

Certificate of Calibration

Calibration of:	An Accelerometer
Manufacturer:	PCB
Model number:	353B03
Serial number:	12254
Calibrated for:	BUSINESS ENTERPRISE AT UNIVERSITY OF PRETORIA Pretoria
Calibration procedure:	AV\VS-0006 & AV\VS-0001
Period of calibration:	2 March 2015 and 9 July 2015

1 PROCEDURE

The accelerometer was calibrated using the back to back method (in compliance with ISO 16063-21) against a reference accelerometer. The level response of the accelerometer was calibrated using a laser interferometer in compliance with ISO 16063 part 11, method 3. The results of the calibration are traceable to the relevant national measurement standards. The following equipment was used:

1.1 Laboratory Standards:

PCB M353B17 Accelerometer (VS-WSTD-17)
 Polytec OFV-505 Heterodyne laser interferometer head (VS-STD-06)



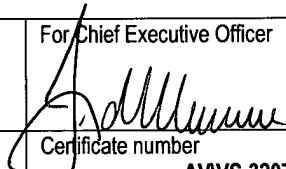
1.2 Other Equipment:

SPEKTRA CS18 Calibration System (VS-85)
 SPEKTRA SE-10 Exciter

 HP 53132A Universal Counter (VS-40)
 BMS S3010 Electronic Torque Wrench (VS-70)
 Brüel & Kjær NEXUS Conditioning Amplifier (VS-74)
 ENDEVCO 2911 Vibration Exciter (VS-55)
 MB Dynamics SS530 Power Amplifier
 Agilent 33510B Function Generator (VS-81)

1.3 Vibration Calibration Software

Version number: 2.13.8.0
 Version number: 4

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1.4 Mounting Conditions and Considerations

Mounting Torque : Stud
 Mounting Orientation : Vertical
 Cable : Gentle bend supported on exciter
 Reference Level : At the bottom of the accelerometer
 g : 9,806 65 m/s²

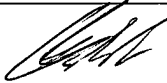

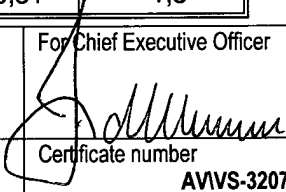
2 RESULTS

2.1 Sensitivity

The sensitivity of the accelerometer was found to be 1,042 mV/(m/s²) with an applied vibration level of 50 m/s² at a reference frequency of 160 Hz. The uncertainty of measurement was found to be 1,0 %.

2.2 Frequency response:

Nominal Frequency (Hz)	Acceleration (m/s ²)	Sensitivity (mV/(m/s ²))	Sensitivity (mV/g)	Uncertainty (%)
3	0,4	1,009	9,89	1,7
3,15	0,6	1,009	9,89	1,7
4	1,0	1,014	9,94	1,5
5	1,0	1,017	9,97	1,5
6,3	2,0	1,019	9,99	1,5
8	2,1	1,021	10,01	1,5
10	5,2	1,023	10,03	1,5
12,5	5,2	1,025	10,05	1,0
16	5,2	1,028	10,08	1,0
20	10,3	1,030	10,10	1,0
25	10,3	1,032	10,12	1,0
31,5	10,2	1,034	10,14	1,0
40	10,2	1,035	10,15	1,0
50	20,4	1,037	10,17	1,0
63	20,2	1,038	10,18	1,0
80	20,2	1,040	10,20	1,0
100	20,1	1,041	10,21	1,0
125	20,1	1,041	10,21	1,0
160	20,1	1,042	10,22	1,0
200	20,1	1,044	10,24	1,0
250	20,1	1,045	10,25	1,0
315	20,1	1,045	10,25	1,0
400	20,1	1,046	10,26	1,0
500	50,1	1,046	10,26	1,0
630	50,1	1,047	10,27	1,0
800	50,1	1,047	10,27	1,0
1 000	50,1	1,048	10,28	1,0
1 250	50,2	1,048	10,28	1,3
1 600	50,2	1,049	10,29	1,3
2 000	50,3	1,051	10,31	1,3



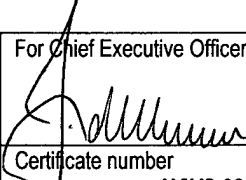
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CALIBRATION OF AN ACCELEROMETER
(12254)

Nominal Frequency (Hz)	Acceleration (m/s ²)	Sensitivity (mV/(m/s ²))	Sensitivity (mV/g)	Uncertainty (%)
2 500	50,3	1,053	10,33	1,3
3 150	50,2	1,056	10,36	1,3
3 350	50,3	1,057	10,37	1,3
3 550	50,3	1,058	10,38	1,3
4 000	50,3	1,059	10,39	1,3
4 220	50,3	1,061	10,40	1,3
4 470	50,3	1,062	10,41	1,3
4 730	50,2	1,064	10,43	1,9
5 010	50,3	1,064	10,43	1,9
5 310	50,3	1,068	10,47	1,9
5 620	50,3	1,071	10,50	1,9
6 000	50,2	1,075	10,54	1,9
6 300	50,2	1,079	10,58	1,9
6 680	50,2	1,083	10,62	1,9
7 080	50,3	1,083	10,62	1,9
7 500	50,2	1,076	10,55	1,9
7 940	50,2	1,081	10,60	1,9
8 410	50,2	1,087	10,66	1,9
8 910	50,2	1,092	10,71	1,9
9 440	50,2	1,095	10,74	1,9
10 000	50,2	1,101	10,80	1,9

2.3 Level response:



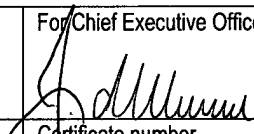
Frequency (Hz)	Acceleration (m/s ²)	Sensitivity (mV/(m/s ²))	Sensitivity (mV/g)	Uncertainty (%)
160	1	1,044	10,24	0,5
160	2	1,042	10,22	0,5
160	5	1,045	10,24	0,5
160	10	1,042	10,22	0,5
160	20	1,043	10,23	0,5
160	50	1,043	10,23	0,5
160	100	1,043	10,23	0,5
160	200	1,043	10,23	0,5

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3 REMARKS

- 3.1 The reported uncertainties of measurement were calculated and expressed in accordance with the BIPM, IEC, ISO, IUPAP, OIML document entitled "A Guide to the Expression of Uncertainty in Measurement" (International Organisation for Standardisation, Geneva, Switzerland, 1993).
- 3.2 The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by a coverage factor of $k = 2$, which for a normal distribution approximates a level of confidence of 95,45 %.
- 3.3 Certain of the NMISA certificates are consistent with the capabilities that are included in Appendix C of the MRA (Mutual Recognition Arrangement) drawn up by the CIPM. Under the MRA, all participating institutes recognise the validity of each other's calibration and measurement certificates for the quantities and ranges and measurement uncertainties specified in Appendix C. For details see <http://www.bipm.org>.
- 3.4 The calibrations were carried out at an ambient temperature of $23\text{ °C} \pm 3\text{ °C}$ and a relative humidity of $50\text{ \%RH} \pm 15\text{ \%RH}$.
- 3.5 Reason for re-issue of certificate: The level response calibration was added to the certificate and corrected mV/g calculation.

----- *end of certificate* -----

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