ACTIVITY 1.4
TRAININGS OF MOLDAC PERSONNEL INVOLVED IN ACCREDITATION PROCESS INCLUDING THE ISSUE REGARDING THE REQUIREMENTS OF THE NEW VERSIONS OF THE EA, IAF, ILAC DOCUMENTS

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GUIDANCE SERIES	ILAC-G24 Edition 2007 (E)	INTERNATIONAL DOCUMENT	OIML D 10 Edition 2007 (E)

Guidelines for the determination of calibration intervals of measuring instruments

Guide pour la détermination des intervalles de calibration des instruments de mesure

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Guidelines to the determination of calibration intervals of measuring instruments

PREAMBLE

It is important to point out that:

- It is **not the responsibility of accreditation bodies to teach laboratories** how to **run their business**.
- It **is the responsibility** of **each individual laboratory** to **choose** to implement any or none of **the methods described in this Document** based on its **individual needs** and its **individual assessment of risks**.

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Guidelines to the determination of calibration intervals of measuring instruments

PREAMBLE

It is important to point out that:

- **It i**s also the **responsibility of the laboratory** to **evaluate** the **effectiveness** of **the method** it chooses to **implement** and **take responsibility** for the consequences of the decisions taken as a result of the method chosen.

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Guidelines to the determination of calibration intervals of measuring instruments

PURPOSE

The purpose of this Document **is to give laboratories**, particularly while setting up their calibration system, **guidance on how to determine calibration intervals**.

This Document **identifies** and **describes** the **methods** that are **available** and **known** for the **evaluation of calibration intervals**.

INTRODUCTION

An important aspect for maintaining the capability of a laboratory **to produce traceable and reliable measurement results** is a **determination of the maximum period that should be permitted between successive calibrations (recalibrations)** of the reference or working standards and measuring instruments used.

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International Standard Requirements

ISO/IEC 17025: 2005

Clause 5.5.2*: "Calibration programs shall be established for key quantities or values of the instruments where these properties have a significant effect on the results".*

International Standard Requirements

ISO/IEC 17025: 2005

Clause 5.5.8: *"Whenever practicable,* ***all equipment*** *under the control of the laboratory and* ***requiring calibration*** *shall be* ***labeled, coded, or otherwise identified to indicate the status of calibration****, including the* ***date when last calibrated*** *and* ***the date or expiration criteria when recalibration is due****".*

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Example of an internal label (ACCREDIA RG-09 §13.1.2)

Logo del Centro

ACCREDIA
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LAT N° 000

Cod. Strum. __________
Certificato __________
Data Taratura __________
Data Succ. Taratura __________
Firma Resp. Lab. __________

b - modello dell'etichetta per uso interno

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International Standard Requirements

ISO/IEC 17025: 2005

Clause 5.6.1: "*“**All equipment** used for tests and/or calibrations, including equipment for subsidiary measurements (e.g. for environmental conditions) **having a significant effect on the accuracy or validity** of the result of the test, calibration or sampling **shall be calibrated before being put into service.**”*

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International Standard Requirements

ISO/IEC 17025: 2005

Clause 5.6.1*: " The laboratory shall have an established program and procedure for the calibration of its equipment."*

Note: Such a program should include a system for selecting, using, calibrating, checking, controlling and maintaining measurement standards, reference materials used as measurement standards, and measuring and test equipment used to perform tests and calibrations.

Example of ACCREDIA-DT application form (DA-05 rev.04 §7): information needed on calibration intervals of reference standards and working standards

DA-05 §7

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International Standard Requirements

Requirements on calibration programs are also confirmed in the **CD1 ISO/IEC 17025**

6.5.4 A calibration programme shall be established for measuring equipment unless it has been determined that the associated contribution of the measuring equipment to the uncertainty of the measurement result is negligible.

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International Standard Requirements

Requirements on calibration programs are also confirmed in the **CD1 ISO/IEC 17025**

6.5.5 All measuring equipment under the control of the laboratory and requiring calibration shall be labelled, coded or otherwise identified to allow the user of the equipment to readily identify the status of calibration.

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International Standard Requirements

Requirements on calibration programs are also confirmed in the **CD1 ISO/IEC 17025**

Case study:

ACCREDIA comment's on CD1 ISO/IEC 17025

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The general purpose of a periodic calibration is:

- **to improve the estimation of the deviation** between a reference value and the value obtained using a measuring instrument, **and the uncertainty in this deviation**, at the time the instrument is actually used;

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The general purpose of a periodic calibration is:

- to **reassure the uncertainty** that can be **achieved** with the measuring instrument;
- **to confirm whether or not** there has been any **alteration of the measuring instrument** which could introduce doubt about the results delivered in the elapsed period.

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Decision process on calibration:

- When to do it?
- How often to do it?

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Most important factors that can influence the calibration interval:

- uncertainty of measurement required or declared by the laboratory;
- risk of a measuring instrument exceeding the limits of the maximum permissible error when in use;
- type of instrument;

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Most important factors that can influence the calibration interval:

- cost of necessary correction measures when it is found that the instrument was not appropriate over a long period of time;
- manufacturer's recommendation;
- extent and severity of use;
- environmental conditions (climatic conditions, vibration, ionizing radiation, etc.);

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Most important factors that can influence the calibration interval:

- frequency of cross-checking against other reference standards or measuring devices;
- frequency and quality of intermediate checks in the meantime;
- transportation arrangements and risk; and
- degree to which the serving personnel are trained.

[..]

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§2. Initial choice of calibration intervals

The initial decision in determining the calibration interval is based on the following factors:

- the instrument manufacturer's recommendation;
- expected extent and severity of use;
- the influence of the environment;
- the required uncertainty in measurement;
- maximum permissible errors (e.g. by legal metrology authorities);

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§2. Initial choice of calibration intervals

The initial decision in determining the calibration interval is based on the following factors:

- ❑ adjustment of (or change in) the individual instrument;
- ❑ influence of the measured quantity (e.g. high temperature effect on thermocouples); and
- ❑ pooled or published data about the same or similar devices.

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§2. Initial choice of calibration intervals

The target is to the length of time the instrument is likely to remain within the maximum permissible error after calibration.

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§3. Methods of reviewing calibration intervals

The target is to optimize the balance of risks and costs

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§3. Methods of reviewing calibration intervals

The reasons on **reviewing calibration intervals** could be, for example:

- instruments may be less reliable than expected;
- the usage may not be as anticipated;
- it may be sufficient to carry out a limited calibration of certain instruments instead of a full calibration

§3. Methods of reviewing calibration intervals

The reasons on **reviewing calibration intervals** could be, for example:

- the drift determined by the recalibration of the instruments may show that longer calibration intervals may be possible without increasing risks;

[..]

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Method 1: Automatic adjustment or 'staircase' (calendar-time)

Each time an instrument is calibrated on a routine basis, **the subsequent interval is extended if it is found to be within** e.g. 80 % **of the maximum permissible error** that is required for measurement, **or reduced if it is found to be outside this maximum permissible error.**

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Method 1: Automatic adjustment or 'staircase' (calendar time)

Advantages:

- ✓ Rapid adjustment of intervals
- ✓ Easy to carry out with no clerical effort

Disadvantages:

- X Instruments treated individually
- X Difficult balanced workload

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Method 2: Control chart (calendar-time)

Significant calibration points are chosen and the **results are plotted against time**.

From these plots, both **dispersion of results** and **drift** are calculated, the drift being either the mean drift over one calibration interval, or in the case of very stable instruments, the drift over several intervals.

From these figures, the optimum interval may be calculated.

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Method 2: Control chart (calendar-time)

Advantages:

- ✓ Reliable
- ✓ Efficient

Disadvantages:

- X Considerable knowledge of the law of variability of the instrument;
- X Difficult balanced workload

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Method 3: “In-use” time

The calibration interval is expressed **in hours of use**, rather than calendar months.
The instrument is fitted with an elapsed time indicator and is returned for calibration when the indicator reaches a specified value.

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Method 3: "In-use" time

Examples:

- ❑ Thermocouples used at extreme temperatures
- ❑ Dead weight tester for gas pressure
- ❑ Length gauges (i.e. instruments that may be subject to mechanical wear).

Method 3: "In-use" time

Advantages:

✓ The number of calibrations performed and therefore the cost of calibration varies directly with the length of time that the instrument is used

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Method 3: “In-use” time

Disadvantages:

X it cannot be used with passive instruments (e.g. attenuators) or standards (resistance, capacitance,etc.);

X it should not be used when an instrument is known to drift or deteriorate when on the shelf, or when handled, or when subjected to a number of short on-off cycles;

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Method 3: "In-use" time

Disadvantages:

X the initial cost of the provision and installation of suitable timers is high;

X Difficult balanced workload.

Method 4: In service checking, or 'black-box' testing

Critical parameters are checked frequently by portable calibration gear, or preferably, by a "black box" **made up specifically to check the selected parameters.**

If the **instrument** is found to **be outside the maximum permissible error by the "black box", it is returned for a full calibration.**

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Method 4: In service checking, or 'black-box' testing

Advantages:

- ✓ it provides maximum availability for the instrument user
- ✓ is suitable for instruments geographically separated from the calibration laboratory

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Method 4: In service checking, or ‘black-box’ testing

Disadvantages:

X Difficulty in deciding on the critical parameters

X Difficulty on designing the “black box”

Method 4: In service checking, or 'black-box' testing

Examples:

- ❑ Density meters (resonance type);
- ❑ Pt-resistance thermometers;
- ❑ Dosimeters (source included);
- ❑ Sound level meters (source included).

Method 5: Other statistical approaches

These methods are gaining more and more interest, especially when used in combination with adequate software tools.

References:

[X] Lepek, A.: Software for the prediction of measurement standards
NCSL International Conference, 2001

[X] Pau, L.F.: Périodicité des Calibrations
Ecole Nationale Supérieure des Télécommunications, Paris, 1978

Method Comparison

	Method 1 «stair case»	Method 2 «control chart»	Method 3 «in use time»	Method 4 «black box»	Method 5 «others statistics approaches»
Reliabilty	Medium	High	Medium	High	Medium
Effort of application	Low	High	Medium	Low	High
Work-load balanced	Medium	Medium	Bad	Medium	Bad
Applicability with respect to particular devices	Medium	Low	High	High	High
Availiability of instruments	Medium	Medium	Medium	High	Medium

Example of ACCREDIA-DT accepted calibration intervals

TIPO DI STRUMENTO	*INTERVALLO DI TARATURA (mesi)*	
	Uso come campioni di riferimento	*Uso come campioni di lavoro*
Strumenti indicatori analogici	*24*	*12*
Strumenti indicatori numerali	*12*	*6*
Resistori campione	24	12
Condensatori campione	36	12
Induttori campione	36	12
Derivatori campione	24	6

Example of ACCREDIA-DT recommended calibration intervals

TIPO DI STRUMENTO	*INTERVALLO DI TARATURA (mesi)*	
	Uso come campioni di riferimento	*Uso come campioni di lavoro*
Ponti (R-L-C)	24	12
Cassette di resistenza	12	3
Cassette di capacità	24	12
Cassette d'induttanza	24	12
Trasformatori di tensione	60	36
Trasformatori di corrente	60	36

Example of ACCREDIA-DT recommended calibration intervals

TIPO DI STRUMENTO	INTERVALLO DI TARATURA (mesi)	
	Uso come campioni di riferimento	Uso come campioni di lavoro
Contatori di energia	24	6
Strumenti registratori	-	6
Pirometri	12	6
Termocoppie	12	6
Termoresistenze	12	6

Example of ACCREDIA-DT recommended calibration intervals

TIPO DI STRUMENTO	*INTERVALLO DI TARATURA (mesi)*	
	Uso come campioni di riferimento	*Uso come campioni di lavoro*
Blocchetti piano paralleli grado "00"	36	12
Blocchetti piano paralleli grado "0"	12	6
Micrometri (formato < 0,01 mm)	12	6
Micrometri (formato 0,01 mm)	6	3
Calibri a corsoio (formato < 0,1 mm)	12	6
Calibri a corsoio (formato 0,1 mm)	6	3

Example of ACCREDIA-DT recommended calibration intervals

TIPO DI STRUMENTO	*INTERVALLO DI TARATURA (mesi)*	
	Uso come campioni di riferimento	*Uso come campioni di lavoro*
Comparatori ad asta	24	12
Comparatori a leva	18	6
Trasduttori lineari	36	12
Masse di classe E2	12	6
Masse di classe F1	24	12
Strumenti per pesare non automatici	12	6

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Case Studies:

GUIDE TO QUALITY IN ANALYTICAL CHEMISTRY
CITAC/Eurachem Guide APPENDIX B
Calibration intervals and Performance Checks

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Case Studies:

Calibration Guide
EURAMET cg-8
Version 2.1 (10/2011)

CALIBRATION OF THERMOCOUPLES
§13 Recalibration

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