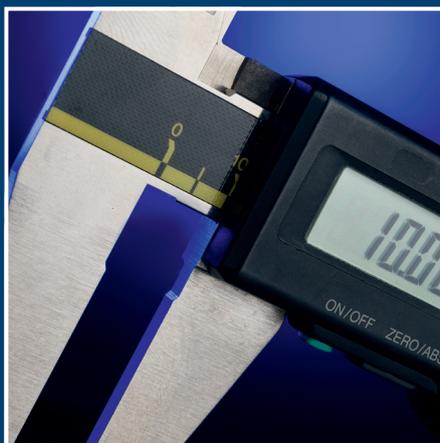




## SPECIAL ISSUE

## The new German Calibration Service **DKD**

English Edition – April 2015



**Special Journal for the Economy and Science**  
**Official Information Bulletin of the Physikalisch-Technische Bundesanstalt**  
**Braunschweig und Berlin**

**Special Issue**  
**Volume 124 (2014) No. 2**

## **Contents**

---

The new German Calibration Service (DKD)

- *Peter Ulbig*: The new German Calibration Service (Deutscher Kalibrierdienst, DKD):  
A success story continues 3
  - *Peter Ulbig*: The re-establishment of the German Calibration Service (Deutscher Kalibrierdienst, DKD)  
to ensure the uniformity of metrology 5
  - Technical Committees at a glance 11
- 

### **Cover picture**

The cover shows typical measuring instruments which are calibrated by calibration laboratories on behalf of the industry. The pictures show a digital ammeter, a calliper and a torque wrench.

# Imprint

The PTB-Mitteilungen are the metrological specialist journal and the official information bulletin of the Physikalisch-Technische Bundesanstalt. As a specialist journal the PTB-Mitteilungen publish original scientific contributions and general articles on metrological subjects from the areas of activities of the PTB. The individual volumes are focused on one subject. As the official journal, the Mitteilungen have a long tradition dating back to the beginnings of the Physikalisch-Technische Reichsanstalt (founded in 1887).

## **Publisher/Editor**

Physikalisch-Technische Bundesanstalt (PTB),  
Braunschweig and Berlin  
Postal address:  
Postfach 33 45, 38023 Braunschweig  
Delivery address:  
Bundesallee 100, 38116 Braunschweig

## **Editorial Staff/Layout**

Press and Information Office, PTB  
Dr. Dr. Jens Simon (Editor in Chief)  
Dr. Peter Ulbig (Scientific Editor)  
Bernd Warnke  
Phone: (05 31) 592-93 21  
Fax: (05 31) 592-30 08  
email: bernd.warnke@ptb.de

The technical articles from this issue of the PTB-Mitteilungen are also available online at:  
**doi: 10.7795/310.20140299en**



The Physikalisch-Technische Bundesanstalt, Germany's national metrology institute, is a scientific and technical higher federal authority falling within the competence of the Federal Ministry for Economic Affairs and Energy.

## The new German Calibration Service (Deutscher Kalibrierdienst, DKD): A success story continues



Peter Ulbig<sup>1</sup>

### The new German Calibration Service (Deutscher Kalibrierdienst, DKD): A success story continues

The world changes with every passing day and so does the world of metrology. Therefore, this edition of the *PTB-Mitteilungen* takes into account the major changes in the field of calibration in recent years. What started in 1977 with the foundation of the *Deutscher Kalibrierdienst* at PTB, has evolved over the years into an indispensable tool for the dissemination of the units within the field of calibration. The DKD logo (in the same colour as the PTB logo) shows the proximity to the PTB and is known worldwide as a symbol for quality in calibration. This has been achieved through PTB's long-standing and close cooperation with the predominantly German calibration laboratories. Since the beginnings of the DKD, PTB has always made sure that the participating calibration laboratories possess a high level of metrological competence. With the establishment of the accreditation system in the early 1990s, globally valid rules were laid down, and these rules include the demonstration of competence. As an accreditation body for calibration laboratories, the DKD paved the way for a modern accreditation system for laboratories, based on the standard DIN EN ISO/IEC 17025. Simultaneously, there was the need for a coordinated approach regarding the practical work in the laboratories, in order to be able to perform calibrations at a high level. This task was performed by the gradually established Technical Committees of the DKD, where representatives of accredited calibration laboratories – together with PTB employees – developed a work basis in written form, the so-called DKD guidelines.

According to the EU Regulation on Accreditation and Market Surveillance EU/765/2008, there shall be only one accreditation body per Member State. Therefore, with effect from 1 January 2010,



Dr. Peter Ulbig  
Chairman of the  
DKD

the accreditation body of the DKD and 16 further German accreditation bodies were reorganized within a single new structure: the *Deutsche Akkreditierungsstelle GmbH* (DAkkS). Based on the Accreditation Body Act (AkkStelleG), the DAkkS since then has been the only body responsible for accreditation in Germany, including the accreditation of calibration laboratories. The creation of technical rules, however, does not form part of the tasks assigned to it by the law.

The DKD Technical Committees therefore returned to PTB in May 2011. The PTB assumed the patronage of these committees and re-established the DKD as a forum within the PTB. In accordance with Article 6 of the German Units and Time Act (EinhZeitG), the main focus lies on the promotion of the metrological uniformity when disseminating the units. This is achieved through the development of DKD guidelines and other DKD documents which still provide a uniform work basis for accredited calibration laboratories. According to PTB's legal mandate, the DKD enables the PTB to reach one of its most

---

<sup>1</sup> Dr. Peter Ulbig  
Head of Division Q  
Scientific-technical  
Cross-sectional tasks  
email: peter.ulbig@  
ptb.de

important stakeholder groups. The members of the DKD mainly represent small and medium-sized enterprises which are closely linked to the German industry. The DKD remains the foremost platform for the technical exchange between all participants, since ultimately metrology is always made by people for people. The DKD will therefore remain true to its principles, in order to support a successful calibration system for the German economy – so as to be able to write another chapter in the success story. ■

# The re-establishment of the German Calibration Service (Deutscher Kalibrierdienst, DKD) to ensure the uniformity of metrology

Peter Ulbig<sup>1</sup>

## 1. Introduction

The *Deutscher Kalibrierdienst* (DKD) was founded in 1977 to address the growing number of calibrations for the German economy with the help of private laboratories. Since that time, the DKD has successfully gone through various stages of development. Until the end of 2009, the DKD consisted of two parts: the DKD was both accreditation body for the accreditation of calibration laboratories according to ISO/IEC 17025 and a forum for technical exchange between accredited calibration laboratories and the PTB. This forum consisted of the 12 Technical Committees. Due to the changes in the accreditation system required by the EU, a new regulation came into effect as of 1 January 2010. According to this regulation there should be only *one* accreditation body per Member State. Therefore, the accreditation body of the DKD and 16 further German accreditation bodies were reorganized within a single new structure: the *Deutsche Akkreditierungsstelle GmbH* (DAkkS). So initially, the 12 DKD Technical Committees found themselves without a home. At a meeting of the Advisory Board 5 for Metrology in November 2011 (one of the seven advisory boards of the National Accreditation Advisory Board to advise the federal government on accreditation issues), the PTB assumed the patronage of the DKD Technical Committees. Simultaneously, the author was commissioned to develop an organizational structure for the future development of the DKD.

Until the end of 2009, calibration laboratories automatically became members of the DKD Committees after having obtained a DKD accreditation (membership in one or more of the Committees, depending on the scope of accreditation). Due to the changes in the accreditation system and since from then on accreditations were carried out by the DAkkS, this automatism ceased to exist - the laboratories could only opt for a voluntary mem-

bership in the new DKD. Therefore, a framework agreement was developed. It describes the main objectives and working methods of the new DKD and allows an easy accession to the new DKD if the respective institution or person identifies itself/him or herself with the objectives of the DKD. With this agreement, the new DKD became a forum for the PTB to support the dissemination of the units. According to Article 6 of the German Units and Time Act, it is the legal task of the PTB to ensure the uniformity of metrology whenever third parties disseminate the units. This has to be taken fully into account with regard to the cooperation between the accredited calibrations laboratories and the PTB. Thus, the new DKD constitutes an essential instrument to comply with this statutory mandate. In addition to the framework agreement, two written rules of procedure were composed, containing basic rules for cooperation within the Board and the Technical Committees of the DKD.

## 2. The objectives of the new DKD

The basic objective of the DKD is to ensure the uniformity of metrology, particularly in the field of calibration. This is to be achieved through active participation in the preparation of regulations for calibrations at the national, European and international level.

At European level, guidelines for calibration are drawn up in cooperation with the European Association of National Metrology Institutes – EURAMET. In that regard, the DKD sees itself as a national mirror committee of EURAMET. As a result of PTB's membership in EURAMET, a close professional connection has been established, thus creating a bridge between the national and European level.

The main objective of the DKD is the promotion of calibration in terms of the dissemination of the units, in accordance with Article 6 of the Units and

---

<sup>1</sup> Dr. Peter Ulbig  
Head of Division Q  
Scientific-technical  
Cross-sectional tasks  
email: peter.ulbig@  
ptb.de

Time Act. This concerns in particular the promotion of the exchange of information between the members and the development of calibration guidelines, which represent the state of the art and can be used as a basis for accreditation procedures and assessments.

In order to reach these targets, the following tasks have to be performed:

- information of the members about new national and international developments in calibration, at meetings or in another suitable way,
- active participation in the preparation of regulations for calibrations at the national, European and international level,
- publication of documents,
- participation in meetings and forums of Germany's National Accreditation Body (DAkks),
- promotion of training courses for employees in the field of calibration,
- provision of information to the public regarding the activities of the DKD,
- promotion of interlaboratory comparisons/ comparison measurements.

This set of tasks and objectives takes into account the needs of the accredited calibration laboratories in terms of technical assistance, allowing an intensive exchange between both the laboratories and with the PTB.

### 3. Membership in the new DKD

In terms of the dissemination of the units, the new DKD primarily addresses German accredited calibration laboratories. But the DKD is also open to all individuals and institutions that, in the broadest sense, are involved in calibration and interested in working with the DKD. This applies in particular to calibration laboratories which have not yet been accredited, or assessors who assess calibration laboratories on behalf of the DAkks.

The DKD offers the following types of membership:

- full members
- associate members
- honorary members
- supporting members.

Any legal or natural person who operates an accredited calibration laboratory in the Federal Republic of Germany can become a full member. By definition, the PTB is also a full member, due to the acquisition of the patronage of the DKD.

Associate membership is an option for accredited calibration laboratories that are not located on the territory of the Federal Republic of Germany. Thanks to the good contacts with the neighbouring countries Austria and Switzerland, there are already some foreign accredited calibration laboratories that are members of the new DKD.

Honorary membership may be conferred upon proposal by the Executive Board on individuals who have rendered outstanding services to the DKD. Thus, in 2013 two honorary memberships have been awarded to individuals who, over many years, have made outstanding contributions to the work of the DKD.

Supporting membership is open to those who do not qualify for a full or associate membership but identify themselves with the goals of the DKD. This applies in particular to assessors and individuals who have belonged to accredited calibration laboratories and who, now retired, want to share their knowledge and experience.

Membership in the DKD may be requested by signing a declaration of accession to the framework agreement. The Board decides on the admission of members. Since the start of the new DKD on 3 May 2011, a total of 330 members have been admitted (as of 1 April 2014). The DKD membership is free of charge because with the new DKD as a national and technical forum for calibration, the PTB fulfills its statutory mandate to ensure the uniformity of metrology.

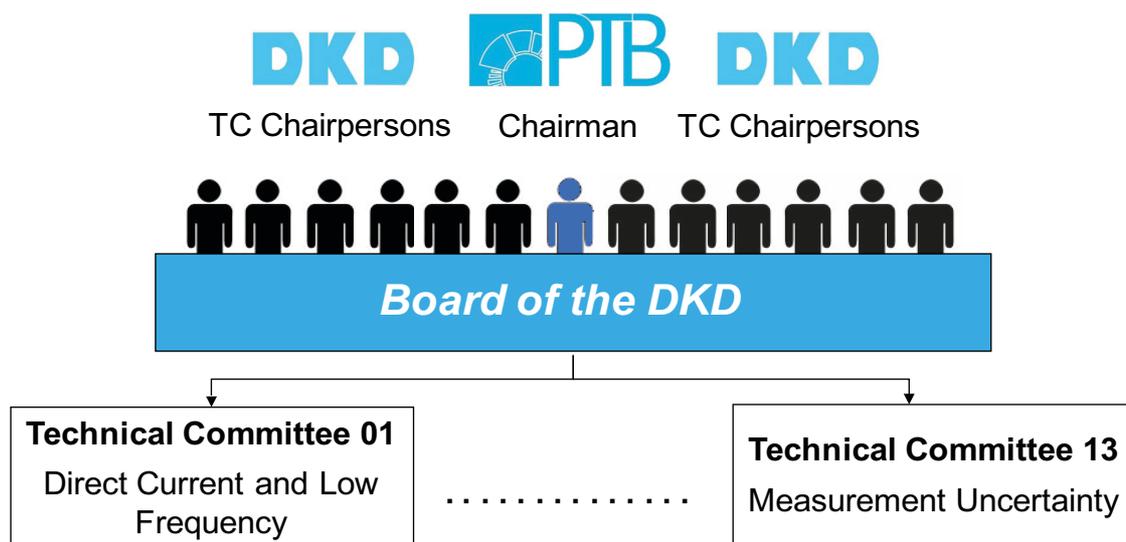


Fig. 1: Board and Technical Committees (TC) of the DKD

#### 4. Organization and structure of the new DKD

Essentially, the new DKD is divided into the Steering Committee (DKD Board), which has an operating function, and the Technical Committees, which deal with the development of technical bases for calibrations. In addition, a General Assembly of all members may be convened on important occasions.

The Board is responsible for general aspects and issues regarding the DKD. In particular, the Board is responsible for the adoption of DKD documents that are published on the website of the DKD.

The Board consists of a PTB representative acting as chairman and the elected chairpersons of the respective Technical Committees. (see Fig. 1).

The now 13 DKD Technical Committees are responsible for specific technical areas:

- 01: Direct Current and Low Frequency
- 02: High Frequency and Optics
- 03: Force and Acceleration
- 04: Length
- 05: Temperature and Humidity
- 06: Pressure and Vacuum
- 07: Mass and Weighing Instruments
- 08: Chemical Measurands and Material Properties
- 09: Materials Testing Machines
- 10: Torque
- 11: Flow Measurands
- 12: Measurands in Laboratory Medicine
- 13: Measurement Uncertainty

The DKD Technical Committee 13 *Measurement Uncertainty* sort of represents a horizontal Technical Committee. Each of the other Technical Committees is asked to send two representatives. The Technical Committee 13 treats fundamental issues which are related to measurement uncertainty and play a role in calibration. In general, the Technical Committees are responsible for the development and maintenance of the corresponding DKD documents. Through membership in the DKD, each member acquires the right to collaborate in the DKD Technical Committees. The Technical Committees usually meet once or twice a year. After having successfully completed its start-up phase, the DKD Board now usually meets once a year.

#### 5. The documents of the new DKD

Since the early 90s, the DKD has published over 60 documents that have been developed in the Technical Committees. These documents gather the expertise that is necessary to carry out calibrations. Due to their high quality and usefulness, these documents have not only been spread in Germany and Europe but, in part, also worldwide. The documents represent the state of the art and are adapted

from time to time, as is the case with standards. Assessors from many countries use the DKD documents as a basis for the technical part of their assessment during the accreditation.

Until 31 December 2009, there were four different types of documents:

- DKD Guidelines (DKD-R)
- DKD Guides (DKD-L)
- DKD General Documents
- DKD Leaflets

While the guidelines and guides have a technical character, the general documents and leaflets deal with fundamental issues regarding the accreditation of calibration laboratories, e.g. the issuing of calibration certificates or the use of logos. As agreed with the DAkkS and with effect from 1 January 2015, the new DKD will continue to take care of the guidelines and guides, whereas the DAkkS will look after the general documents and leaflets.

In 2011 and in addition to the established guidelines and guides, there was a desire to publish useful information gathered while drafting the afore-mentioned documents, in order to provide this kind of information to the calibration experts. The information includes, for example, study or measurement results obtained by members of the Technical Committees prior to the development of the guidelines. This was also the reason for creating a new type of document: the “DKD Expert report” (DKD-E). This was done on the basis of the “Expert reports” of the International Organization of Legal Metrology (OIML) which also serve to document valuable knowledge gathered by technical experts and to make it available to the relevant professional circles.

Furthermore, the issue of “comparison measurements” (interlaboratory comparisons or start-type comparisons) is of great importance for all accredited calibration laboratories. In the past, many comparison measurements were organized by the DKD Technical Committees and the results were discussed during their meetings. In order to document this valuable work and knowledge, a new type of document has been introduced: the “DKD Comparisons” (DKD-V).

Overall, the DKD documents therefore now comprise the following types of documents (see Fig. 2):

- DKD Guidelines (DKD-R)
- DKD Guides (DKD-L)
- DKD Expert Reports (DKD-E)
- DKD Comparisons (DKD-V)

The DKD Guidelines (as normative procedures) and the DKD Comparisons can be directly used for accreditation, since they help to meet the requirements for ensuring the quality of test and calibration results according to the standard DIN EN ISO/IEC 17025, chapter 5.9.

Fig. 2: The new DKD documents



The Technical Committees can make use of these options according to their needs. The creation of the two new types of documents has contributed to an intensification of the work in some of the Technical Committees. At the same time, it has generated more attention from abroad. There is a growing demand for foreign language versions of the new DKD documents, e.g. in English, French, Russian or Spanish, particularly for the use within the projects of PTB’s so-called “Technical Cooperation” in developing and emerging economies. This demand can be partly taken into account. At

least English translations of the most important documents are usually provided.

### 6. Cooperation with DAkkS

As of 1 January 2010, the German calibration landscape has changed fundamentally, due the foundation of the DAkkS. According to the Accreditation Body Act (AkkStelleG), the DAkkS today is the only national body offering accreditations. The accreditation body of the DKD was taken up by the DAkkS, and the DKD Technical Committees

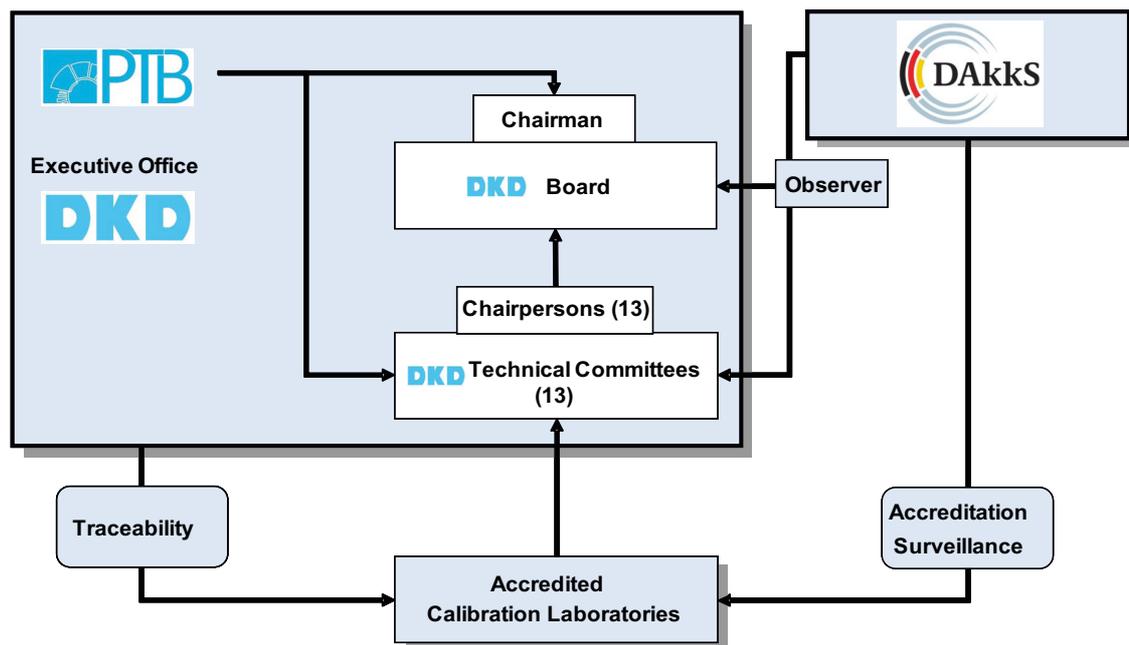


Fig. 3: The cooperation between DAkkS and PTB with the new DKD acting as a link

found their new (old) home at PTB. A well-functioning calibration system requires that all parties work together. Therefore, when re-establishing the DKD much attention was paid to a close and good cooperation with the DAkkS. Based on the framework agreement as well as the internal rules of procedure of the DKD, the DAkkS was granted the right to participate without exception in all meetings and events as guest or observer. Thus, DAkkS and PTB can fulfill their respective tasks: on the one hand, the accreditation of calibration laboratories and on the other hand, the assurance of the metrological traceability of the accredited calibration laboratories' standards. In this way, DAkkS and PTB complement each other perfectly and the new DKD forms the link between both institutions and the accredited calibration laboratories (see Fig. 2).

## 7. Summary

The re-establishment of the DKD in May 2011 has proven to be a useful and appropriate step to ensure the uniformity of metrology in Germany. Thus, the DKD provides an important tool for the PTB to fulfill its statutory mandate. The fact that within only three years 300 accredited calibration laboratories and 30 individuals have applied for membership in the new DKD (and the trend is rising) demonstrates the value that still is attached to the work of the DKD regarding the German calibration system. The work of the DKD intensively supports the dissemination of the units, from PTB to the accredited calibration laboratories and from the laboratories to the German industry. The creation of a uniform work basis for accredited calibration laboratories was, is and remains the central concern of the DKD. The DKD logo, which is known throughout the world as a symbol for the quality of calibrations, should in future be considered as a symbol for high-quality documents that allow accredited calibration laboratories to conduct the dissemination of the units to the satisfaction of their customers. ■



## DKD Technical Committee 01: Direct Current and Low Frequency

**Christian Rott**

The DKD Technical Committee “Direct Current and Low Frequency“ deals with the calibration of electrical quantities in the frequency range from 0 Hz to 1 MHz. The Technical Committee currently consists of 79 members, including accredited calibration laboratories, interested persons and representatives of the PTB. Considering the size of the committee, the realization of the technical work is a difficult task. Therefore, small groups of members have been established for the preparation of calibration guidelines. These groups are particularly supported by the Association of German Engineers (VDI/VDE-GMA Division 3.12). Thus, over the last 20 years, the calibration guideline VDI/VDE/DGQ/DKD Sheet 2622 et seq. has been created. Through the translation into English, the calibration guideline series aims to reach a greater degree of acceptance outside the German-speaking countries.

The Technical Committee meets once a year for an exchange of information. The meeting agenda includes reports from the board of the DKD, the respective sector committee of the DAkkS and the Technical Advisory Board 5 of the Accreditation Advisory Board of the Federal Government. Other topics are

- the current state of the VDI/VDE/DGQ/DKD guidelines and discussions
- information provided by and/or submitted to the Technical Committee “Measurement Uncertainty“
- guidance concerning calibration technology
- guidance concerning the evaluation of measurement results

Especially the organization and realization of comparison measurements is a current topic. Here, we rely heavily on the support of the PTB.

These and many more topics are covered in close cooperation with the PTB, with representatives of the DAkkS and members of other Technical Committees.

In addition to the relevant VDI/VDE/DGQ/DKD guidelines, the Technical Committee so far has published the following calibration guideline:

- *DKD-R 1-1: Measurement and generation of small AC voltages with inductive voltage dividers*

# A, Hz



### Chairperson:

Karl-Peter Lallmann  
1A CAL GmbH  
Gesellschaft für Metrologie  
Kassel



Digital ammeter



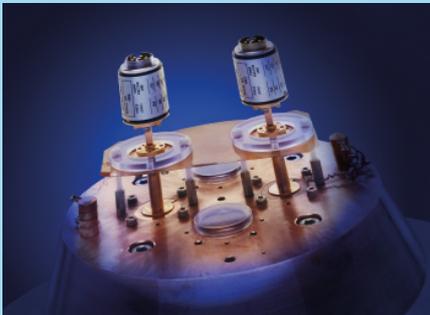
Digital multimeter and multifunction calibrator

# Hz, cd, Gy

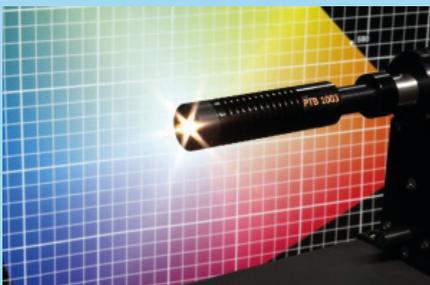


**Chairperson:**

Dr. Gerhard Rösel  
Rohde & Schwarz  
Messgerätebau GmbH  
Memmingen



Calorimeter for the calibration of HF power thermistors



100 Lumen LED transfer standard

## DKD Technical Committee 02: High Frequency and Optics

**Paul Winkler**

The DKD Technical Committee “High Frequency and Optics“ comprises the departments “High Frequency“, “Optics“ and “Dosimetry“. It consists of currently 31 accredited laboratories and three PTB representatives, one for each of the three departments, as well as interested guests from the PTB, DAkkS and industry.

According to the Units and Time Act, the PTB has to ensure the uniformity of metrology and is responsible for the dissemination of the units and their metrological traceability. In this context, the Technical Committee serves as an important forum of communication between the PTB and the accredited laboratories – it enables both sides to fulfill their respective tasks.

The Technical Committee specifically deals with the following topics and questions:

- Current topics/problems in the fields of metrology, calibration, measurement uncertainty and accreditation. The topics are discussed in the Technical Committee and the necessary measures are initiated, e.g.:
  - Clarifications of a metrological nature, in cooperation with the departments of the PTB
  - Clarifications regarding accreditation issues together with the responsible DAkkS committees
  - Clarification of topics regarding measurement uncertainty or, if necessary, forwarding of the topics to the DKD Technical Committee “Measurement Uncertainty“
- Supplying information to members and guests from the departments of the PTB, the accreditation body DAkkS and the VDI/VDE-GMA
- Organization of interlaboratory comparisons/comparison measurements in cooperation with the PTB. The interlaboratory comparisons for the individual measurement quantities are timed in accordance with the requirements of the DAkkS.
- The development of guidelines/guides for traceable calibration procedures in accordance with the departments of the PTB and by participating in the guideline activities of the VDI/VDE-GMA, Division 3.12.

The Technical Committee’s current project is to create a series of guides dealing with the traceability of so-called derived quantities for the calibration of complex high frequency measurement instruments. For efficiency reasons, a working group that mainly deals with topics of electronic communication has been set up within the Technical Committee.

The following calibration guidelines have been published by the Technical Committee:

- *DKD-L 02-1, Sheet 1: Traceability of the derived high frequency measurement quantity “Display Linearity“ (from the guide series “Traceability of derived high frequency measurement quantities“)*
- *DKD-L 02-2: Guide for a traceable measurement of HF voltage*

## DKD Technical Committee 03: Force and Acceleration

**Daniel Schwind**

The Technical Committee “Force and Acceleration“ was created in 2009, as a successor to the former Technical Committee “Mechanical Quantities“. Force and acceleration were the two remaining mechanical disciplines after the transformation of the Working Group “Torque“ into a separate Technical Committee in 2002.

Approximately 40 members from Germany and other European countries are actively engaged in the work of the Technical Committee. Calibration laboratories of the industry as well as institutes for material testing, interested and experienced supporting members, assessors of the DAkkS and employees of the PTB participate in the annual meeting of the Technical Committee. The meeting is always held prior to the meeting of the Technical Committee “Materials Testing Machines“, so that synergies can be exploited here.

In relation to issues concerning the measurement of the physical quantities force and acceleration, the Technical Committee “Force and Acceleration“ serves as the most important competence association in the German-speaking area. The task of the Technical Committee and its voluntary members is to promote the metrological infrastructure in their respective fields. This is achieved primarily through an intensive exchange of experiences during the meetings of the Technical Committee, through the organization of interlaboratory comparisons and the development of guidelines.

Regarding the measurement of force, the Technical Committee –in close cooperation with the Technical Committee “Materials Testing Machines“– has set itself the task to develop guidelines for the calibration of dynamic forces. Since the beginning of 2013, a 20 kN intercomparison for static forces is being performed, in which 23 accredited calibration laboratories from Germany and Europe are taking part.

With regard to the measurand acceleration, the Technical Committee is currently developing an important guideline for the calibration of measuring amplifiers that are used for dynamic measurements of kinematic and mechanical quantities.

So far, the following calibration guidelines have been published by the Technical Committee:

- *DKD-R 3-1: Calibration of accelerometers according to the comparison procedure Basics | Shock excitation | Sinus and multisinus excitation | Primary calibration of vibration meters with sinusoidal excitation and interferometric measurement of the vibration magnitude*
- *DKD-R 3-3: Calibration of force measuring devices*
- *DKD-R 3-9: Continuous calibration of force transducers according to the comparison procedure*

# N, m/s<sup>2</sup>

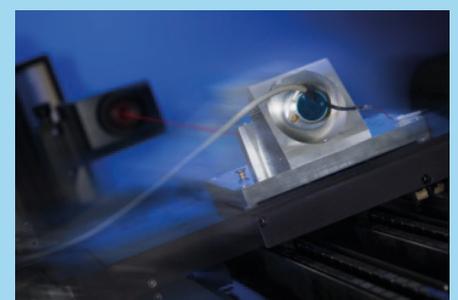


**Chairperson:**

Daniel Schwind  
GTM Gassmann Testing and Metrology  
GmbH  
Bickenbach



Stack of weights of a 100 N force standard machine



Acceleration measurement

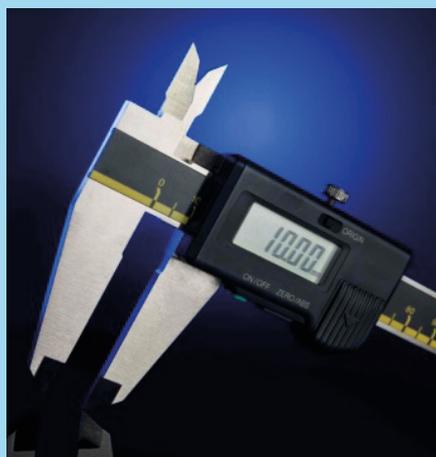
m



**Chairperson:**  
Christian Neukirch  
Volkswagen AG  
Wolfsburg



Set of gauge blocks



Calliper

## DKD Technical Committee 04: Length

**Christian Neukirch**

The DKD Technical Committee “Length” has a very long tradition and has been in existence practically since the foundation of the DKD in the 1970s. It currently has about 75 members and is thus the largest Technical Committee within the DKD. Traditionally, the committee meetings are also used for an intensive exchange with the experts of the PTB. This includes the discussion of topics regarding the calibration of measuring equipment in the field of length measurement.

In addition, there are two sub-working groups:

- the sub-working group “Measuring Equipment” together with the VDI/VDE-GMA Division 3.11 “Inspection of Test Equipment”
- the sub-working group “Roughness/Form”

Guidelines regarding the following topics are currently being prepared: test plates, test cylinders/test plugs, dial gauges and horizontal length measuring instruments.

For example, the following calibration guidelines have been published by the Technical Committee:

- *DKD-R 4-1: Selection and calibration of measuring instruments for gauge blocks for the use as standard devices in calibration laboratories*
- *DKD-R 4-2 Sheet 01: Calibration of measuring instruments and standards for roughness metrology – calibration of standards for roughness metrology*
- *DKD-R 4-2 Sheet 02: Calibration of measuring instruments and standards for roughness metrology – calibration of the vertical measuring system of stylus instruments*
- *DKD-R 4-3 Sheet 01: Calibration of measuring equipment for geometrical measurands – basics*
- *DKD-R 4-3 Sheet 3.1: Calibration of measuring equipment for geometrical measurands – calibration of gauge blocks*

## DKD Technical Committee 05: Temperature and Humidity

Herbert Kirchner

The Technical Committee “Temperature and Humidity” was founded in 1987, and today it represents around 70 members from Germany and abroad.

For more than 25 years and in cooperation with the Physikalisch-Technische Bundesanstalt (PTB), our Technical Committee has provided the harmonization of many metrological procedures and paved the way for their dissemination at the European level.

This year we focus on the calibration procedure for temperature block calibrators above 600 °C. In order to gain new insights regarding the evaluation of the measurement uncertainty for this calibration object, a pilot study with different standards has been carried out. The results will be available at the meeting of our Technical Committee in May and will be discussed in our forum.

In the field of humidity, we are aiming at establishing a new working basis for the calibration of humidity systems. So far, there is no calibration guideline for the calibration of humidity sensors. These issues will be tackled at this year’s meeting of the Technical Committee.

The Technical Committees’s annual meeting provides an active forum for laboratories, assessors of the DAkkS (German Accreditation Body), representatives of the PTB and designated bodies.

Comprehensive calibration guidelines exist in the field of temperature metrology:

- DKD-R 5-1 *Calibration of resistance thermometers*
- DKD-R 5-3 *Calibration of thermocouples*
- DKD-R 5-4 *Calibration of temperature block calibrators*
- DKD-R 5-5 *Calibration of temperature indicators and simulators by electrical simulation and measurement*
- DKD-R 5-6 *Determination of temperature characteristic curves*
- DKD-R 5-7 *Calibration of climatic chambers*

# K, % rh



**Chairperson:**  
Herbert Kirchner  
imetrologie GmbH  
Helmstadt



Water fixed-point cell



Dewpoint mirror

Pa

## DKD Technical Committee 06: Pressure and Vacuum

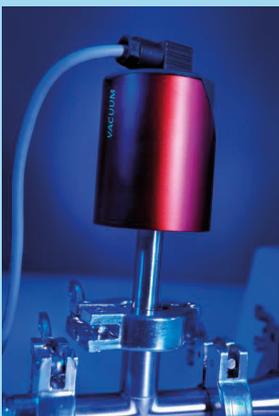
**Christian Elbert**



**Chairperson:**  
Christian Elbert  
Wika Calibration Technology  
Klingenberg



Pressure balance



Vacuum measuring cell

More than 60 laboratories are currently represented in the Technical Committee “Pressure and Vacuum“. A broad mix of participants, consisting of equipment manufacturers, users in in-plant laboratories and service providers, guarantees the representation of the different stakeholders. Moreover, the chairperson’s participation in committees of the Accreditation Body DAkkS and the Federal Ministry of Economics ensures the coordination of interests, which is further intensified through the regular participation of employees from the DAkkS and the PTB in the meetings of the Technical Committee. These meetings, which usually take place on an annual basis, serve as a communication platform to promote the mutual exchange and to facilitate discussions on current topics of metrology. For example, the calibration of small differential pressures at high static pressures as well as the ever-increasing demands regarding the accuracy of the pressure measurement represent the challenges that are placed on the calibration laboratories by the industry.

In addition to the current tasks, the different internal working groups of the Technical Committee work on fundamental specialized topics in cooperation with the employees of the PTB. For example, the calibration guideline DKD-R 6-1 is currently being revised. The first version had found its way into the international world of calibration years ago and still serves as a basic document. Various translations as well as its use in an EA guideline underline its global significance.

The working group for particularly small pressures, i.e. the working group “Vacuum“, can claim a similar success. Here too, a pathbreaking fundamental work was carried out by creating the Guideline DKD-R 6-2.

Last but not least, the DKD Technical Committee complements its role as technical committee of PTB by organizing and executing interlaboratory comparisons. This range of interlaboratory comparisons serves the accredited laboratories as a proof of suitability and guarantees the customer technical competence within the scope of services.

To round things off, trendsetting topics form an integral part of the agenda and are regularly discussed. In the “digital” age, special emphasis is given to the possibilities of electronic generation and transfer of calibration data.

Interested guests are welcome and can check the homepage of the DKD about current events.

## DKD Technical Committee 07: Mass and Weighing Instruments

**Norbert Schnell**

This Technical Committee was established in 1995 and brings together the DAkkS-accredited calibration laboratories for the mechanical measurand mass. It currently represents 23 laboratories for the calibration of weights and 38 laboratories for the calibration of weighing instruments.

Through the traceability of their calibration results, the calibration laboratories for weights guarantee that all weighing results within the range from milligram to tonne are comparable to the prototype kilogram.

The requirements for weights are extensively described in the “International Recommendation OIML R 111” of the International Organization of Legal Metrology. It contains, inter alia, requirements for accuracy classes (permissible errors and measurement uncertainties), configurations, surface quality and material (density and magnetic properties).

The classes E1 and E2 represent the highest accuracies which can only be achieved under very demanding measurement conditions in special laboratories. For this purpose, mass comparators that, for example, can calibrate one kilogram up to  $1 \mu\text{g}$  accuracy are used.

The calibration of balances is usually carried out at the customers premises (location of the device), in order to take into account the installation and ambient conditions. The smallest achievable relative measurement uncertainty, that can be attained for analytical balances and high precision scales under very good conditions and with highly accurate test weights, amounts to  $1 \cdot 10^{-6}$ .

The Technical Committee has played a major part in the elaboration of the Guideline EURAMET cg-18 (Guideline on the Calibration of Non-Automatic Weighing Instruments) which is generally used for the calibration of balances in Germany. The guideline is currently being revised with regard to the practice-oriented requirements by an international group of experts of the EURAMET TC-Mass and with the support of German experts (including the Committee’s chairperson). In doing so, special emphasis is placed on supporting the users of weighing instruments in order to meet the process requirements. Besides the official results, the calculation of uncertainties in everyday use of the weighing instrument and the resultant minimum sample weights will be explained.

Currently, the Technical Committee deals with the organization of interlaboratory comparisons for balances and E1 weights. Moreover, an interlaboratory comparison to determine the magnetic properties of weights has been carried out. The replacement of the prototype kilogram by redefining the material measure mass (Avogadro Project as well as watt balance) has been discussed by the Technical Committee and, with regard to the achieved uncertainties, has been judged as being conservative.

It is planned to publish the German translation of the rev. 4 of the Guideline EURAMET cg-18 as a DKD Guideline.

kg



**Chairperson:**

Norbert Schnell  
Sartorius Lab Instruments GmbH &  
Co. KG  
Göttingen



Weights



Analytical balance

mol, m<sup>3</sup>,  
kg/m<sup>3</sup>, S



**Chairperson:**

Dr. Olaf Schnelle-Werner  
ZMK – Analytik-GmbH  
Bitterfeld-Wolfen



Conductivity measuring cell



Ubbelohde viscometer

## DKD Technical Committee 08: Chemical Measurands and Material Properties

**Olaf Schnelle-Werner**

The Technical Committee “Chemical Measurands and Material Properties“ was established in October 2012, thus being the youngest Technical Committee of the DKD. It represents approximately 15 calibration laboratories which have been accredited by the DAkkS according to DIN EN ISO/IEC 17025:2005. These laboratories cover the following analytical measurands: pH, electrolytic conductivity, density, viscosity and volume.

The Technical Committee primarily develops calibration guidelines, in order to complement existing standards. The aim is to harmonize the calibration processes in the accredited calibration laboratories for chemical measurands at the national and international level by implementing the developed calibration guidelines. For this purpose, the Technical Committee supports the work of the DKD in the translation of guidelines and expert reports as well as their international communication.

The current objective of the Technical Committee “Chemical Measurands and Material Properties“ is the development of guidelines for pH and electrolytic conductivity. Viscometers of various kinds are calibrated for the measurand viscosity, e.g. Ubbelohde capillary viscometers for the use in laboratories as well as flow cups.

Reference materials and reference liquids are equally important. They provide the metrological basis for the traceability of the above-mentioned measuring instruments. These include, for example, Newtonian standard specimen of viscosity, density reference liquids, pH reference buffer solutions and materials as well as reference solutions for electrolytic conductivity. Stability and homogeneity have a significant impact on the quality of reference materials. These requirements are laid down in the ISO Guide 34:2009 and are increasingly being required by the customers. In the future, the expansion according to DIN EN ISO/IEC 17025:2005 / ISO Guide 34:2009 will also influence the guideline activities of the Technical Committee.

The technical subcommittee “Volume/Density”, as part of the Technical Committee, is already active in the field of the measurand volume. As a result of this work, and through the direct involvement of the manufacturers, the guideline DKD-R 8-1 “Calibration of piston-operated pipettes with air cushion” as well as several expert reports have been developed. These guideline activities will be continued and extended to include positive displacement pipettes, dispensers and piston burettes. Extensive interlaboratory comparisons according to DIN EN ISO/IEC 17043:2010 have been performed in order to metrologically confirm the results, including measurement uncertainties.

Due to the worldwide response, the guideline DKD-R 8-1 was also published in English, French and Russian. It is already being used by several NMIs and accredited calibration laboratories.

## DKD Technical Committee 09: Materials Testing Machines

**Siegfried Gerber**

The first DKD calibration laboratory for the calibration of materials testing machines was accredited on February 10, 1994. That same year, on June 28, 1994, the first meeting of a corresponding expert panel, back then under the name of “Working Group Materials Testing Machines” and formerly belonging to the Technical Committee “Force, Pressure, Mass”, was held at the PTB. It was attended by 23 participants. This Committee has set itself the task to discuss topics related to the calibration of materials testing machines. This includes primarily the calibration of universal testing machines, hardness testing machines, pendulum impact testing machines or testing machines for building materials.

Each year, between 50 and 60 interested persons from 7 European countries take part in the meeting of the Technical Committee “Materials Testing Machines”. Due to the fact that 70 % to 80 % of all laboratories accredited by the DAkkS are regularly represented at the meetings, the Committee very well reflects the calibration landscape in the field of materials testing machines. This allows efficient working and ensures a homogenous implementation of the standards and guidelines by the accredited laboratories.

The Committee includes members of the accreditation body who provide news and information. Furthermore, representatives of the PTB and DIN provide information regarding new standards and committee activities, even during the revision process. Thus, the drafts can be discussed and new suggestions can be presented to the committees. Moreover, the Technical Committee organizes interlaboratory comparisons, discusses recent developments and topics, draws up complementary guides for standards or develops DKD guidelines within the working groups. The effective operation is supported by the fact that the Chair of the Technical Committee “Materials Testing Machines” is also acting as chairman of the DIN working committee NA 062-08-11 AA “Materials Testing Machines” as well as deputy chairman of the DIN working committee NA 062-018-44 AA “Impact Testing for Metals”.

The meeting always takes place after the meeting of the Technical Committee “Force and Acceleration” and prior to the gathering of the VMPA working group “Testing Machines and Testing Equipment”, so here synergies can be exploited

The Technical Committee, in cooperation with the Technical Committee “Force and Acceleration”, currently works on a guideline for the dynamic calibration of force measuring devices and testing machines.

The Technical Committee has already published the following documents:

- *Guides for the calibration/testing of tensile/compression testing machines*
- *Guides for the calibration/testing of hardness testing machines*

Pictures: Materialprüfungsanstalt Universität Stuttgart

# N, m



**Chairperson:**  
Siegfried Gerber  
Materialprüfungsanstalt  
Universität Stuttgart



Calibration of a materials testing machine



Force standard

N · m

**Chairperson:**

Siegfried Herbold  
Eduard Wille GmbH & Co. KG  
Wuppertal



Torque calibration machine



Torque wrench

## DKD Technical Committee 10: Torque

**Dirk Röske**

The Technical Committee “Torque” deals with questions regarding the realization and measurement of the physical quantity of torque, i.e. “pure torque” (also represented as moment of a force couple) and “torque with cross force” (to be seen as moment of a single force). The former occurs, for example, in drives with a negligible influence of cross forces or bending moments. The latter is the typical application case of a torque wrench where a torque is generated with the help of a cross force that acts on the lever; on this occasion, however, the introduced force as well as usually also an additional bending moment are involved, in addition to the torque.

The tasks of the Technical Committee include the preparation of calibration standards and guidelines for the quantity of static torque, the technical consultation on issues in the field of torque measurement, the organization and evaluation of interlaboratory comparisons and the exchange of experience among its members, which are usually accredited calibration laboratories for this measurand.

The Technical Committee “Torque” develops drafts for DKD guidelines. In addition, members of the Technical Committee also support standardization bodies, such as DIN and VDI, with their expertise. The expert reports serve the gathering and transfer of knowledge for the realization and dissemination of the quantity of torque. Comparison measurements are an important element in the evaluation of the calibration capabilities of accredited laboratories in the field of torque.

The Technical Committee currently has 41 members, including nearly all of the more than 30 accredited laboratories for torque calibration.

Currently, the Technical Committee is revising the guidelines DKD-R 3-7 and DKD-R 3-8 for the static calibration of indicating torque wrenches as well as calibration devices for torque wrenches. In addition, an interlaboratory comparison for the calibration of indicating and clicking torque wrenches according to DIN EN ISO 6789 is in the process of being completed. A report on the previous interlaboratory comparison for the calibration of torque transducers according to DIN 51309 is ready for publication.

In February 2014, the Technical Committee organized a seminar on measurement uncertainties in torque realization and torque measurement for the employees of accredited laboratories (276th PTB Seminar).

The Technical Committee has already published the following calibration guidelines:

- *DKD-R 3-5: Calibration of torque measuring devices for static alternating torque*
- *DKD-R 3-7: Static calibration of indicating torque wrenches*
- *DKD-R 3-8: Static calibration of torque tool calibration devices*

## DKD Technical Committee 11: Flow Measurands

Georg Giesen

The Technical Committee “Flow Measurands” was founded in March 2007 and is thus one of the youngest DKD Technical Committees. It represents about 25 accredited calibration laboratories for the measurands “flowrates of gases and liquids” and “flow velocity”.

The Technical Committee’s activities focus on:

- the realization of interlaboratory comparisons among the member laboratories
- the information of its members about new developments/trends in the fields of calibration (provided by employees of the PTB) and accreditation (provided by the responsible representatives of the the DAkkS)
- the development of calibration guidelines as a basis for identical approaches and the comparability of calibration results

In line with the areas of expertise, three working groups were formed, each dealing with one of the three specific topics.

Currently, the Technical Committee is conducting an interlaboratory comparison for flow calibrations with the medium water at room temperature. To this end, general rules for the realization as well as a table containing the possible measuring ranges of the participants have been set up. The PTB has assumed the role of pilot laboratory and will also support the evaluation. The necessary transfer standards were either made available by the participants or were jointly purchased. The latter are to be kept at PTB for future similar comparisons after the completion of the measurements.

In addition, the Working Group “Flow Velocity” has dealt with the comparability of calibration conditions for the calibration of anemometers. The basis for this was provided by a comparison measurement carried out among the respective calibration laboratories.

Moreover, work is being done to create a guideline for the measurement of thermal energy.

The international comparability of accreditations regarding technical aspects is another point that requires harmonization and should be improved in cooperation with the DAkkS and PTB.

$m^3/s$

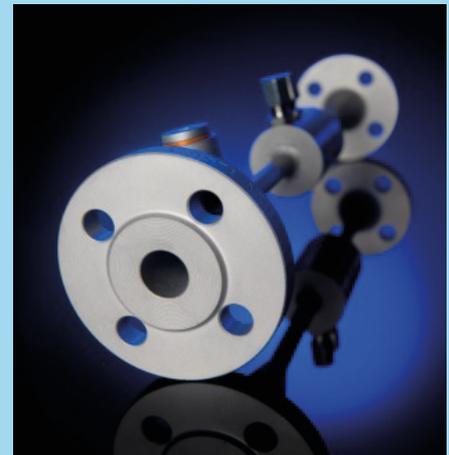


**Chairperson:**

Georg Giesen

Rota Yokogawa GmbH & Co. KG

Wehr



Flowmeter



Critical nozzle

# mol/m<sup>3</sup>


**Chairperson:**

Prof. Dr. Lothar Siekmann  
 Institut für klinische Chemie und Pharmakologie am Universitätsklinikum Bonn



Blood samples for analysis



Samples for gas-chromatographic analysis

## DKD Technical Committee 12: Measurands in Laboratory Medicine

**Lothar Siekmann**

The Technical Committee “Measurands in Laboratory Medicine“ currently comprises four accredited laboratories that offer a total of approximately 35 different measurands. The laboratories represented in the Technical Committee are also integrated into the global system “Joint Committee for Traceability in Laboratory Medicine (JCTLM)“ which was founded by the International Bureau of Weights and Measures (BIPM), the International Federation of Clinical Chemistry and Laboratory Medicine (IFCC) and the International Laboratory Accreditation Cooperation (ILAC). The task of the JCTLM (<http://www.bipm.org/jctlm>) is the regular listing of

- calibration/reference materials,
- calibration/reference measurement procedures,
- calibration/reference laboratories with their respective measurands

Prerequisites for the listing of calibration and reference laboratories services by the JCTLM are

- the application of a calibration/reference method accepted (listed) by the JCTLM,
- the accreditation as calibration laboratory according to DIN EN ISO/IEC 17025 and DIN EN ISO 15195,
- the regular participation in interlaboratory comparisons for reference/calibration laboratories.

A corresponding proficiency testing system (RELA) was introduced as a project of the IFCC by the Reference Institute for Bioanalytics (Bonn) in 2002. The results of all laboratories, as well as their identity, are published once a year on the Internet (<http://www.dgkl-rfb.de:81>). Approximately 50 internationally spread laboratories regularly participate in these ring trials.

The JCTLM-recognized calibration and reference materials and measurement procedures serve as a basis for the accreditation by the DAkkS.

The evaluation of the comparison measurements within the scope of the accreditation is carried out using the results presentation of the RELA ring trials. The German reference and calibration laboratories as well as the PTB regularly participate in these ring trials.

## DKD Technical Committee 13: Measurement Uncertainty

Philip M. Fleischmann

„Sicher is, dass nix sicher is, drum bin ich vorsichtshalber misstrauisch.“

“It is certain that nothing is certain, so I'd rather be sceptical.”

(Karl Valentin)

It is a horrible idea to assume that measurements might be uncertain. Even more so in the case of calibration laboratories! But unfortunately, even the most accurate method has the unpleasant characteristic that its measurement uncertainty cannot be zero. And that is exactly what the Technical Committee “Measurement Uncertainty” deals with.

In addition to the exchange of information in this area, the balancing act between a practice-oriented handling and a mathematically correct formulation has to be managed: “root sum of squares”, “correlation coefficients” and “Monte Carlo simulation” are the names of the tools. But since the Technical Committee consists of participants from all disciplines, it is often very difficult to agree on general methods in order to find the best solution for a problem. But perhaps it is in the nature of things that only “approximately accurate” information can be provided?

Currently, the Technical Committee deals with creating a checklist for the validation of measurement uncertainty budgets: a sort of cookery book which classifies, summarizes and thoroughly explains the “ingredients” for the most common types of measurement uncertainty calculations from measurement tasks through to process and model measurement, taking into account normative references and basic principles. Thus, the users in the calibration laboratories will be provided with a viable tool which enables them to create process descriptions including the respective measurement uncertainties or to validate them, fulfilling all the essential requirements of the DIN EN ISO/ IEC 17025 and the GUM. Moreover, recommendations for the realization of interlaboratory comparisons shall soon be developed and handed over to the sector committee of the DAkkS. Besides, another guide for the determination of calibration intervals with regard to the calculation of measurement uncertainty is planned and shall be discussed during the next meetings.

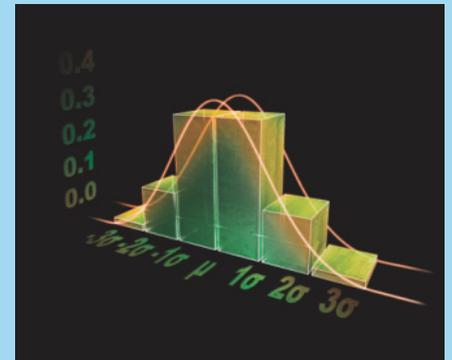
The Technical Committee has recently published the following guide:

- *DKD-L 5: Guide to the practical determination of measurement uncertainty – basics and procedures for simple models without correlation*

$$u_c(x_i)$$


### Chairperson:

Philip M. Fleischmann  
esz AG  
calibration & metrology  
Eichenau



Probability density function

$$u_c^2(y) = \sum_{i=1}^N \left( \frac{\partial f}{\partial x_i} \right)^2 u^2(x_i)$$

Combined measurement uncertainty

## Authors

*Christian Elbert*  
Wika Calibration Technology  
Klingenberg  
Germany

*Philip M. Fleischmann*  
esz AG calibration & metrology  
Eichenau  
Germany

*Siegfried Gerber*  
Materialprüfungsanstalt Universität Stuttgart  
Germany

*Georg Giesen*  
Rota Yokogawa GmbH & Co. KG  
Wehr  
Germany

*Herbert Kirchner*  
imetrologie GmbH  
Helmstadt  
Germany

*Christian Neukirch*  
Volkswagen AG  
Wolfsburg  
Germany

*Dr. Dirk Röske*  
Physikalisch-Technische Bundesanstalt  
Head of Working group 1.21 "Realization of Force"  
Braunschweig  
Germany

*Christian Rott*  
GfM Gesellschaft für Metrologie GmbH  
Ottobrunn  
Germany

*Norbert Schnell*  
Sartorius Lab Instruments GmbH & Co. KG  
Göttingen  
Germany

*Dr. Olaf Schnelle-Werner*  
Zentrum für Messen und Kalibrieren & ANALY-  
TIK GmbH  
Bitterfeld-Wolfen  
Germany

*Daniel Schwind*  
GTM Gassmann Testing and Metrology GmbH  
Bickenbach  
Germany

*Prof. Dr. Lothar Siekmann*  
Institut für klinische Chemie und Pharmakologie  
am Universitätsklinikum Bonn  
Germany

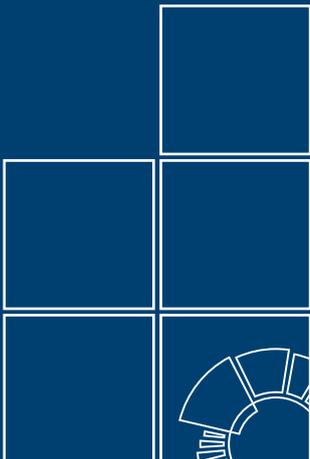
*Dr. Peter Ulbig*  
Physikalisch-Technische Bundesanstalt  
Head of Division Q "Scientific-technical Cross-  
sectional Tasks"  
Braunschweig  
Germany  
email: peter.ulbig@ptb.de

*Paul Winkler*  
EADS Deutschland GmbH  
Airbus Defence and Space  
Manching  
Germany



Federal Ministry  
for Economic Affairs  
and Energy

The Physikalisch-Technische Bundesanstalt, Germany's national metrology institute, is a scientific and technical higher federal authority falling within the competence of the Federal Ministry for Economic Affairs and Energy.



**Physikalisch-Technische Bundesanstalt  
Braunschweig and Berlin**  
National Metrology Institute

Bundesallee 100  
38116 Braunschweig, Germany

Press and Information Office

phone: +49 531 592-3006

fax: +49 531 592-3008

e-mail: [presse@ptb.de](mailto:presse@ptb.de)

[www.ptb.de](http://www.ptb.de)