

# Accreditation



The Deutsche Akkreditierungsstelle attests with this **Accreditation Certificate** that the calibration laboratory

**SPEKTRA Schwingungstechnik und Akustik GmbH Dresden**  
**Heidelberger Straße 12, 01189 Dresden**

meets the requirements of DIN EN ISO/IEC 17025:2018 for the conformity assessment activities specified in the following partial accreditation certificates. This includes additional existing legal and normative requirements for the calibration laboratory, including those in relevant sectoral schemes, provided that these are explicitly confirmed in the annexes to the partial accreditation certificates listed below.

**D-K-15183-01-01**

**D-K-15183-01-02**

The management system requirements of DIN EN ISO/IEC 17025 are written in the language relevant to the operations of calibration laboratories and they conform to the principles of DIN EN ISO 9001.

This accreditation was issued in accordance with Art. 5 Para. 1 Sentence 2 of Regulation (EC) 765/2008, after an accreditation procedure was carried out in compliance with the minimum requirements of DIN EN ISO/IEC 17011 and on the basis of a review and decision of the appointed accreditation committees.

This accreditation certificate consists of this cover sheet, the reverse side of the cover sheet and the following annex. It only applies in connection with the partial accreditation certificates listed above and the notices referred to there.

Registration number of the certificate: **D-K-15183-01-00**

Berlin, 07.03.2024

Dipl.-Wirtsch.-Ing. (BA) Tim Harnisch  
Head of Technical Unit

Translation issued:  
07.03.2024

Dipl.-Wirtsch.-Ing. (BA) Tim Harnisch  
Head of Technical Unit

*The certificate together with the annex reflects the status as indicated by the date of issue. The current status of any given scope of accreditation can be found in the directory of accredited bodies maintained by Deutsche Akkreditierungsstelle GmbH ([www.dakks.de](http://www.dakks.de)).*

This document is a translation. The definitive version is the original German accreditation certificate.

See notes overleaf

# Deutsche Akkreditierungsstelle GmbH

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The Deutsche Akkreditierungsstelle GmbH (DAkKS) is the entrusted national accreditation body of the Federal Republic of Germany according to § 8 section 1 AkkStelleG in conjunction with § 1 section 1 AkkStelleGBV. DAkKS is designated as the national accreditation authority by Germany according to Art. 4 Para. 4 of Regulation (EC) 765/2008 and clause 4.7 of DIN EN ISO/IEC 17000.

Pursuant to Art. 11 section 2 of Regulation (EC) 765/2008, the accreditation certificate shall be recognised as equivalent by the national authorities within the scope of this Regulation as well as by the WTO member states that have committed themselves in bilateral or multilateral mutual agreements to recognise the certificates of accreditation bodies that are members of ILAC or IAF as equivalent.

DAkKS is a signatory to the multilateral agreements for mutual recognition of the European co-operation for Accreditation (EA), International Accreditation Forum (IAF) and International Laboratory Accreditation Co-operation (ILAC).

The up-to-date state of membership can be retrieved from the following websites:

EA: [www.european-accreditation.org](http://www.european-accreditation.org)

ILAC: [www.ilac.org](http://www.ilac.org)

IAF: [www.iaf.nu](http://www.iaf.nu)

# Deutsche Akkreditierungsstelle

## Annex to the Partial Accreditation Certificate D-K-15183-01-02 according to DIN EN ISO/IEC 17025:2018

**Valid from:** 11.12.2024

**Date of issue:** 11.12.2024

This annex is a part of the accreditation certificate D-K-15183-01-00.

Holder of partial accreditation certificate:

**SPEKTRA Schwingungstechnik und Akustik GmbH Dresden  
Heidelberger Straße 12, 01189 Dresden**

with the location

**SPEKTRA Schwingungstechnik und Akustik GmbH Dresden  
Heidelberger Straße 12, 01189 Dresden**

The calibration laboratory meets the requirements of DIN EN ISO/IEC 17025:2018 to carry out the conformity assessment activities listed in this annex. The calibration laboratory meets additional legal and normative requirements, if applicable, including those in relevant sectoral schemes, provided that these are explicitly confirmed below.

The management system requirements of DIN EN ISO/IEC 17025 are written in the language relevant to the operations of calibration laboratories and they conform to the principles of DIN EN ISO 9001.

*This certificate annex is only valid together with the written accreditation certificate and reflects the status as indicated by the date of issue. The current status of any given scope of accreditation can be found in the directory of accredited bodies maintained by Deutsche Akkreditierungsstelle GmbH at <https://www.dakks.de>.*

**Annex to the Partial Accreditation Certificate D-K-15183-01-02**

Calibrations in the fields:

**Mechanical quantities**

- **Acceleration** <sup>a)</sup>
- **Velocity**

**Measuring instruments for vehicle inspection**

- **Brake deceleration recorder (HU adapter)**

**Acoustical quantities**

<sup>a)</sup> also on-site calibration

Within the measurands/calibration items marked with \*, the calibration laboratory is permitted, without being required to inform and obtain prior approval from DAkkS, to use calibration standards or equivalent calibration procedures listed here with different issue dates.

The calibration laboratory maintains a current list of all calibration standards / equivalent calibration procedures within the flexible scope of accreditation.

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**This document is a translation. The definitive version is the original German annex to the accreditation certificate.**

**Annex to the Partial Accreditation Certificate D-K-15183-01-02**

**Permanent Laboratory**

**Calibration and Measurement Capabilities (CMC)**

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement		Remarks	
<b>Acoustical quantities *</b> Sound pressure level (free field) / Measuring microphone Free-field open-circuit or effective sensitivity level of measuring microphones with / without wind shield	Sensitivity level: -60 dB to +20 dB (referring to 1V / Pa) 125 Hz to < 250 Hz	IEC 61094-8:2012 Substitution method in an anechoic chamber with ½" or 1" standard microphone at sound pressure level 74 dB to 94 dB	0.30 dB		Measurement of cartridge capacitance	
	250 Hz to 8 kHz		0.25 dB			
	> 8 kHz to 10 kHz		0.35 dB			
	> 10 kHz to 20 kHz		0.40 dB			
Sound pressure level (pressure) / Measuring microphone Open-circuit or effective pressure sensitivity level of measuring microphones	Sensitivity level: -60 dB to +20 dB (referring to 1 V / Pa) 250 Hz / 94 dB	IEC 60942:2004 Calibration with reference standard: Calibrator	0.15 dB			
	250 Hz / 114 dB	Calibrator				
	250 Hz / 124 dB	Pistonphone				
	1 000 Hz / 94 dB	Calibrator				
	1 000 Hz / 114 dB	Calibrator				
	Sensitivity level: -60 dB to +20 dB (referring to 1V / Pa) 31.5 Hz to 5 kHz	IEC 61094-5:2016 Comparative measurement in an electro-acoustical coupler  ½"-micr. 31.5 Hz to 16 kHz 1"-micr. 31.5 Hz to 8 kHz at 64 dB to 124 dB	SPEKTRA SQ-4.2 0.15 dB	SPEKTRA SQ-4.1 0.15 dB		Calibration at frequency f > 10 kHz (½"-microphone) or f > 5 kHz (1"-microphone) only possible with removable microphone grid
	> 5 kHz to 10 kHz		0.20 dB	0.50 dB		
	> 10 kHz to 16 kHz		0.40 dB	-		
	31.5 Hz to 2 kHz	IEC 61094-5:2016 ¾"- or ½" at sound pressure level 84 dB to 114 dB	0.25 dB			
	Sound pressure level (pressure), frequency, total harmonic distortion / Calibrators Pistonphones and Sound calibrators	Sound pressure level: 74 dB to 130 dB (referring to 20 µV / Pa) 250 Hz / 94 dB	IEC 60942:2004 Substitution measurement with traced-back calibrators	Approved calibrators		Any other calibrators
250 Hz / 114 dB						
250 Hz / 124 dB		0.1 dB		0.2 dB		
1 000 Hz / 94 dB						
1 000 Hz / 114 dB						
Frequency: 250 Hz or 1 000 Hz		Measurement with traced-back frequency counter	0.05 Hz			
Total harmonic distortion: 0.1 % to 10 %		Ratio of the fundamental frequency to ten harmonic components	0.2 %			

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Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement		Remarks		
Sound pressure level (pressure), frequency, total harmonic distortion / Calibrators Multi-tone calibrators	Sound pressure level: 60 dB to 130 dB (referring to 20 µV / Pa)	IEC 60942:2004 Calibration with reference standard (LS1P or LS2P) ½" or 1"	0.2 dB				
	31.5 Hz to 10 kHz		0.3 dB				
	> 10 kHz to 16 kHz	Measurement with traced-back frequency counter	0.05 Hz				
	Frequency 31.5 Hz to 16 kHz	Ratio of the fundamental frequency to ten harmonic components	0.2 %				
Sound pressure level (free field) / Sound level meters Sound level meters with separate microphone with / without wind shield	Deviation of indication infrequency range	IEC 61672-3:2013Substitution method in an anechoic chamber with ½" or 1" standard microphone at sound pressure level 74 dB to 94 dB	Approved sound level meters	Any other sound level meters			
	125 Hz to < 250 Hz		0.35 dB	0.65 dB			
	250 Hz to 8 kHz		0.30 dB	0.40 dB			
	> 8 kHz to 10 kHz		0.40 dB	0.50 dB			
> 10 kHz to 20 kHz	0.45 dB		0.60 dB				
Sound level meters with microphone attached to body with / without wind shield	Deviation of indication in frequency range						
	125 Hz to < 250 Hz			0.5 dB		0.8 dB	
	250 Hz to 8 kHz			0.4 dB		0.5 dB	
	> 8 kHz to 10 kHz	0.5 dB		0.6 dB			
Sound pressure level Sound level meters (pressure)	Deviation of indication at reference point	IEC 61672-3:2013 Calibration with reference standard:	Approved sound level meters	Any other sound level meters	Deviation of indication is stated without considering the effect of the device body Calibration at frequency f > 10 kHz (½"-microphone) or f > 5 kHz (1"-microphone) only possible with removable microphone grid		
	250 Hz / 94 dB	Calibrator					
	250 Hz / 114 dB	Calibrator					
	250 Hz / 124 dB	Pistonphone					
	1 000 Hz / 94 dB	Calibrator					
	1 000 Hz / 114 dB	Calibrator	0.15 dB	0.20 dB			
	Deviation of indication in the frequency range	IEC 61672-3:2013 Comparison in an electro-acoustic coupler				Approved sound level meters	Any other sound level meters
	31.5 Hz to 5 kHz	½"-micr. 31.5 Hz to 16 kHz 1"-micr. 31.5 Hz to 8 kHz at 64 dB to 124 dB				0.25 dB	0.30 dB
	> 5 kHz to 10 kHz		0.30 dB	0.40 dB			
	> 10 kHz to 16 kHz		0.50 dB	0.60 dB			
31.5 Hz to 2 kHz	IEC 61672-1:2013 ¼"-microphone or ½" microphone at a sound pressure level 84 dB to 114 dB	0.25 dB	0.30 dB				

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Sound level meter Inherent noise	Lowest measuring range A weighting	IEC 61672-3:2013 Measurement at lowest possible ambient sound (down to 20 dB (A) )	0.5 dB	
		IEC 61672-3:2013 Measurement with shorted dummy capacitor	0.1 dB	
Frequency weighting	A, B, C, LIN, Z, FLAT weightings 22.4 Hz to 22.4 kHz	IEC 61672-3:2013  Supply of electrical signal through dummy capacitor in voltage range RMS 20 $\mu$ VRMS to 20 VRMS 26 dB to 146 dB (re 1 $\mu$ V)	0.1 dB	
Frequency weighting at 1 kHz	A, B, C, LIN, Z, FLAT weightings 1 kHz		0.05 dB	
Level linearity	A, B, C, LIN, Z, FLAT weightings 22.4 Hz to 22.4 kHz		0.1 dB	
Tone burst response	Tone pulse duration: 0.25 ms to 1 000 ms 4 kHz		0.1 dB	
C-weighted peak level	Test signal: 0.5 and 1 cycle 31.5 Hz; 500 Hz; 8 kHz		0.1 dB	
Overload indication	Positive and negative half-sinusoidal signals 4 kHz		0.1 dB	
Exceedance peak level $L_W$	4 kHz tone pulse	DIN 45657:2014 Supply of electrical signal through dummy capacitor in voltage range RMS 20 $\mu$ VRMS to 20 VRMS	0.10 dB	
Tact maximum peak level $L_{AFT}$	4 kHz continuance signal		0.12 dB	
Signal conditioner for microphones Polarization voltage	Polarization voltage 200 V	IEC 61672-3:2013 Measurement of voltage difference to reference source	0.2 V	
Force sensitivity ( <i>Mechanical impedance</i> )	125 Hz to 800 Hz	IEC 60318-6:2007 Calibration with impedance head at (23.0 $\pm$ 0.5) $^{\circ}$ C	0.4 dB (0.5 dB)	Calibration at 5.4 N and 2.5 N contact force
	> 800 Hz to 4 kHz		0.5 dB (0.7 dB)	
	> 4 kHz to 8 kHz		1.0 dB (1.0 dB)	
Artificial mastoid	250 Hz		1.0 degree	

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Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement	Remarks	
<b>Acceleration</b>	For sinusoidal excitation and narrow-band evaluation methods (sine approximation), the amplitudes of vibration acceleration, vibration velocity and vibration displacement are unambiguously linked to one another by the vibration frequency. This is why vibration velocity sensors and vibration displacement sensors can be calibrated using the measurand acceleration as stated in the table in ranges of velocity and displacement - converted accordingly for the stated frequency ranges. All measuring ranges refer to peak values (sinus amplitude).				
Acceleration (secondary) sinusoidal * Vibration sensor Digital Vibration meter (DTI) Vibration meter Laser vibrometer Calibration System for vibration Sensors	0.01 m/s <sup>2</sup> to 20 m/s <sup>2</sup>	ISO 16063-21:2003 DKD-R 3-1, Part 3:2018		Sensor weight up to 0.9 kg Displacement amplitude up to 400 mm  Calibration result: - complex sensitivity (amount/phase) - displayed deviation - vibration amplitude	
		0.1 Hz to < 0.2 Hz	1.5 % / 2.0°		
		0.2 Hz to < 0.4 Hz	1.0 % / 1.0°		
		0.4 Hz to < 1 Hz	0.7 % / 0.7°		
		1 Hz to 63 Hz	0.5 % / 0.7°		
		> 63 Hz to 160 Hz	1.0 % / 1.0°		
	0.1 m/s <sup>2</sup> to 500 m/s <sup>2</sup>	2 Hz to < 5 Hz	1.5 % / 1.0°	Sensor weight up: 1.0 kg at 2 Hz to 2 kHz 0.5 kg at 2 kHz to 10 kHz Displacement amplitude up to 10 mm	
		5 Hz to < 20 Hz	1.0 % / 1.0°		
		20 Hz to 1 kHz	0.5 % / 0.5°		
		> 1 kHz to 5 kHz	1.0 % / 1.0°		
		> 5 kHz to 10 kHz	2.0 % / 1.0°		
	1 m/s <sup>2</sup> to 250 m/s <sup>2</sup>	5 Hz to < 10 Hz	1.0 % / 1.0°	Sensor weight up to 0.2 kg Displacement amplitude up to 8 mm	
		10 Hz to < 20 Hz	0.7 % / 0.7°		
		20 Hz to 1 kHz	0.5 % / 0.5°		
		> 1 kHz to 5 kHz	0.7 % / 0.7°		
		> 5 kHz to 10 kHz	1.5 % / 1.0°		
		> 10 kHz to 15 kHz	2.0 % / 2.0°		
		> 15 kHz to 20 kHz	2.5 % / 3.0°		
	Geophone / Seismometer Measurement chain	0.001 m/s <sup>2</sup> to 20 m/s <sup>2</sup>	ISO 16063-21:2003 DKD-R 3-1, Part 3:2018		Maximum payload refer under chapter: "Acceleration sinusoidal Geophones / Seismometer"  Calibration result: - complex sensitivity (amount/phase)
			0.2 Hz to < 1 Hz	1.5 % / 1.5°	
			1 Hz to 10 Hz	1.0 % / 1.0°	
> 10 Hz to 160 Hz			2.0 % / 2.0°		
	> 160 Hz to 400 Hz	3.0 % / 3.0°			

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement	Remarks
Acceleration (secondary) shock (sin <sup>2</sup> -pulse) * Vibration sensor Vibration meter Digital Vibration meter (DTI) Calibration system for vibration sensors	0.2 km/s <sup>2</sup> to 2 km/s <sup>2</sup>	ISO 16063-22:2005 DKD-R 3-1, Part 2:2018 Shock excitation Pulse width (PWHS): 10 ms to 1 ms	1 %	Excitation with pendulum Sensor weight up to 0.3 kg
	0.2 km/s <sup>2</sup> to 2 km/s <sup>2</sup>	4.0 ms to 1.6 ms	0.8 %	Excitation with PN-LMS Sensor weight up to 0.05 kg
	> 2 km/s <sup>2</sup> to 20 km/s <sup>2</sup>	0.4 ms to 0.1 ms	1.5 %	
	> 20 km/s <sup>2</sup> to 100 km/s <sup>2</sup>	0.2 ms to 0.08 ms	3.0 %	
Acceleration (secondary) shock (sin-pulse) * Vibration sensor Vibration meter Calibration system for vibration sensors	0.2 km/s <sup>2</sup> to 2.5 km/s <sup>2</sup>	ISO 16063-22:2005 Shock excitation Pulse width (PWHS): 200 µs to 150 µs	1.0 %	Excitation with HOP-MS Sensor weight up to 0.05 kg
	0.2 km/s <sup>2</sup> to 5.5 km/s <sup>2</sup>	< 150 µs to 100 µs	1.5 %	
	0.2 km/s <sup>2</sup> to 10 km/s <sup>2</sup>	< 100 µs to 30 µs	2.0 %	
	10 km/s <sup>2</sup> to 40 km/s <sup>2</sup>	70 µs to 30 µs	4.0 %	
Acceleration (primary) sinusoidal * Vibration sensor Vibration meter Laser-vibrometer Calibration system for vibration Sensors	0.01 m/s <sup>2</sup> to 30 m/s <sup>2</sup>	ISO 16063-11:1999DKD-R 3-1, Part 4:2018 0.1 Hz to < 0.2 Hz	1.0 % / 1.5°	Sensor weight up to 0.9 kg Displacement amplitude up to 400 mm Calibration result:- complex sensitivity (amount /phase)- displayed deviation- vibration amplitude
		0.2 Hz to < 0.4 Hz	0.5 % / 0.7°	
		0.4 Hz to < 1 Hz	0.5 % / 0.5°	
		1 Hz to 63 Hz	0.3 % / 0.5°	
		> 63 Hz to 160 Hz	0.7 % / 0.7°	
Geophone / Seismometer Measurement chain	0.001 m/s <sup>2</sup> to 20 m/s <sup>2</sup>	ISO 16063-11:1999 DKD-R 3-1, Part 4:2018 0.1 Hz to < 0.2 Hz <i>m<sub>mMax</sub></i> vertical: 50 kg <i>m<sub>max</sub></i> horizontal: 30 kg	1.5 % / 2.0°	<i>m<sub>max</sub></i> : maximum Payload Device under Test Calibration result:- complex sensitivity (amount/phase)- displayed deviation
		0.2 Hz to < 1 Hz <i>m<sub>max</sub></i> vertical: 50 kg <i>m<sub>max</sub></i> horizontal: 30 kg	1.0 % / 1.0°	
		1 Hz to 10 Hz <i>m<sub>max</sub></i> vertical: 50 kg <i>m<sub>max</sub></i> horizontal: 30 kg	0.7 % / 1.0°	
		> 10 Hz to 160 Hz <i>m<sub>max</sub></i> vertical: 20 kg <i>m<sub>max</sub></i> horizontal: 20 kg	1.5 % / 1.5°	
		> 160 Hz to 400 Hz <i>m<sub>max</sub></i> vertical: 10 kg	2.0 % / 2.0°	
		> 160 Hz to 260 Hz <i>m<sub>max</sub></i> : horizontal 6 kg	3.0 % / 3.0°	
		> 260 Hz to 320 Hz <i>m<sub>max</sub></i> : horizontal 6 kg	5.0 % / 4.0°	

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Annex to the Partial Accreditation Certificate D-K-15183-01-02

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement	Remarks
Vibration sensor is integrated in vibration exciter (internal reference accelerometer)	0.01 m/s <sup>2</sup> to 30 m/s <sup>2</sup>	ISO 16063-11:1999 DKD-R 3-1, Part 4:2018 0.1 Hz to < 0.2 Hz	1.0 % / 1.5°	For vibration exciters whose technical data correspond to the vibration exciters used in the laboratory Displacement up to 400 mm Calibration result: - complex sensitivity (amount /phase)
		0.2 Hz to < 0.4 Hz	0.5 % / 0.7°	
		0.4 Hz to < 1 Hz	0.4 % / 0.5°	
		1 Hz to 63 Hz	0.3 % / 0.4°	
		> 63 Hz to 160 Hz	0.5 % / 0.7°	
Vibration sensor Vibration meter Laser vibrometer Calibration System for vibration sensors	1 m/s <sup>2</sup> to 250 m/s <sup>2</sup>	ISO 16063-11:1999DKD-R 3-1, Part 4:2018 5 Hz to < 20 Hz	0.5 % / 0.5°	Sensor weight up to 0.9 kg Displacement amplitude up to 400mm Calibration result: - complex sensitivity (amount /phase) - displayed deviation - vibration amplitude
		20 Hz to 1 kHz	0.3 % / 0.5°	
		> 1 kHz to 5 kHz	0.5 % / 0.5°	
		> 5 kHz to 10 kHz	1.0 % / 1°	
		> 10 kHz to 15 kHz	2.0 % / 2°	
Vibration sensor is integrated in vibration exciter (internal reference accelerometer)	1 m/s <sup>2</sup> to 100 m/s <sup>2</sup>	ISO 16063-11:1999DKD-R 3-1, Part 4:2018 5 Hz too < 20 Hz	0.5 % / 0.4°	For vibration exciters whose technical data correspond to the vibration exciters used in the laboratory Calibration result:- complex sensitivity (amount /phase)
		20 Hz to 1 kHz	0.3 % / 0.4°	
		> 1 kHz to 5 kHz	0.3 % / 0.4°	
		> 5 kHz to 10 kHz	0.5 % / 0.7°	
		> 10 kHz to 15 kHz	1.0 % / 1.5°	
Reference Laser vibrometer	0.01 m/s <sup>2</sup> to 30 m/s <sup>2</sup>	ISO 16063-41:2011 0.1 Hz to < 0.4 Hz	0.25 % / 0.20°	Calibration result:Deviation of indication Displacement amplitude up to 400 mm Calibration result:- complex sensitivity (amount /phase)
		0.4 Hz to < 1.0 Hz	0.15 % / 0.20°	
		1.0 Hz to 160 Hz	0.15 % / 0.20°	
	1.0 m/s <sup>2</sup> to 250 m/s <sup>2</sup>	ISO 16063-41:2011 5 Hz to 1 kHz	0.15 % / 0.2°	Displacement amplitude up to 8 mm Calibration result: - complex sensitivity (amount /phase)
		> 1 kHz to 10 kHz	0.15 % / 0.5°	
		> 10 kHz to 15 kHz	0.25 % / 1.0°	
		> 15 kHz to 20 kHz	0.30 % / 1.5°	

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement	Remarks
Acceleration (primary) static * Vibration sensor	0.17 m/s <sup>2</sup> to < 0.342 m/s <sup>2</sup>	ISO 16063-16:2014 Calibration from 0 m/s <sup>2</sup> until maximum local gravity acceleration by inclination in the earth's gravity field	2.4 %	Calibration result: deviation for measuring instruments and transmission coefficient for sensors (transducer)
	0.342 m/s <sup>2</sup> to < 0.513 m/s <sup>2</sup>		1.3 %	
	0.513 m/s <sup>2</sup> to < 1.703 m/s <sup>2</sup>		0.90 %	
	1.703 m/s <sup>2</sup> to < 3.355 m/s <sup>2</sup>		0.30 %	
	3.355 m/s <sup>2</sup> to < 6.306 m/s <sup>2</sup>		0.20 %	
	6.306 m/s <sup>2</sup> to < 9.219 m/s <sup>2</sup>		0.10 %	
	9.219 m/s <sup>2</sup> to 9.811 m/s <sup>2</sup>		0.04 %	
Vibration meter	0 m/s <sup>2</sup> to 9.811 m/s <sup>2</sup>		0.01 m/s <sup>2</sup>	
Inclination angle (secondary) Inclination angle sensor	1.0 to < 2°	B-Stat-01_V1:A01 Calibration in the angular range 1° to 90° in relation to the direction of the gravitational vector $g_i$	2.2 %	Calibration result: - transfer coefficient
	2° to < 3°		1.2 %	
	3° to < 10°		0.50 %	
	10° to < 25°		0.30 %	
	25° to < 50°		0.20 %	
	50° to < 75°		0.10 %	
	75° to 90°		0.04 %	
Angular rate dynamic (secondary)	8 °/s to 3000 °/s	W-Rot-01_V1: A01 0.5 Hz to < 1 Hz < 1 Hz to 200 Hz	0.7 % / 0.8° 0.6 % / 0.8°	Calibration result: - complex sensitivity (value/phase) - displayed deviation
Charge conditioner * Charge amplifier	0.1 pC to 10.000 pC	DKD-R 3-2:2019 0.2 Hz to 20 kHz	0.25 % / 0.5°	Calibration result: - complex sensitivity (value/phase)
Voltage amplifier		> 20 kHz to 50 Hz	1.0 %	
	10 mV to 30 V	0.2 Hz to 20 kHz	0.2 % / 0.5°	
		> 20 kHz to 50 Hz	1.0 %	
Dynamic Force (secondary) shock Impact hammer	10 N to 500 N	K-Imp-01_V1: A01 Shock excitation (sin <sup>2</sup> -pulse) 10 ms to 0.1 ms	5 %	Calibration result: transfer coefficient
Vibration calibrator * Vibration amplitude	0.1 m/s <sup>2</sup> to 200 m/s <sup>2</sup>	DIN ISO 160633-44:2018		
		5 Hz to < 20 Hz	1.0 %	
		20 Hz to 1 kHz	0.5 %	
		> 1 kHz to 5 kHz	1.0 %	
		> 5 kHz to 10 kHz	2.0 %	
Frequency	5 Hz to 10 kHz	DIN ISO 160633-44:2018	0.05 %	
Total harmonic distortion			10 % of THD in %	

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Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement	Remarks
Impact energy Drill hammer for impact energy by: - weighing of dismantled impact element	0.1 J to 2 J	K-E-01_V1 Issue 02	1.2 %	Calibration result: Impact energy at time of activated projectile
			2.3 %	
<b>Brake deceleration recorder (HU adapter)</b> Acceleration (secondary)	0.5 m/s <sup>2</sup> to 20 m/s <sup>2</sup>	Verkehrsblatt 2018, issue 21, No. 156 ISO 16063-21:2003 *DKD-R 3-1, Part 3:2018 * 0.5 Hz to < 10 Hz 10 Hz to 20 Hz	1.0 %	
			2.0 %	
Angular rate	8 °/s to 100 °/s	Verkehrsblatt 2018, issue 21, No. 156 0.5 Hz to 10 Hz > 10 Hz to 20 Hz	1.2 %	
			2.2 %	
<b>Velocity</b> GNSS based velocity GNSS-acceptor with display function for velocity	0 m/s to 138.89 m/s	G-GNSS-01_V2:A01 Velocity simulation by a GNSS-simulator	0.033 m/s	Displayed deviation of velocity
			$\frac{0.333 \text{ m/s}}{v_{\text{REF}}} + 2.5 \cdot 10^{-4}$	Transmission coefficient Output voltage of velocity $v_{\text{REF}}$ : supplied velocity
GNSS-acceptor with velocity voltage output	1.389 m/s to 138.89 m/s			

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**Annex to the Partial Accreditation Certificate D-K-15183-01-02**

**On-site Calibration**

**Calibration and Measurement Capabilities (CMC)**

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement	Remarks
Acceleration (secondary) sinusoidal vibration test system	0.79 m/s <sup>2</sup> to 500 m/s <sup>2</sup>	B-VOK-01_V1:A02 2 Hz to 5 Hz	2.0 %	Calibration result: displayed deviation The environmental conditions and characteristics of the vibration test system must be within specified limits
		> 5 Hz to 2 kHz	1.5 %	
		> 2 kHz to 5 kHz	2.0 %	
Acceleration (secondary) shock vibration test system	20 m/s <sup>2</sup> to 500 m/s <sup>2</sup>	B-VOK-01_V1:A02 20 ms to 10 ms	2.0 %	
		10 ms to 2 ms	1.5 %	
		2 ms to 0.5 ms	2.0 %	
AC voltage vibration controller	16 mV to 7 V	E-VOK-01_V1:1.0 1.0 Hz to 10 Hz	$3.0 \cdot 10^{-3} \cdot G$	G = measured value
		> 10 Hz to 1 kHz	$3.0 \cdot 10^{-3} \cdot G$	
		> 1 kHz to 10 kHz	$3.0 \cdot 10^{-3} \cdot G$	
		> 10 kHz to 20 kHz	$4.0 \cdot 10^{-3} \cdot G$	
Charge vibration controller	2.8 pC to 7 nC	E-VOK-01_V1:1.0 1.0 Hz to 10 Hz	$4.0 \cdot 10^{-3} \cdot G$	G = measured value
		> 10 Hz to 1 kHz	$4.0 \cdot 10^{-3} \cdot G$	
		> 1 kHz to 10 kHz	$4.0 \cdot 10^{-3} \cdot G$	
		> 10 kHz to 20 kHz	$5.0 \cdot 10^{-3} \cdot G$	

**Abbreviations used:**

- CMC Calibration and measurement capabilities
- DIN Deutsches Institut für Normung e.V. – German institute for standardization
- DKD-R Guideline of Deutscher Kalibrierdienstes (DKD), published by Physikalisch-Technische Bundesanstalt
- B-VOK-..., K-E..., E-VOK-..., B-Stat..., W-Rot..., K-Imp..., G-GNSS...: Self-developed calibration procedures of SPEKTRA Schwingungstechnik und Akustik GmbH Dresden
- IEC International Electrotechnical Commission
- ISO International Organization for Standardisation

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