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Confidence in measurement

Calibration interval guide

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Kistler calibration services

Kistler is the world market leader in the field of dynamic measurement technology. Uncompromising quality and maximum precision are our daily goals.

This applies both to the products we manufacture and the services we provide. Our comprehensive range of services features several types of calibration: **service calibrations**, available worldwide at Kistler sites; **traceable calibrations**, performed by laboratories accredited to DIN EN ISO/IEC 17025; **onsite calibrations** at our customers' premises; and **in-situ calibrations**, if it is impossible to disassemble the measurement setup.

Calibration intervals

Test and measurement equipment is present in almost all areas of everyday life – and it plays a crucial part in industrial applications.

Questions are often asked about the need for calibration, calibration intervals or changes to the intervals, and the interval length.

The general requirements are defined by ISO 9001:2015, which states (in section 7.1.5.2, Measurement traceability, extract):

"When measurement traceability is a requirement, or is considered by the organization to be an essential part of providing confidence in the validity of measurement results, measuring equipment shall be:

a) calibrated or verified, or both, at specified intervals, or prior to use, against measurement standards traceable to international or national measurement standards; when no such standards exist, the basis used for calibration or verification shall be retained as documented information;

b) identified in order to determine its status."

However, this information does not help you to choose an appropriate calibration interval. These past and present standards apply to calibration intervals:

Standards:

DIN ISO 10012: Measurement management systems, Requirements for measurement processes and measuring equipment

ILAC-G24 / OIML D-10: Guidelines for the determination of calibration intervals of measuring instruments:
Initial choice of calibration intervals

Methods of reviewing calibration intervals
- Method 1: Automatic adjustment or "staircase" (calendar-time)
- Method 2: Control chart (calendar-time)
- Method 3: "In-use" time
- Method 4: In service checking, or "black-box" testing
- Method 5: Other statistical approaches

Initial choice

For a new device, the manufacturer's specifications or recommendations should generally be adopted. If necessary, you can select a different interval grid to allow practice-oriented calibration planning.

Kistler recommends these intervals:

- For sensors and systems in use in a normal environment: at least every two years
- For sensors and systems used in exposed environments: at least once a year
- For sensors and systems used in safety-relevant facilities in a normal environment: at least annually
- For sensors and systems used in safety-related facilities in exposed areas: every six months if necessary

These initial frequencies can vary depending on use, environment, and number of shifts operated (one, two or three). These factors must be taken into account when deciding on the intervals.

However, these are only recommendations. Plant manufacturers and operators must carry out a risk analysis to define appropriate guidelines for their application, and to ensure compliance.

Kistler cannot accept any liability for the handling of the above principles, since it does not know the application in detail and it is the responsibility of the plant manufacturers and operators to prepare the corresponding risk analyses and implement the resulting calibration intervals.

The approaches to determining calibration intervals for test and measurement devices are numerous and varied:

- on the one hand, rigid requirements can be applied;
- on the other, different approaches can be taken to determine a suitable interval in each individual case.

Complex mathematical relationships are often developed and stored for calculation.

Kistler recommends that intervals should only be set individually in exceptional cases.

It is advisable to assign and implement uniform intervals for each type of measuring device so that similar devices are interchangeable. If a technician's multimeter fails, it would be a fatal error to borrow the same device from another department where it is classified as not requiring calibration – so the technician would use a device that was never calibrated.

Typical intervals

Most test and measurement equipment is calibrated at intervals of either 12 months or 24 months.

Shorter intervals are chosen:

- For devices that are unstable but irreplaceable, or for one-of-a-kind items
- For equipment used in harsh environments
- For equipment used in production processes with high precision requirements

Longer intervals may be chosen for:

- Low-cost equipment with low quality requirements (such as simple multimeters)
- Self-contained items (such as triple-point cells)
- Low-wear items (such as Coriolis flow meters)

Evaluating calibration results

If you want to adjust the calibration interval for a device based on its technical history, you must refer to the results of past calibrations. This means that you need to evaluate the calibration results, which are usually documented on calibration certificates.

One simple but very effective method for this purpose is to assign processing codes after each calibration or repair.

These codes are based on the calibration results, and they are easy to consult; this method eliminates the need to evaluate the measurement results and the measurement uncertainty.

We explain this method in our full-day seminar and the accompanying book titled "Calibration compendium".

Extending a calibration interval

If you need to decide about extending a calibration interval, you should follow these steps:

Check whether a decision to extend the interval is technically justifiable.

A purely economic decision is strongly discouraged.

The measuring device is used very little or rarely: even when not in use, measuring devices experience changes that significantly influence their metrological properties.

If a calibration interval is extremely extended (for example: four years), a warning must be issued before using the test and measurement equipment, and it must be considered as "not calibrated".

It also makes no sense to extend calibration intervals (significantly) if the instrument is not in use.

A better solution: lock the measuring device away and attach a clear identification tag to it (calibration sticker), deny access, and enter the relevant information in the calibration overview.

Influences on test and measurement equipment

If you are considering calibration intervals or extensions to intervals, you need to have some knowledge about the instrument. The idea that the interval can be extended because the instrument is only used sporadically is based on incorrect or missing information. Here are some background facts you should take into account.

- Measuring devices with moving components such as torque wrenches: greases inside the device can become gummy, bearings can become stiff, and the constant of springs can change depending on the tension.
- Measuring devices without moving components such as mass standards or standard weights: for example, their buoyancy can change due to small magnetic influences, and their surface can oxidize during storage in rooms without air conditioning.
- Electronic measuring devices in general, such as multimeters, oscilloscopes, etc.: components can dry out and change.

These are only a few examples. Please contact you Kistler partner – we will be happy to help you adjust the calibration intervals for your instruments.

Intervals on calibration certificates

Calibration laboratories are not generally allowed to specify intervals. This is to avoid the customer becoming (economically) dependent on the calibration laboratory.

However, an agreement with the customer is permitted. If the customer requests an interval or date for the next due calibration, this may also be noted on the calibration certificate.

In some cases, extreme intervals such as four or more years were found. This came to the attention of various working groups for specialist committees of the DKD/DAkkS as well as working groups for the development of DIN or VDE/VDI guidelines. They then decided to limit the validity period of calibration certificates: it is the calibration certificates that have a validity period – not the calibration itself or the calibration interval!

Example:
DIN 51309:2005-12 section 6.3.2, Recalibration:

"*The calibration certificate is valid for a maximum of 26 months.*"

We can clearly see the recommendation for a two-year interval here. Two more months were added to allow compensation for unpredictability (unavoidable measurement requirements, audit, appointment of the calibration center, etc.).

Indication of the time of recalibration

One question that is often discussed is: exactly when does the calibration expire? (See also the information above about specifying intervals on calibration certificates).

There is no official or standard-based requirement that can answer this question.

Let's assume that a measuring device has been assigned a calibration interval of 12 months, and the last calibration was on April 16, 2018. When does it have to be calibrated again?

Some operational management systems that are also used to monitor measuring equipment keep a complete record of due dates.

In this case, the measuring device should no longer be used from April 16, 2019 onwards, unless it was recalibrated before that date.

It would better and more practical to stipulate that a measuring device must always be presented for calibration in a specified month of the year. In our example, this would be in April 2019.

- This means that a maximum of almost a full month can be "gained". At first glance, this only seems to be additional usage time. It is generally impossible to specify an exact day when the device must be re-presented for calibration: there are too many uncertain or unknown factors that affect your own company as well as the external calibration service provider.
- Choosing the target month as the expiry date therefore gives the necessary scope for calibration registration.

If you decide to do this:
- The target month must be recorded in the quality management manual
- The applicable re-presentation date must be maintained in the measuring equipment monitoring system
- Only the specified month and year can be entered on your company's own calibration sticker (if used).

General information about calibrations and calibration intervals

- During calibrations, around 8% of all test and measurement devices are found to need adjustments or repairs.

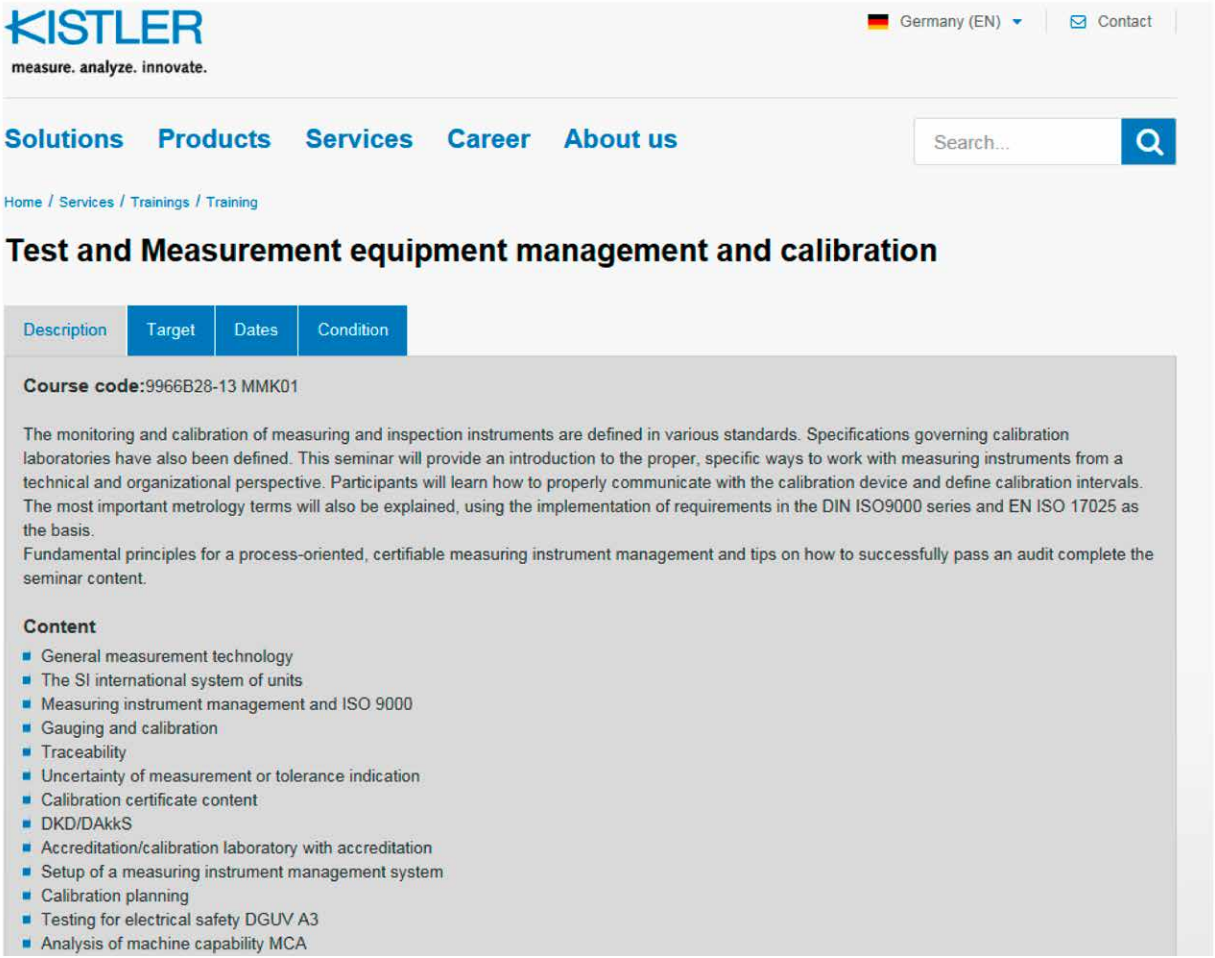
This figure of 8% does not include:

- Devices identified as "defective" when presented to the manufacturer or calibration service (these are often identical).
- Cases where the operator knew that there was a failure (malfunction or breakage). The 8% figure refers to devices presented for "calibration only", which users did not suspect of measuring incorrectly or inaccurately.
- This number involves a degree of uncertainty, but it is based on evaluation of a large device pool (> 250,000 devices including over 10,000 different device types, ranging from simple multimeters to spectrum analyzers and high-end equipment).

Training by Kistler

This brochure is a brief summary of some of the information provided in a full-day seminar offered by Kistler.
Our seminar offers full insights into standards and references; terms such as accreditation, traceability and measurement uncertainty are explained in detail; and one complete section of the seminar focuses on calibration intervals and interval calculations.

Check out our seminar at:
https://www.kistler.com/en/services/training/type-9966b28-13-mmk01/



Seminar

Test and Measurement equipment management and calibration

Seminar description
Various standards define how test and measurement instruments must be monitored and calibrated. Specifications have also been defined for calibration laboratories. This seminar starts with an introduction to the correct ways of working with measuring instruments, covering specific methods as well as technical and organizational aspects. Participants will learn how to communicate correctly with the calibration device, and how to define calibration intervals. The most important terms in metrology will also be explained, based on compliance with the requirements specified in the DIN ISO 9000 series and EN ISO 17025. The seminar concludes with an overview of the fundamental principles of process-oriented, certifiable measuring instrument management and some tips on how to pass an audit successfully.

Seminar content
- General measurement technology
- The SI international system of units
- Measuring instrument management and ISO 9000
- Gauging and calibration
- Traceability
- Measurement uncertainty or tolerance indication
- Content of a calibration certificate
- DKD/DAkkS
- Accreditation: what is an accredited calibration laboratory?
- Setup of a measuring instrument management system
- Calibration planning
- Testing for electrical safety: DGUV A3
- Analysis of machine capability MCA
- Measuring instrument capability

Goal
Application of measuring technology fundamentals in daily work

Trainer/presenter
- **Peter Jäger,** Metrologist

Target group
Staff in charge of measuring equipment, owners of measuring instruments

Requirements for participation
None

Duration
1 day

8:30 a.m.–5:30 p.m.

Seminar number
9966B28-13 MMK01 (at Kistler Remscheid GmbH, Germany)

Seminar fee
EUR 450

This seminar can also be conducted at your company premises on request. Please inquire about dates and cost.

Register at:
training.de@kistler.com

Standards, norms and references

The following documents are the basis and normative reference for this guideline.There are several subordinate documents that may have to be applied.

– International Vocabulary of Metrology. Basic and general concepts and associated terms (VIM), August 2012; DIN e.V. (publisher), Burghart Brinkmann (author)

– DIN EN ISO 17025:2017: General requirements for the competence of testing and calibration laboratories

– DIN EN ISO/IEC 17000:2005-03: Conformity assessment – Vocabulary and general principles

– ILAC-G5 (withdrawn)

– ILAC-G24 / OIML D-10: Guidelines for the determination of calibration intervals of measuring instruments

– DIN EN ISO 10012:2003: Measurement management systems. Requirements for measurement processes and measuring equipment

– ILAC-G8:03/2009: Guidelines on the Reporting of Compliance with Specification

– IATF 16949: Quality management system requirements for automotive production and relevant service parts organizations

– DIN EN ISO 9001:2015: Quality management systems – Requirements

– UKAS M3003: The Expression of Uncertainty and Confidence in Measurement (Edition 4, 2019)

– UKAS M3003: The Expression of Uncertainty and Confidence in Measurement (Edition 4, 2019), Appendix M, Assessment of Conformity with Specification

– Czaske, M.: Usage of the uncertainty of measurement by accredited calibration laboratories when stating compliance; Accred Qual Assur (2008) 13:645-651 (DOI 10.1007/s00769-008-0460-0)

– Jäger, Peter: Calibration compendium, ISBN 9783750436039

– Jäger, Peter – Measurement Science Conference 2011: Determination and evaluation of calibration intervals

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