

## Calibration Guidelines, Expert Reports, Technical Reports

### Flow

Reference	Title	Title (original)	Available in
DKD-R 8-1	Calibration of piston-operated pipettes with air cushion <a href="https://doi.org/10.7795/550.20240415">https://doi.org/10.7795/550.20240415</a>	Kalibrierung von Kolbenhubpipetten mit Luftpolster <a href="https://doi.org/10.7795/550.20240307">https://doi.org/10.7795/550.20240307</a>	de, en, es, fr, ru
DKD-R 8-2	Calibration of Multiple Delivery Dispensers <a href="https://doi.org/10.7795/550.20240528">https://doi.org/10.7795/550.20240528</a>	Kalibrierung von Mehrfachdispensern <a href="https://doi.org/10.7795/550.20240318">https://doi.org/10.7795/550.20240318</a>	de, en
DKD-R 8-3	Calibration of single stroke dispensers and piston burettes <a href="https://doi.org/10.7795/550.20240529">https://doi.org/10.7795/550.20240529</a>	Kalibrierung von Einzelhubdispensern und Kolbenbüretten <a href="https://doi.org/10.7795/550.20240319">https://doi.org/10.7795/550.20240319</a>	de, en, es
DKD-E 8-1	Experimental study on the calibration of piston-operated pipettes with air cushion <a href="https://doi.org/10.7795/550.20250319">https://doi.org/10.7795/550.20250319</a>	Experimentelle Studie zur Kalibrierung von Kolbenhubpipetten mit Luftpolster <a href="https://doi.org/10.7795/550.20250307">https://doi.org/10.7795/550.20250307</a>	de, en
DKD-E 8-2	Analysis of influencing parameters on calibration of piston-operated pipettes with air cushions	Analyse der Einflussgrößen auf die Kalibrierung von Kolbenhubpipetten mit Luftpolster <a href="https://doi.org/10.7795/550.20250320">https://doi.org/10.7795/550.20250320</a>	de, en
DKD-E 8-3	The influence of altitude on the volume result of a piston pipette with air cushion <a href="https://doi.org/10.7795/550.20250324">https://doi.org/10.7795/550.20250324</a>	Einfluss der Höhenlage auf das Volumenergebnis einer Kolben-Hubpipette mit Luftpolster <a href="https://doi.org/10.7795/550.20250321">https://doi.org/10.7795/550.20250321</a>	de, en
DKD-E 8-4	Tip replacement in the calibration of piston-operated pipettes - economic and environmental implications <a href="https://doi.org/10.7795/550.20231106">https://doi.org/10.7795/550.20231106</a>	Wechsel der Spitzen bei der Kalibrierung von Kolbenhubpipetten – wirtschaftliche und ökologische Aspekte <a href="https://doi.org/10.7795/550.20240508">https://doi.org/10.7795/550.20240508</a>	en, de

#### 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 8-1	<p><b>Calibration of piston-operated pipettes with air cushion</b></p> <p>This guideline defines the minimum requirements for the calibration procedure taking into account special influences and the measurement uncertainty contributions for the calibration of piston-operated pipettes with air cushion. The guideline does not refer to pipettes without air cushion (positive displacement pipettes). It applies to the calibration of single-channel piston-operated pipettes with fixed volume, single-channel piston-operated pipettes with variable volume and multichannel piston-operated pipettes.</p>
DKD-R 8-2	<p><b>Calibration of Multiple Delivery Dispensers</b></p> <p>This guideline specifies the minimum requirements for the calibration procedure taking into account the special influences and the measurement uncertainty contributions for the calibration of multiple delivery dispensers. It applies to the calibration of multiple delivery dispensers with positive displacement (motor-operated and non-motor operated). It does not apply to piston-operated pipettes with dispenser function. In preparation for this guideline, two pilot studies were carried out in the form of interlaboratory comparisons.</p>
DKD-R 8-3	<p><b>Calibration of single stroke dispensers and piston burettes</b></p> <p>This guideline defines the minimum requirements for the calibration procedure, taking into account special influences and measurement uncertainty contributions in the calibration of single-stroke dispensers and piston burettes, with and without motor drive. For devices with exchange dosing units, the definitions and requirements refer to the combination of basic device and dosing unit used.</p>
DKD-E 8-1	<p><b>Experimental study on the calibration of piston-operated pipettes with air cushion</b></p> <p>Within the scope of an international pilot study on the "Calibration of piston-operated pipettes with air cushion", the influences on the measurement uncertainty budgets have been extensively analysed. This pilot study was carried out as a laboratory comparison between twelve calibration laboratories which are accredited according to ISO/IEC 17025:2005, and one National Metrology Institute. As calibration objects, piston-operated pipettes from different manufacturers were used. The evaluation of the measurement results led to a more accurate estimation of previously known measurement uncertainty contributions as well as to the identification of new contributions to the measurement uncertainty budget. Derived from this, the calibration procedures and the measuring conditions were specified or determined to ensure national and international comparability.</p>
DKD-E 8-2	<p><b>Analysis of influencing parameters on calibration of piston-operated pipettes with air cushions</b></p> <p>For illustrating and supplementing Guideline DKD-R 8-1 the effect of the major influencing quantities on measurement uncertainty of piston-operated pipettes with air cushion is explained. The thermodynamic description of the pipetting process enables to identify three system-related influencing factors:</p> <ol style="list-style-type: none"> <li>1) temperature differences between test liquid, air and pipette,</li> <li>2) external air moisture and</li> <li>3) air pressure.</li> </ol> <p>Furthermore, instrumental and system-related effects such as angle of inclination, waiting period, pipetting frequency, immersion depth, operational force, reproducibility of piston stroke, counter hysteresis and heat transfer of hand warming are examined. Air pressure and sensitivity coefficients are presented as well as the impact of various factors. A model for measurement uncertainty is developed.</p>

DKD-E 8-3	<p><b>The influence of altitude on the volume result of a piston pipette with air cushion</b></p> <p>The altitude above sea level of the measuring location has a significant influence on the measured result of a piston pipette with air cushion. If a pipette is adjusted correctly at 1013 hPa (selected volume is the volume at reference temperature of 20 °C), the same pipette will dispense, at an air pressure of 850 hPa (about 1500 m.a.s.l.), an effective volume which is close to the lower limit of the admissible systematic error according to ISO 8655. Pipettes with air cushion should be adjusted and calibrated at the intended location of operation. Electronic pipettes can apply the correction factor in such a way that the pipette balances the error out according to the air pressure or to the altitude above sea level. For this purpose, the user must feed in either the air pressure or the altitude above sea level. For comparison measurements, the measured value can be corrected. For this purpose, however, the exact dead volume and the capillary rise must be known. These two values must be taken into account in the measurement uncertainty budget.</p>
DKD-E 8-4	<p><b>Tip replacement in the calibration of piston-operated pipettes – economic and environmental implications</b></p> <p>According to the new version of ISO 8655-6, a tip change must be performed when calibrating piston-operated pipettes with air cushion. The requirements for tip replacement are given in chapter 8.3.2 of ISO 8655-6. The necessity is explained by the fact that the tip change would reveal the use of damaged or incorrectly manufactured tips. The requirement also applies to direct displacement piston-operated pipettes. To verify the influence of the tip change, a member of the DKD has carried out repeated investigations.</p>