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Guideline DKD-R 9-2	**Supplementary information regarding the calibration/verification of tensile/compression testing machines**

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Deutscher Kalibrierdienst (DKD) - German Calibration Service

Since its foundation in 1977, the German Calibration Service has brought together calibration laboratories of industrial enterprises, research institutes, technical authorities, inspection and testing institutes. On 3rd May 2011, the German Calibration Service was reestablished as a *technical body* of PTB and accredited laboratories.
This body is known as *Deutscher Kalibrierdienst* (DKD for short) and is under the direction of PTB. The guidelines and guides developed by DKD represent the state of the art in the respective areas of technical expertise and can be used by the *Deutsche Akkreditierungsstelle GmbH* (the German accreditation body – DAkkS) for the accreditation of calibration laboratories.
The accredited calibration laboratories are now accredited and supervised by DAkkS as legal successor to the DKD. They carry out calibrations of measuring instruments and measuring standards for the measurands and measuring ranges defined during accreditation. The calibration certificates issued by these laboratories prove the traceability to national standards as required by the family of standards DIN EN ISO 9000 and DIN EN ISO/IEC 17025.

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* VMPA = Verband der Materialprüfungsanstalten e.V. (Association of Material Testing Institutes)

Foreword

DKD guidelines 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. Moreover, the implementation of the guidelines helps to ensure that the state of the art in the respective field is taken into account in laboratory practice.

The DKD guidelines should not impede the further development of calibration procedures and processes. Deviations from guidelines as well as new procedures are permitted in agreement with the accreditation body if there are technical reasons to support this action.

Calibrations by accredited laboratories provide the user with the security of reliable measuring results, increase the confidence of customers, enhance competitiveness in the national and international markets, and serve as metrological basis for the monitoring of measuring and test equipment within the framework of quality assurance measures.

This guideline has been drawn up by the DKD Technical Committee *Materials Testing Machines* and the VMPA working group *Testing Machines and Equipment* and approved by the Board of the DKD.

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1 Scope of application

The following specifications shall serve to ensure a uniform procedure for the calibration/verification of materials testing machines. Special attention will therefore be paid to particularly important or unclearly defined points in the standard.

2 Specifications regarding DIN EN ISO 7500-1:2018-06

2.1 Relative resolution of the force indicator

(cf. DIN EN ISO 7500-1:2018-06 subsection 6.3)

In case of automatic measuring range switching, it must be considered that the relative resolution a is not only to be taken into account for *each calibration point*, but also for the smallest calibration point to be calibrated and whenever changing the measuring range. The calibration certificate / test certificate shall state the largest value of the relative resolution in the classified calibration range.

2.2 Machines with separate work areas

(cf. DIN EN ISO 7500-1:2018-06 subsection 6.4.1)

If, according to the standard, calibration is carried out in just one direction of force – although both directions of force shall meet the conformity requirements – a corresponding note must be included in the calibration certificate / test certificate.

2.3 Influence of different piston positions

(cf. DIN EN ISO 7500-1:2018-06 subsection 6.4.7)

If – contrary to the standard – the influence of different piston positions could not be tested, a corresponding note has to be included in the calibration certificate / test certificate.

2.4 Reversibility error

(cf. DIN EN ISO 7500-1:2018-06 subsection 6.4.8 and DIN EN ISO 7500-1 Supplement 1:1999-11 subsection 2.2.1)

According to the procedure laid out in the standard, the relative reversibility error (if technically possible) must generally be recorded in the smallest and largest force indicating range during calibration. This does also apply to machines to be classified merely for increasing forces.

By measuring the reversal span, important application-oriented results about the condition of the testing machine are obtained. However, classification of the testing machine is also possible without determination of the reversibility error – provided this is stated in the calibration certificate / test certificate under “Classification”.

The mean value $\bar{F}$ is calculated from all three increasing measurement series.

When using equation (8), it must be taken into account that the forces of the force-proving instrument must be interpolated to the respective identical value of the machine display (if – according to section 6.4.4 – the exactly identical measured values have not been approached during the series of measurements).

2.5 Classification of the testing machine

(cf. DIN EN ISO 7500-1:2018-06 section 7)

Deviating from the standard, classification of the force indication ranges from at least 20 % of the final value to the final value reached is possible, if the nominal force itself cannot be reached for technical reasons. In this case, a note in the calibration certificate / test certificate is required. However, it is necessary that at least a final value of ≥ 80 % of the nominal force is achieved.

The nominal force of the force indicating range may be limited by:
- the nominal force of the force transducer of the materials testing machine with measuring chain,
- the nominal force of the load frame of the materials testing machine,
- the maximum permissible force of structurally unchangeable clamping parts.

Examples:
- classification of a 100 kN tensile testing machine may range from 20 kN to 95 kN if, for technical reasons, only 95 kN can be achieved,
- 150 kN is considered as nominal force for a tensile/compression testing machine with 150 kN load frame and built-in 250 kN force transducer.

Supplement 4 of DIN EN ISO 7500-1 contains information regarding the consideration of measurement uncertainty.

2.6 Measurement uncertainty

(cf. DIN EN ISO 7500-1:2018-06 Annex C)

The measurement uncertainty must be stated in the calibration certificate / test certificate.

2.7 Settings of the force measuring systems

(cf. DIN EN ISO 7500-1 Supplement 1:1999-11 subsection 2.2.2)

The setting of the force measuring system used during calibration should be secured by the calibration laboratory, e.g. by sealing or through documentation in the calibration certificate / test certificate or any other form of documentation supplied to the customer.

2.8 Influence of bending

(cf. DIN EN ISO 7500-1 Supplement 1:1999-11 subsection 2.1.4)

For compression testing machines for hardened concrete with $F_N \geq 2$ MN, the bending influence must always be determined for safety reasons.

3 Specifications regarding DIN EN ISO 9513:2013-05

3.1 Calibration range

(cf. DIN EN ISO 9513:2013-05 subsection 8.1.1)

Generally, calibration of the extensometer measurement system should be carried out using a temperature range of 18 °C to 28 °C.

In case extensometers are to be used in the temperature range between 10 °C and 35 °C, calibration may also be performed in this range.

Deviating from the standard, the temperature of the calibration device must not change by more than 2 K during the calibration sequence.

3.2 Extensometer systems without initial measuring length

(cf. DIN EN ISO 9513:2013-05 Annex H)

In addition to the calibration of cross-head measurement systems as described in Annex H of the standard, the calibration procedure may also be used for measuring probes, LVDT, piston displacement and similar measuring systems without L_e, as well as for transducers whose initial measuring length is specified by the test specimen (e.g. transducers for crack width measurement).

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