

## Calibration Guidelines, Expert Reports, Technical Reports

### Length

Reference	Title	Title (original)	Available in
DKD-R 4-1	Selection and calibration of measuring instruments for gauge blocks for the use as standard devices in calibration laboratories	Auswahl und Kalibrierung von Endmaßmessgeräten zur Verwendung als Normalgeräte in Kalibrierlaboratorien <a href="https://doi.org/10.7795/550.20180823K">https://doi.org/10.7795/550.20180823K</a>	de
DKD-R 4-2	Calibration of measuring instruments and standards for roughness metrology	Kalibrieren von Messgeräten und Normalen für die Rauheitsmesstechnik	
Sheet 1	Calibration of standards for roughness metrology	Kalibrieren von Normalen für die Rauheitsmesstechnik <a href="https://doi.org/10.7795/550.20180828B">https://doi.org/10.7795/550.20180828B</a>	de
Sheet 2	Calibration of the vertical measuring system of stylus instruments	Kalibrieren des vertikalen Messsystems von Tastschnittgeräten <a href="https://doi.org/10.7795/550.20180828C">https://doi.org/10.7795/550.20180828C</a>	de
Sheet 3	Calibration of standards with periodic profiles in horizontal direction by means of stylus instruments <a href="https://doi.org/10.7795/550.20201215">https://doi.org/10.7795/550.20201215</a>	Kalibrierung von Normalen mit periodischen Profilen in horizontaler Richtung mit Tastschnittgeräten <a href="http://dx.doi.org/10.7795/550.20170629DE">http://dx.doi.org/10.7795/550.20170629DE</a>	de, en, es
Sheet 4	Calibration of the horizontal measuring system of stylus instruments <a href="https://doi.org/10.7795/550.20240701">https://doi.org/10.7795/550.20240701</a>	Kalibrierung des horizontalen Messsystems von Tastschnittgeräten <a href="https://dx.doi.org/10.7795/550.20240411">https://dx.doi.org/10.7795/550.20240411</a>	de, en
DKD-R 4-3	Calibration of measuring equipment for geometric measurands: Calibration of metrological properties of coordinate measuring machines (CMMs) according to DIN EN ISO 10360 und VDI/VDE 2617	Kalibrieren von Messmitteln für geometrische Messgrößen: Kalibrieren der messtechnischen Eigenschaften von Koordinatenmessgeräten (KMG) nach DIN EN ISO 10360 und VDI/VDE 2617 <a href="https://doi.org/10.7795/550.20180828AA">https://doi.org/10.7795/550.20180828AA</a>	de
DKD-R 4-4	Calibration of standards and measuring instruments for form measurement	Kalibrieren von Normalen und Messgeräten für die Formmesstechnik <a href="https://doi.org/10.7795/550.20180828AB">https://doi.org/10.7795/550.20180828AB</a>	de
DKD-R 4-5	Application of Coordinate Measuring Machines (CMMs) <a href="https://doi.org/10.7795/550.20240123">https://doi.org/10.7795/550.20240123</a>	Anwendung Koordinatenmesssysteme (KMS) <a href="https://doi.org/10.7795/550.20231213">https://doi.org/10.7795/550.20231213</a>	de, en
DKD-E 4-1	Traceability of thread measurements <a href="https://doi.org/10.7795/550.20230717">https://doi.org/10.7795/550.20230717</a>	Rückführung von Gewindemessgrößen <a href="https://doi.org/10.7795/550.20220914">https://doi.org/10.7795/550.20220914</a>	de, en
DKD-E 4-2	Roughness Metrology: Conversion of profiles from measurements with reference plane profilometers into skidded probe profiles <a href="https://doi.org/10.7795/550.20250207">https://doi.org/10.7795/550.20250207</a>	Rauheitsmesstechnik: Umrechnung von Profilen aus Bezugsflächentastmessungen in Kufentasterprofile <a href="https://doi.org/10.7795/550.20250116">https://doi.org/10.7795/550.20250116</a>	de, en

**Calibration Guidelines:**

DKD calibration guidelines (DKD-R) are application documents that meet the requirements of DIN EN ISO/IEC 17025. The guidelines contain a description of technical, process-related and organizational procedures used by accredited calibration laboratories as a model for defining internal processes and regulations. DKD guidelines may become an essential component of the quality management manuals of calibration laboratories. The implementation of the guidelines promotes equal treatment of the equipment to be calibrated in the various calibration laboratories and improves the continuity and verifiability of the work of the calibration laboratories. In addition, the implementation of the guidelines allows the state of the art in the respective field to be incorporated into laboratory practice.

**Expert Reports:**

DKD expert reports (DKD-E) aim to provide background information and references in connection with other DKD documents as, for example, the DKD guidelines. In some cases, they may even go far beyond these documents. They do not replace the original DKD documents but do provide a lot of supplementary information worth knowing.

Download of DKD documents: <https://www.ptb.de/cms/nc/en/metrological-services/dkd/publications.html>

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## Annex – Abstracts

DKD-R 4-1	<p><b>Selection and calibration of measuring instruments for gauge blocks for the use as standard devices in calibration laboratories</b></p> <p>This guideline applies to measuring instruments for calibrating gauge blocks up to 100 mm nominal dimension according to the differential measuring method (see DIN 861, Part 1, January 1980, Section 6.3). The terms used in this guideline correspond to DIN 861, Part 1, Gauge blocks, DIN 1319, Part 3, Fundamentals of Metrology, and DIN 2257, Sheet 2, Definitions of Length Verification Practice.</p>
DKD-R 4-2	<p><b>Calibration of measuring instruments and standards for roughness metrology</b></p>
Sheet 1	<p><b>Calibration of standards for roughness metrology</b></p> <p>This sheet applies to the calibration of type A, C, D and E standards in accordance with ISO 5436-1. These standards are used in roughness metrology according to the stylus method. The definitions in ISO 5436-1 and the standards cited therein apply.</p>
Sheet 2	<p><b>Calibration of the vertical measuring system of stylus instruments</b></p> <p>This sheet describes the calibration of the vertical measuring system of stylus instruments (DIN EN ISO 3274). The basic rules of DIN EN ISO 12179 are observed. Procedures for calculating the measurement uncertainty when calibrating stylus instruments by means of depth setting standards and roughness standards are specified. Calibration with depth setting standards establishes the metrological traceability to the national length standard, while calibration with roughness standards validates the function of the entire transmission chain of the stylus instrument.</p>
Sheet 3	<p><b>Calibration of standards with periodic profiles in horizontal direction by means of stylus instruments</b></p> <p>In many stylus instruments, the length in direction of the feed (x-axis) is determined on the assumption of a constant feed rate and a fixed sampling interval. Therefore, a traceability chain to the unit of length has to be established for the calibration of the horizontal axis. Sheet 3 describes how to calibrate horizontal parameters such as RSm on surface standards with a regular profile of type C according to DIN EN ISO 5436-1 (in normal usage called “geometrical standards”). The thus calibrated standards are used to calibrate the horizontal axis of stylus instruments. This step is described in Sheet 4 of the Guideline 4-2. Through the dissemination of the unit of length by means of embodied standards, the entire measuring chain of the instrument, from the stylus tip to the display, is included during calibration.</p>
Sheet 4	<p><b>Calibration of the horizontal measuring system of stylus instruments</b></p> <p>This guideline describes how to establish traceability for the scaling of the horizontal axis of stylus instruments to the national length standard in accordance with ISO 3274. The metrological traceability is based on the determination of the value of a horizontal surface parameter (characteristic quantity) such as RSm on a calibrated reference standard. The unit of length is passed on by alternately using a standard for calibrating a device, and a calibrated device for calibrating a standard. The scope of this guideline applies to the second and to the fourth step in the dissemination chain (described in the guideline sheet in Appendix A and Appendix B, respectively).</p>

DKD-R 4-3	<p><b>Calibration of measuring equipment for geometric measurands: Calibration of metrological properties of coordinate measuring machines (CMMs) according to DIN EN ISO 10360 und VDI/VDE 2617</b></p> <p>This guideline applies to the calibration of the metrological properties of coordinate measuring machines (CMM) referred to in DIN EN 10360 and VDI/VDE 2617. The calibration must be carried out in accordance with the acceptance and monitoring procedures described in DIN EN ISO 10360 and VDI/VDE 2617. This DKD guideline requires knowledge of the standards and guidelines mentioned. It provides information on the application of these standards and guidelines and specifies special boundary conditions. In particular, it describes the measurement uncertainty in the calibration of the metrological properties of the CMM.</p>
DKD-R 4-4	<p><b>Calibration of standards and measuring instruments for form measurement</b></p> <p>This guideline applies to the calibration of roundness standards (e.g. spheres, hemispheres, cylinders), magnification standards (e.g. flattened cylinders, multi-shaft standards, non-circular spheres) and straightness standards (e.g. cylinders, straightness rulers). The terms used correspond to those in DIN ISO/TS 12181-1 for roundness, DIN ISO/TS 12780-1 for straightness and DIN EN ISO 11562 for metrological characteristics of phase-correct filters. The definitions and specifications in DIN EN ISO 1101, VDI/VDE 2631, and VIM (International Dictionary of Metrology) and the standards cited therein apply. Calibration is performed by comparing the form of the standard to be calibrated with the form of a material measure in the measurement setup.</p>
DKD-R 4-5	<p><b>Application of Coordinate Measuring Machines (CMMs)</b></p> <p>This guideline serves to implement the requirements of DIN EN ISO/IEC 17025 for the use of coordinate measuring machines (CMMs). Criteria are specified both for stationary measuring technology in so-called measuring rooms (cf. VDI/VDE 2627 Part 1) as well as for portable systems used at the customer's premises (indoors) or outdoors. It is aimed at accredited calibration and testing laboratories as well as industrial users in need of QA measures due to the requirements of other standards and guidelines (e.g. DIN EN ISO 9001, IATF 16949). The requirements are largely based on relevant standards and guidelines such as VDI/VDE 2617, 2630, 2634, DIN EN ISO 10360, DIN EN ISO 14253, ISO/TS 15530, ISO/TS 23165, ISO/TS 17865, and VDI/VDE 2627 series.</p>
DKD-E 4-1	<p><b>Traceability of thread measurements</b></p> <p>This expert report provides an in-depth overview of requirements for reliable and traceable thread measurements, applicable to single and multiple-threaded cylindrical or tapered plug and ring gauges. As a first step, the scope of application is defined, and the most important thread parameters are summarised. Chapter 4 gives an overview of the measurement methods currently used in calibration. Chapter 5 describes the influences of the measurement uncertainty depending on the method used and discusses various methods for determining these influences. The topic of traceability and the associated requirements for measuring instruments and equipment are discussed in chapter 6. Finally, chapter 7 lists specific recommendations for practical application in calibration laboratories, as part of a catalogue of measures to be taken.</p>

DKD-E 4-2

**Roughness Metrology: Conversion of profiles from measurements with reference plane profilometers into skidded probe profiles**

This expert report presents a procedure for the calibration of roughness standards used to represent the surface quality of sheet metal, which makes it possible to dispense with the use of double-skid probes during calibration.

When using this procedure, profiles acquired with reference plane profilers are converted into skid probe profiles. This is relevant for the maximum height parameters,  $R_z$ ,  $R_{zmax}$  und  $R_{zx}$ . For thin sheets with typical  $R_z$  values in the range of  $5 \mu\text{m}$  to  $5,5 \mu\text{m}$ , the results of skid and reference plane profilers differ by approximately  $0,6 \mu\text{m}$ . The uncertainty of the skidless to skidded transformation procedure is approximately  $0,1 \mu\text{m}$ . There is no significant change in the values when determining the arithmetic mean height  $R_a$  and the peak value  $R_{Pc}$  or  $R_{pc}$ , so there is no need to convert those values.

The skidless to skidded transformation method helps to reduce time needed for modification and adjustment of the measuring set-up, and it eliminates uncertainty components due to form and position tolerances of the double-skid probes. Reduction of the smallest accredited measurement uncertainties is therefore recommended.