

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 minimum requirements according to DIN EN ISO/IEC 17025:2018 for the conformity assessment activities specified in more detail in the partial accreditation certificates listed below. This includes additional existing legal and normative requirements, including those in relevant sectoral schemes.

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 confirm generally with 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, 12.08.2022

Dipl.-Ing. Gabriel Zrenner
Head of Department

Translation issued:
12.08.2022



Dipl.-Ing. Gabriel Zrenner
Head of Department

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).

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

See notes overleaf

Deutsche Akkreditierungsstelle GmbH

Office Berlin
Spittelmarkt 10
10117 Berlin

Office Frankfurt am Main
Europa-Allee 52
60327 Frankfurt am Main

Office Braunschweig
Bundesallee 100
38116 Braunschweig

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

ILAC: www.ilac.org

IAF: www.iaf.nu

Deutsche Akkreditierungsstelle

Annex to the Accreditation Certificate D-K-15183-01-00 according to DIN EN ISO/IEC 17025:2018

Valid from: 12.08.2022

Date of issue: 12.08.2022

Holder of accreditation certificate:

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

The calibration laboratory meets the minimal requirements of DIN EN ISO/IEC 17025:2018 and, where applicable, additional legal and normative requirements, including those in relevant sectoral schemes, in order to carry out the conformity assessment activities specified in 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 confirm generally with the principles of DIN EN ISO 9001.

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Accreditation



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

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

meets the minimum requirements according to DIN EN ISO/IEC 17025:2018 for the conformity assessment listed in the annex to this certificate. This includes additional existing legal and normative requirements, including those in relevant sectoral schemes.

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

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This partial accreditation certificate only applies in connection with the notices of 12.08.2022 with accreditation number D-K-15183-01.
It consists of this cover sheet, the reverse side of the cover sheet and the following annex with a total of 2 pages.

Registration number of the partial accreditation certificate: **D-K-15183-01-01**
It is a part of the accreditation certificate: D-K-15183-01-00.

Berlin, 12.08.2022

Dipl.-Ing. Gabriel Zrenner
Head of Department

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

Calibrations in the fields:

Electrical quantities

DC and low frequency quantities

- DC voltage
- AC voltage
- DC current
- Capacitance
- Charge

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Abbreviations used: see last page

Page 1 of 2

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Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement	Remarks
Electrical quantities				
DC voltage Measuring instruments	0.1 V to 25 V	E-DC-03.U_V1	$50 \cdot 10^{-6} \cdot U$	U = measured value
DC voltage Sources	0.1 V to 25 V	E-DC-01.U_V1	$50 \cdot 10^{-6} \cdot U$	U = measured value
	200 V		$1.5 \cdot 10^{-3} \cdot U$	
DC current Measuring instruments	20 μ A to < 12 mA 12 mA to < 120mA 120 mA to 1000 mA	E-DC-02.I_V1	$0.10 \cdot 10^{-3} \cdot I$ $0.10 \cdot 10^{-3} \cdot I$ $0.30 \cdot 10^{-3} \cdot I$	I = measured value
DC current Sources	20 μ A to < 12 mA 12 mA to < 120mA 120 mA to 1000 mA	E-DC-04.I_V1	$0.10 \cdot 10^{-3} \cdot I$ $0.10 \cdot 10^{-3} \cdot I$ $0.30 \cdot 10^{-3} \cdot I$	I = measured value
AC voltage Measuring instruments, sources	3.4 mV to 7000 mV	E-AC-02.U_LF_V1, E-AC-02.U_MF_V1 0.1 Hz to < 10 Hz	$1.3 \cdot 10^{-3} \cdot U$	U = measured value
	0.012 V to 12 V	E-AC-03.U_LF_V1, E-AC-03.U_MF_V1 10 Hz to 40 Hz > 40 Hz to 1 kHz > 1 kHz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.60 \cdot 10^{-3} \cdot U$ $0.40 \cdot 10^{-3} \cdot U$ $0.50 \cdot 10^{-3} \cdot U$ $0.80 \cdot 10^{-3} \cdot U$ $1.5 \cdot 10^{-3} \cdot U$	
Charge Measuring instruments		E- AC-02.Q_LF_V1, E- AC-02.Q_MF_V1		Q = measured value
	1.37 pC to 7000 pC	1.0 Hz to < 10 Hz 10 Hz to 40 Hz > 40 Hz to 1 kHz > 1 kHz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$1.3 \cdot 10^{-3} \cdot Q$ $0.6 \cdot 10^{-3} \cdot Q$ $0.4 \cdot 10^{-3} \cdot Q$ $0.5 \cdot 10^{-3} \cdot Q$ $0.8 \cdot 10^{-3} \cdot Q$ $1.5 \cdot 10^{-3} \cdot Q$	
Capacitance	100 pF, 1000 pF	E-C-01.C_V1 Substitution measurement with reference capacitor 1000 Hz	$0.3 \cdot 10^{-3} \cdot C$	C = measured value

Abbreviations used:

- CMC Calibration and measurement capabilities
E-... Self-developed calibration procedure of SPEKTRA Schwingungstechnik und Akustik GmbH Dresden

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It consists of this cover sheet, the reverse side of the cover sheet and the following annex with a total of 9 pages.

Registration number of the partial accreditation certificate: **D-K-15183-01-02**
It is a part of the accreditation certificate: D-K-15183-01-00.

Berlin, 12.08.2022

Dipl.-Ing. Gabriel Zrenner
Head of Department

Translation issued:
12.08.2022

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

Calibrations in the fields:

Mechanical quantities

- Acceleration ^{a)}
Measuring instruments for vehicle inspection
- Brake deceleration recorder (HU adapter)

Acoustical quantities

^{a)} 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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Abbreviations used: see last page

Page 1 of 9

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Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement		Remarks
Acoustical quantities * 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)	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			Measurement of cartridge capacitance
	125 Hz to < 250 Hz 250 Hz to 8 kHz > 8 kHz to 10 kHz > 10 kHz to 20 kHz		0.30 dB 0.25 dB 0.35 dB 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)	IEC 60942:2004 Calibration with reference standard:			
	250 Hz / 94 dB 250 Hz / 114 dB 250 Hz / 124 dB 1 000 Hz / 94 dB 1 000 Hz / 114 dB	Calibrator Calibrator Pistonphone Calibrator Calibrator	0.15 dB		
	Sensitivity level: -60 dB to +20 dB (referring to 1V / Pa) 31.5 Hz to 5 kHz > 5 kHz to 10 kHz > 10 kHz to 16 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 0.20 dB 0.40 dB	SPEKTRA SQ-4.1 0.15 dB 0.50 dB -	
	31.5 Hz to 2 kHz	IEC 61094-5:2016 ¼"- 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 250 Hz / 114 dB 250 Hz / 124 dB 1 000 Hz / 94 dB 1 000 Hz / 114 dB	IEC 60942:2004 Substitution measurement with traced-back calibrators.	Approved calibrators 0.1 dB	Any other calibrators 0.2 dB	Data apply to reference conditions for approved sound calibrators: (23 °C; 101.3 kPa; 50 % r.h.)
	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 %		

Permanent Laboratory
Calibration and Measurement Capabilities (CMC)

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 μ V / Pa)	IEC 60942:2004 Calibration with reference standard (LS1P or LS2P) ½" or 1"	0.2 dB 0.3 dB		
	31.5 Hz to 10 kHz > 10 kHz to 16 kHz				
	Frequency 31.5 Hz to 16 kHz	Measurement with traced-back frequency counter	0.05 Hz		
	Total harmonic distortion: 0.1 % to 10 % in the Range 31.5 Hz to 4 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 in frequency range	IEC 61672-3:2013 Substitution 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 250 Hz to 8 kHz > 8 kHz to 10 kHz > 10 kHz to 20 kHz		0.35 dB 0.30 dB 0.40 dB 0.45 dB	0.65 dB 0.40 dB 0.50 dB 0.60 dB	
Sound level meters with microphone attached to body with / without wind shield	Deviation of indication in frequency range		0.5 dB 0.4 dB 0.5 dB 0.6 dB	0.8 dB 0.5 dB 0.6 dB 0.8 dB	
Sound pressure level Sound level meters (pressure)	Deviation of indication at reference point	IEC 61672-3:2013 Calibration with reference standard: Calibrator Calibrator Pistonphone Calibrator Calibrator	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 250 Hz / 114 dB 250 Hz / 124 dB 1 000 Hz / 94 dB 1 000 Hz / 114 dB		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 > 5 kHz to 10 kHz > 10 kHz to 16 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 0.50 dB	0.30 dB 0.40 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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Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement	Remarks
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 μ VRMS to 20 VRMS 26 dB to 146 dB (re 1 μ 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_N	4 kHz tone pulse	DIN 45657:2014 Supply of electrical signal through dummy capacitor in voltage range RMS 20 μ 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 (Mechanical impedance)	125 Hz to 800 Hz > 800 Hz to 4 kHz > 4 kHz to 8 kHz	IEC 60318-6:2007 Calibration with impedance head at (23.0 \pm 0.5) $^{\circ}$ C	0.4 dB (0.5 dB) 0.5 dB (0.7 dB) 1.0 dB (1.0 dB)	Calibration at 5.4 N and 2.5 N contact force
Artificial mastoid	250 Hz		1.0 degree	

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement	Remarks
Acceleration	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 ² to 20 m/s ²	ISO 16063-21:2003 DKD-R 3-1, Part 3:2018 0.1 Hz to < 0.2 Hz 0.2 Hz to < 0.4 Hz 0.4 Hz to < 1 Hz 1 Hz to 63 Hz > 63 Hz to 160 Hz	1.5 % / 2.0° 1.0 % / 1.0° 0.7 % / 0.7° 0.5 % / 0.7° 1.0 % / 1.0°	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 m/s ² to 500 m/s ²	2 Hz to < 5 Hz 5 Hz to < 20 Hz 20 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	1.5 % / 1.0° 1.0 % / 1.0° 0.5 % / 0.5° 1.0 % / 1.0° 2.0 % / 1.0°	Sensor weight up to 1.0 kg at 2 Hz to 2 kHz 0.5 kg at 2 kHz to 10 kHz Displacement amplitude up to 10 mm
	1 m/s ² to 250 m/s ²	5 Hz to < 10 Hz 10 Hz to < 20 Hz 20 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz > 10 kHz to 15 kHz > 15 kHz to 20 kHz	1.0 % / 1.0° 0.7 % / 0.7° 0.5 % / 0.5° 0.7 % / 0.7° 1.5 % / 1.0° 2.0 % / 2.0° 2.5 % / 3.0°	Sensor weight up to 0.2 kg Displacement amplitude up to 8 mm
Geophone / Seismometer Measurement chain	0.001 m/s ² to 20 m/s ²	ISO 16063-21:2003 DKD-R 3-1, Part 3:2018 0.2 Hz to < 1 Hz 1 Hz to 10 Hz > 10 Hz to 160 Hz > 160 Hz to 400 Hz	1.5 % / 1.5° 1.0 % / 1.0° 2.0 % / 2.0° 3.0 % / 3.0°	Maximum payload refer under chapter: "Acceleration sinusoidal Geophones / Seismometer" Calibration result: - complex sensitivity (amount / phase)
Acceleration (secondary) shock (sin ² -pulse) * Vibration sensor Vibration meter Digital Vibration meter (DTI) Calibration system for vibration Sensors	0.2 km/s ² to 2 km/s ²	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 ² to 2 km/s ²	4.0 ms to 1.6 ms	0.8 %	Excitation with PN-LMS Sensor weight up to 0.05 kg
	> 2 km/s ² to 20 km/s ²	0.4 ms to 0.1 ms	1.5 %	
	> 20 km/s ² to 100 km/s ²	0.2 ms to 0.08 ms	3.0 %	

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

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

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement	Remarks
Vibration sensor Vibration meter Laser vibrometer Calibration System for vibration Sensors	1 m/s ² to 250 m/s ²	ISO 16063-11:1999 DKD-R 3-1, Part 4:2018 5 Hz to < 20 Hz 20 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz > 10 kHz to 15 kHz > 15 kHz to 20 kHz	0.5 % / 0.5° 0.3 % / 0.5° 0.5 % / 0.5° 1.0 % / 1° 2.0 % / 2° 2.5 % / 3°	Sensor weight up to 0.9 kg Displacement amplitude up to 400mm Calibration result: - complex sensitivity (amount /phase) - displayed deviation - vibration amplitude
Vibration sensor is integrated in vibration exciter (internal reference accelerometer)	1 m/s ² to 100 m/s ²	ISO 16063-11:1999 DKD-R 3-1, Part 4:2018 5 Hz to < 20 Hz 20 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz > 10 kHz to 15 kHz > 15 kHz to 20 kHz	0.5 % / 0.4° 0.3 % / 0.4° 0.3 % / 0.4° 0.5 % / 0.7° 1.0 % / 1.5° 1.5 % / 2.0°	For vibration exciters whose technical data correspond to the vibration exciters used in the laboratory Calibration result: - complex sensitivity (amount /phase)
Reference Laser vibrometer	0.01 m/s ² to 30 m/s ²	ISO 16063-41:2011 0.1 Hz to < 0.4 Hz 0.4 Hz to < 1.0 Hz 1.0 Hz to 160 Hz	0.25 % / 0.20° 0.15 % / 0.20° 0.15 % / 0.20°	Calibration result: Deviation of indication Displacement amplitude up to 400 mm Calibration result: - complex sensitivity (amount /phase)
	1.0 m/s ² to 250 m/s ²	ISO 16063-41:2011 5 Hz to 1 kHz > 1 kHz to 10 kHz > 10 kHz to 15 kHz > 15 kHz to 20 kHz	0.15 % / 0.2° 0.15 % / 0.5° 0.25 % / 1.0° 0.30 % / 1.5°	Displacement amplitude up to 8 mm Calibration result: - complex sensitivity (amount /phase)
Acceleration (primary) static * Vibration sensor	0.17 m/s ² to < 0.342 m/s ² 0.342 m/s ² to < 0.513 m/s ² 0.513 m/s ² to < 1.703 m/s ² 1.703 m/s ² to < 3.355 m/s ² 3.355 m/s ² to < 6.306 m/s ² 6.306 m/s ² to < 9.219 m/s ² 9.219 m/s ² to 9.811 m/s ²	ISO 16063-16:2014 Calibration from 0 m/s ² until maximum local gravity acceleration by inclination in the earth's gravity field	2.4 % 1.3 % 0.90 % 0.30 % 0.20 % 0.10 % 0.04 %	Calibration result: deviation for measuring instruments and transmission coefficient for sensors (transducer)
Vibration meter	0 m/s ² to 9.811 m/s ²		0.01 m/s ²	
Inclination angle (secondary) Inclination angle sensor	1.0° to < 2° 2° to < 3° 3° to < 10° 10° to < 25° 25° to < 50° 50° to < 75° 75° to 90°	Calibration in the angular range 1° to 90° in relation to the direction of the gravitational vector g ₀	2.2 % 1.2 % 0.50 % 0.30 % 0.20 % 0.10 % 0.04 %	Calibration result: - transfer coefficient
Angular rate dynamic (secondary)	8 °/s to 3000 °/s	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

Permanent Laboratory
Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement	Remarks
Charge conditioner * Charge amplifier	0.1 pC to 10.000 pC	DKD-R 3-2:2019 0.2 Hz to 20 kHz > 20 kHz to 50 kHz	0.25 % / 0.5° 1.0 %	Calibration result: - complex sensitivity (value/phase)
Voltage amplifier	10 mV to 30 V	0.2 Hz to 20 kHz > 20 kHz to 50 kHz	0.2 % / 0.5° 1.0 %	
Dynamic Force (secondary) shock Impact hammer	10 N to 500 N	Shock excitation (sin ² -pulse) 10 ms to 0.1 ms	5 %	Calibration result: transfer coefficient
Vibration calibrator *		DIN ISO 160633-44:2018		
Vibration amplitude	0.1 m/s ² to 200 m/s ²	5 Hz to < 20 Hz 20 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	1.0 % 0.5 % 1.0 % 2.0 %	
Frequency	5 Hz to 10 kHz	DIN ISO 160633-44:2018	0.05 %	
Total harmonic distortion			10 % of THD in %	
Impact energy Drill hammer for impact energy by: - weighing of dismounted 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
- weighing of in-situ impact element			2.3 %	
Brake deceleration recorder (HU adapter) Acceleration (secondary)	0.5 m/s ² to 20 m/s ²	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 %	

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 ² to 500 m/s ²	B-VOK-01_V1:A02 2 Hz to 5 Hz > 5 Hz to 2 kHz > 2 kHz to 5 kHz	2.0 % 1.5 % 2.0 %	Calibration result: displayed deviation The environmental conditions and characteristics of the vibration test system must be within specified limits
Acceleration (secondary) shock vibration test system	20 m/s ² to 500 m/s ²	B-VOK-01_V1:A02 20 ms to 10 ms 10 ms to 2 ms 2 ms to 0.5 ms	2.0 % 1.5 % 2.0 %	

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-...	Self-developed calibration procedure of SPEKTRA Schwingungstechnik und Akustik GmbH Dresden
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization