical quantities:

- Lux meters
- Light filters
- Window-transmittance meters

8. Ionising radiation:

- Dosimeters
- Radiometers
- Radiation detectors and sources

9. Electrical and magnetic quantities:

- DC voltage measures and meters
- DC resistance measures and meters
- DC current measures and meters
- AC voltage measures and meters
- AC resistance and impedance measures and meters
- AC current measures and meters
- High voltage sources (DC)
- High voltage sources (AC)
- Voltage transformers
- Current transformers
- Power sources and meters
- Electricity meters
- Conductivity measures and meters
- Capacitance measures and meters
- Inductance measures and meters

10. Frequency and time interval:

- Frequency measures and meters
- Time interval measures and meters

11. Noise and vibration:

- Sound level meters
- Sound pressure measures and meters
- Vibration sensors and meters

12. Physical-chemical quantities:

- pH-meters
- Conductivity meters
- Photometers
- Spectrophotometers
- Refractometers
- Measuring devices for density of liquids
- Ionometers
- Breath analysers
- Areometers and alcoholmeters
- Moisture meters for air and materials
- Exhaust gas analysers
- Exhaust gas opacity meters
- Dissolved oxygen meters
- Anemometers

13. Instruments for measuring the speed of vehicles:

- Doppler effect meters
- Laser instruments for measuring speed of vehicles

Annex 2: First page of the description of accreditation scope *(sample)*

EESTI AKREDITEERIMISKESKUS
ESTONIAN ACCREDITATION CENTRE

LISA AS XXXXX akrediteerimistunnistusele nr K000
ANNEX to the accreditation certificate No K000 of XXXXX Ltd

1. **Akrediteerimisulatus on**:
Accreditation scope is:

Labori asukoht: Metroloogia tee 1 Tallinn
Laboratory`s address:

Nr *No*	Mõõdetav suurus/ kalibreerimisobjekt *Measured quantity / calibration object*	Nimiväärtus või mõõtepiirkond range *Nominal value or range*	Kalibreerimis- ja mõõtevõime (CMC) *Calibration and measurement capability**	Meetodi lühikirjeldus ja märkused *Brief description of measurement method and remarks*
1	Mahumõõdud *Capacity measures*	1 kuni 10 l >10 kuni 50 l	5,0 ml 15 ml	Destilleeritud veega täidetud mahumõõdu kaalumine *Weighing of capacity measure filled with distilled water* MMM777
2	Absoluutrõhu mõõtevahendid *Absolute pressure measuring instruments*	(0,1…6) MPa	$55 + 88 \times 10^{-6} \times p$ *p* – rõhk Pa *p - pressure in Pa*	Võrdlemine etalon-manomeetriga *Comparison with standard manometer* MMM888
3	Pikkusmõõturid ja -mõõdud *Length measuring instruments and material measures of length*	(0,01…1000) mm	(15 + 10 × L) µm L – pikkus meetrites *L – length in meters*	Võrdlemine etalon-pikkusmõõtudega *Comparison with standard length measures* MMM999

*Kalibreerimisvõime on väljendatud laiendmääramatusena *U* (*k*=2).
**Calibration measurement capability (CMC) is expressed as expanded uncertainty U (k=2).*

Revisions page

NEW	OLD	Date	Content of amendments	Confirmation
EAK VJ3 - 2017	-	14.12.2017	First issue of the document	*/digital signature/*