

Deutsche Akkreditierungsstelle GmbH

Annex to the Accreditation Certificate D-K-15183-01-00 according to DIN EN ISO/IEC 17025:2005

Valid from: 07.10.2019

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Holder of certificate:

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

Head:	Dipl.-Ing. (FH) Philipp Begoff
Deputy head:	Dipl.-Ing. (FH) Heiko Deierlein Dipl.-Ing. Mario Chares Dipl.-Ing. Mario Gutbier

Accredited as calibration laboratory since: 10.05.2000

Calibration in the fields:

Mechanical quantities
– **Acceleration**^{a)}

Acoustics

^{a)} also on-site calibration

Abbreviations used: see last page

For the with * marked measurement quantity / calibration item 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.

*The certificate together with its annex reflects the status at the time of the date of issue. The current status of the scope of accreditation can be found in the database of accredited bodies of Deutsche Akkreditierungsstelle GmbH.
<https://www.dakks.de/en/content/accredited-bodies-dakks>*

Annex to the accreditation certificate D-K-15183-01-00

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement ¹⁾		Remarks
Acoustics 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 (re 1V / Pa) 125 Hz to < 250 Hz 250 Hz to 8 kHz > 8 kHz to 10 kHz > 10 kHz to 20 kHz	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 0.25 dB 0.35 dB 0.40 dB		Measurement of cartridge capacitance
Sound pressure level (pressure) / Measuring microphone Open-circuit or effective pressure sensitivity level of measuring microphones	Sensitivity level: -60 dB to +20 dB (re 1 V / Pa) 250 Hz / 124 dB 1 000 Hz / 94 dB 1 000 Hz / 114 dB	IEC 60942:2004 Calibration with reference standard: Pistonphone Calibrator Calibrator	0.15 dB		
	Sensitivity level: -60 dB to +20 dB (re 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 -	Calibration at f > 10 kHz (½") or f > 5 kHz (1") only possible with removable Microphonegrid
	31.5 Hz bis 2 kHz	IEC 61094-5:2016 ¼"- or ½"-Microphone 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 (re 20 µV / Pa) 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 %		
Sound pressure level (pressure), frequency, total harmonic distortion / Calibrators Multi-tone calibrators	Sound pressure level: 60 dB to 130 dB (re 20 µV / Pa) 31.5 Hz to 10 kHz > 10 kHz to 16 kHz	IEC 60942:2004 Calibration with reference standard (LS1P or LS2P) ½" or 1"	0.2 dB 0.3 dB		
	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 %		

¹⁾ The expanded uncertainties according to EA-4/02 M:2013 are part of CMC and are the best measurement uncertainties within accreditation. They have a coverage probability of approximately 95 % and have a coverage factor of $k = 2$ unless stated otherwise. Uncertainties without unit are relative uncertainties referring to the measurement value unless stated otherwise.

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			Approved sound level meters	Any other sound level meters	
Acoustics Sound pressure level (free field) / Sound level meters Sound level meters with separate microphone with / without wind shield	Deviation of indication in frequency range 125 Hz to < 250 Hz 250 Hz to 8 kHz > 8 kHz to 10 kHz > 10 kHz to 20 kHz	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	0.35 dB	0.65 dB	Deviation of indication is stated without considering the effect of the device body
	Deviation of indication in frequency range 125 Hz to < 250 Hz 250 Hz to 8 kHz > 8 kHz to 10 kHz > 10 kHz to 20 kHz		0.30 dB	0.40 dB	
Sound level meters with microphone attached to body with / without wind shield	Deviation of indication in frequency range 125 Hz to < 250 Hz 250 Hz to 8 kHz > 8 kHz to 10 kHz > 10 kHz to 20 kHz	0.40 dB	0.50 dB		
Sound pressure level (pressure) / Sound level meters	Deviation of indication at reference point 250 Hz / 124 dB 1 000 Hz / 94 dB 1 000 Hz / 114 dB	IEC 61672-3:2013 Calibration with reference standard: Pistonphone Calibrator Calibrator	0.45 dB	0.60 dB	
	Deviation of indication in the frequency range 31.5 Hz to 5 kHz > 5 kHz to 10 kHz > 10 kHz to 16 kHz	IEC 61672-3:2013 Comparison in an electro-acoustic coupler ½"-Micr. 31.5 Hz to 16 kHz 1"-Micr. 31.5 Hz to 8 kHz at 64 dB to 124 dB	0.15 dB	0.20 dB	
	Deviation of indication in the frequency range 31.5 Hz to 2 kHz	IEC 61672-1:2013 ¼" Microphone or ½" Microphone by a sound pressure level 84 dB to 114 dB	0.25 dB	0.30 dB	
Test electrical, acoustical / sound level meters Inherent noise	Lowest measuring range A weighting	IEC 61672-3:2013 Measurement at lowest possible ambient sound (down to 20 dB (A))	0.25 dB	0.30 dB	
		IEC 61672-3:2013 Measurement with shorted dummy capacitor	0.30 dB	0.40 dB	
Electrical test / sound level meters Frequency weighting	A 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 20 μV _{RMS} to 20 V _{RMS} 26 dB to 146 dB (re 1 μV)	0.50 dB	0.60 dB	
Frequency weighting at 1 kHz	A, B, C, LIN, Z, FLAT weightings 1 kHz		0.25 dB	0.30 dB	
Level linearity	A, B, C, LIN, Z, FLAT weightings 22.4 Hz to 22.4 kHz		0.30 dB	0.40 dB	
			0.1 dB	0.1 dB	

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	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 Calibration result: - complex sensitivity (amount/phase) - displayed deviation - vibration amplitude
Acceleration (secondary) sinusoidal 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	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, too using 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) shock (sin²-pulse) Vibration sensor Vibration meter Digital Vibration meter (DTI) Calibration system for vibration Sensors	0.2 km/s ² to 2 km/s ² 0.2 km/s ² to 2 km/s ² > 2 km/s ² to 20 km/s ² > 20 km/s ² to 100 km/s ²	ISO 16063-22:2005 DKD-R 3-1, Part 2:2018 Shock excitation Pulse width (PWHS): 10 ms to 1 ms 4.0 ms to 1.6 ms 0.4 ms to 0.1 ms 0.2 ms to 0.08 ms	1.0 % 0.8 % 1.5 % 3.0 %	Excitation with pendulum Sensor weight up to 0.3 kg Excitation with PN-LMS Sensor weight up to 0.05 kg
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

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Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement ¹⁾	Remarks
Acceleration (primary) sinusoidal Vibration sensor Vibration meter Vibration calibrator Laser-vibrometer Calibration system for vibration Sensors Vibration sensor is integrated in vibration exciter (internal reference accelerometer)	0.01 m/s ² to 30 m/s ² 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° / / 1.0 % / 1.5° 0.5 % / 0.7° 0.4 % / 0.5° 0.3 % / 0.4° 0.5 % / 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 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)
		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° / / / 0.5 % / 0.4° 0.3 % / 0.4° 0.3 % / 0.4° 0.5 % / 0.7° 1.0 % / 1.5° 1.5 % / 2.0° / / /	Sensor weight up to 0.9 kg Displacement amplitude up to 400mm Calibration result: - complex sensitivity (amount /phase) - displayed deviation - vibration amplitude For vibration exciters whose technical data correspond to the vibration exciters used in the laboratory Calibration result: - complex sensitivity (amount /phase)

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement ¹⁾	Remarks
Acceleration (primary) sinusoidal Geophone / Seismometer Measurement chain	0.001 m/s ² to 20 m/s ²	ISO 16063-11:1999 DAKKS-DKD-R 3-1, Part 4:2010 0.1 Hz to < 0.2 Hz <i>m</i> _{mMax} vertical: 50 kg <i>m</i> _{max} horizontal: 30 kg	1.5 % / 2.0°	<i>m</i> _{max} : maximum Payload Device under Test Calibration result: - complex sensitivity (amount/phase) - displayed deviation
		0.2 Hz to < 1 Hz <i>m</i> _{max} vertical: 50 kg <i>m</i> _{max} horizontal: 30 kg	1.0 % / 1.0°	
		1 Hz to 10 Hz <i>m</i> _{max} vertical: 50 kg <i>m</i> _{max} horizontal: 30 kg	0.7 % / 1.0°	
		> 10 Hz to 160 Hz <i>m</i> _{max} vertical: 20 kg <i>m</i> _{max} horizontal: 20 kg	1.5 % / 1.5°	
		> 160 Hz to 400 Hz <i>m</i> _{max} vertical: 10 kg	2.0 % / 2.0°	
Acceleration (primary) sinusoidal 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°	Displacement amplitude up to 400 mm
	1.0 m/s ² to 250 m/s ²	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: Deviation of indication
Acceleration (primary) 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	2.40 %	Calibration result: deviation for measuring instruments and transmission coefficient for sensors (transducer)
			1.30 % 0.90 % 0.30 % 0.20 % 0.10 % 0.04 %	
Vibration meter	0 m/s ² to 9.811 m/s ²		0.01 m/s	
Inclination angle (secondary) Inclination angle sensor	1° to < 2°	Calibration in the angular range 1° to 90° in relation to the direction of the gravitational vector <i>g_L</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	0.5 Hz to < 1 Hz 1 Hz to 200 Hz	0.7 % / 0.8°	Calibration result: - complex sensitivity (value/phase) - displayed deviation
			0.6 % / 0.8°	

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Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement ¹⁾	Remarks
Acceleration (secondary)	0.5 m/s ² to 20 m/s ²	ISO 16063-21:2003 DKD-R 3-1, page 3:2018 0.5 Hz to < 10 Hz 10 Hz to 20 Hz	1.0 % 2.0 %	Calibration of "equipment for system data testing and / or testing via the electronic vehicle interface in accordance with § 29 i. V. m. Annex VIIIa StVZO as universal measuring instruments" (HU adapter) Traffic Journal 23/2014 No. 202: 20.11.2014
Angular rate (secondary)	8 °/s to 100 °/s	0.5 Hz to 10 Hz > 10 Hz to 20 Hz	1.2 % 2.2 %	
Charge Charge amplifier	0.1 pC to 10.000 pC	0.2 Hz to 20 kHz > 20 kHz to 50 kHz	0.25 % / 0.5° 1.0 %	Calibration result: - Complex transfer coefficient (module / phase)
Voltage Measuring amplifier	1 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 (sin²-pulse) Impact hammer	10 N to 500 N	Shock excitation Pulse width (PWHS): 10 ms to 0.1 ms	5 %	Calibration result: transfer coefficient

On-site Calibration
Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement ¹⁾	Remarks
Acceleration (secondary) sinusoidal vibration test system	0.79 m/s ² to 500 m/s ²	2 Hz to 5 Hz > 5 Hz to 2 kHz > 2 kHz to 5 kHz	2.0 % 1.5 % 2.0 %	Calibration result: deviation The environmental conditions and characteristics of the vibration test system must be within specified limits
Acceleration (secondary) shock vibration test system		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 (Kalibrier- und Messmöglichkeiten)
DIN	Deutsches Institut für Normung e.V.
DKD-R	Richtlinie des Deutschen Kalibrierdienstes (DKD), herausgegeben von der Physikalisch-Technischen Bundesanstalt
IEC	International Electrotechnical Commission

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