
Certificate of Calibration

Certificate number: TC-2137-1C

| | | |
|--------------|------------------|---|
| Applicant | Name: | Sensornet |
| | Address : | Casuariestraat 7 2511 VB Den Haag |
| Transducer | Manufacturer : | Senteq |
| | Model: | B3 measuring unit |
| | Serial number: | J0398 |
| | Description | SBR module including Complete System on the shaker |
| | Customer ID nr.: | V008 |
| Preamplifier | Manufacturer : | Sensornet |
| | Model: | B3 measuring unit |
| | Serial number: | 13 |
| | Description | Vibration measurements |
| | Customer ID nr.: | 13 |

Calibration method:

This calibration was performed in accordance with the requirement specified in manufacturer specifications and SONOR Kalibratie procedure related to ISO 16063-21. The lowest measurable frequency from the calibration equipment used in the testing setup is 5Hz.

Uncertainties:

The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor $k=2$, which provides a confidence level of approximately 95%. The standard uncertainty has been determined in accordance with EA 04/2.

Traceability:

The measurements have been executed using standards traceable to (inter)national standards. Supporting documentation relative to traceability is on file and is available on request.

Environmental conditions:

| | |
|-------------------|----------|
| Air pressure | 1023 hPa |
| Temperature | 24 °C |
| Relative humidity | 49 % |

| | |
|-----------------------|-----------------|
| Date of Receipt: | 09 October 2015 |
| Date of Calibration : | 09 October 2015 |
| Date of Certificate : | 20 October 2015 |



The stamp is circular with the text 'SONOR Kalibratie' around the top edge and 'Kalibratie Manager' around the bottom edge. In the center, there is a stylized logo. A blue ink signature is written across the stamp.

Authorized Signatory : F. Salama

1.Results

Measurement Uncertainty 0.15 dB

Fixture Wax
Orientation vertical

Sensitivity
transducer 98.42 mV/msec²

Measured values out of the DUT (Device under test)

Calculated values based on the Input Acceleration

| Input Freq in Hz | Meas Lzeq in dB | Meas DUT Vtop in dB | Meas DUT Veff in dB | Meas DUT DIN A in dB | Meas V REF Volt | Acc input Input | Acc dB Input | Vel Input Input | Vel dB RMS Input | Vel Peak Input |
|------------------|-----------------|---------------------|---------------------|----------------------|-----------------|--------------------|---------------------|-----------------|------------------|----------------|
| | | | | | Volt | m/sec ² | dB m/s ² | m/sec | dB m/sec | dB m/sec Piek |
| 159.16 | 120.1 | 118.8 | 101.2 | 104.7 | 1.018 | 1.00 | 120.01 | 0.00 | 120.01 | 123.01 |
| 5.01 | 99.4 | 132.6 | 126.5 | 132.6 | 0.100 | 0.10 | 100.05 | 0.00 | 130.09 | 133.09 |
| 6.31 | 99.6 | 130.4 | 125.3 | 130.4 | 0.098 | 0.10 | 99.86 | 0.00 | 127.90 | 130.90 |
| 7.94 | 99.5 | 128.3 | 124.0 | 128.3 | 0.098 | 0.10 | 99.86 | 0.00 | 125.90 | 128.90 |
| 10.00 | 108.8 | 135.8 | 132.0 | 135.8 | 0.284 | 0.28 | 109.07 | 0.00 | 133.11 | 136.11 |
| 12.59 | 109.1 | 133.9 | 130.5 | 133.9 | 0.289 | 0.29 | 109.20 | 0.00 | 131.24 | 134.24 |
| 15.92 | 109.3 | 132.1 | 128.8 | 132.1 | 0.296 | 0.29 | 109.39 | 0.00 | 129.39 | 132.39 |
| 19.95 | 118.8 | 139.8 | 136.6 | 139.8 | 0.894 | 0.89 | 118.97 | 0.01 | 137.01 | 140.01 |
| 25.12 | 119.1 | 138.0 | 134.9 | 138.0 | 0.921 | 0.91 | 119.22 | 0.01 | 135.26 | 138.26 |
| 31.62 | 119.3 | 136.2 | 133.1 | 136.2 | 0.945 | 0.94 | 119.42 | 0.00 | 133.46 | 136.46 |
| 39.81 | 119.5 | 134.3 | 131.2 | 134.3 | 0.967 | 0.96 | 119.62 | 0.00 | 131.65 | 134.65 |
| 50.12 | 119.8 | 132.5 | 129.4 | 132.5 | 1.011 | 1.00 | 120.00 | 0.00 | 130.03 | 133.03 |
| 63.10 | 120.0 | 130.5 | 127.4 | 130.4 | 1.031 | 1.02 | 120.16 | 0.00 | 128.19 | 131.19 |
| 79.43 | 120.2 | 128.2 | 124.9 | 127.9 | 1.048 | 1.03 | 120.29 | 0.00 | 126.32 | 129.32 |
| 100.00 | 120.0 | 125.4 | 120.8 | 123.8 | 1.040 | 1.03 | 120.22 | 0.00 | 124.25 | 127.25 |
| 125.89 | 120.1 | 122.5 | 113.2 | 116.3 | 1.026 | 1.01 | 120.09 | 0.00 | 122.13 | 125.13 |
| 158.49 | 120.1 | 118.8 | 101.2 | 104.8 | 1.020 | 1.00 | 120.03 | 0.00 | 120.07 | 123.07 |
| 199.53 | 120.3 | 114.3 | 87.2 | 92.5 | 1.026 | 1.01 | 120.08 | 0.00 | 118.12 | 121.12 |

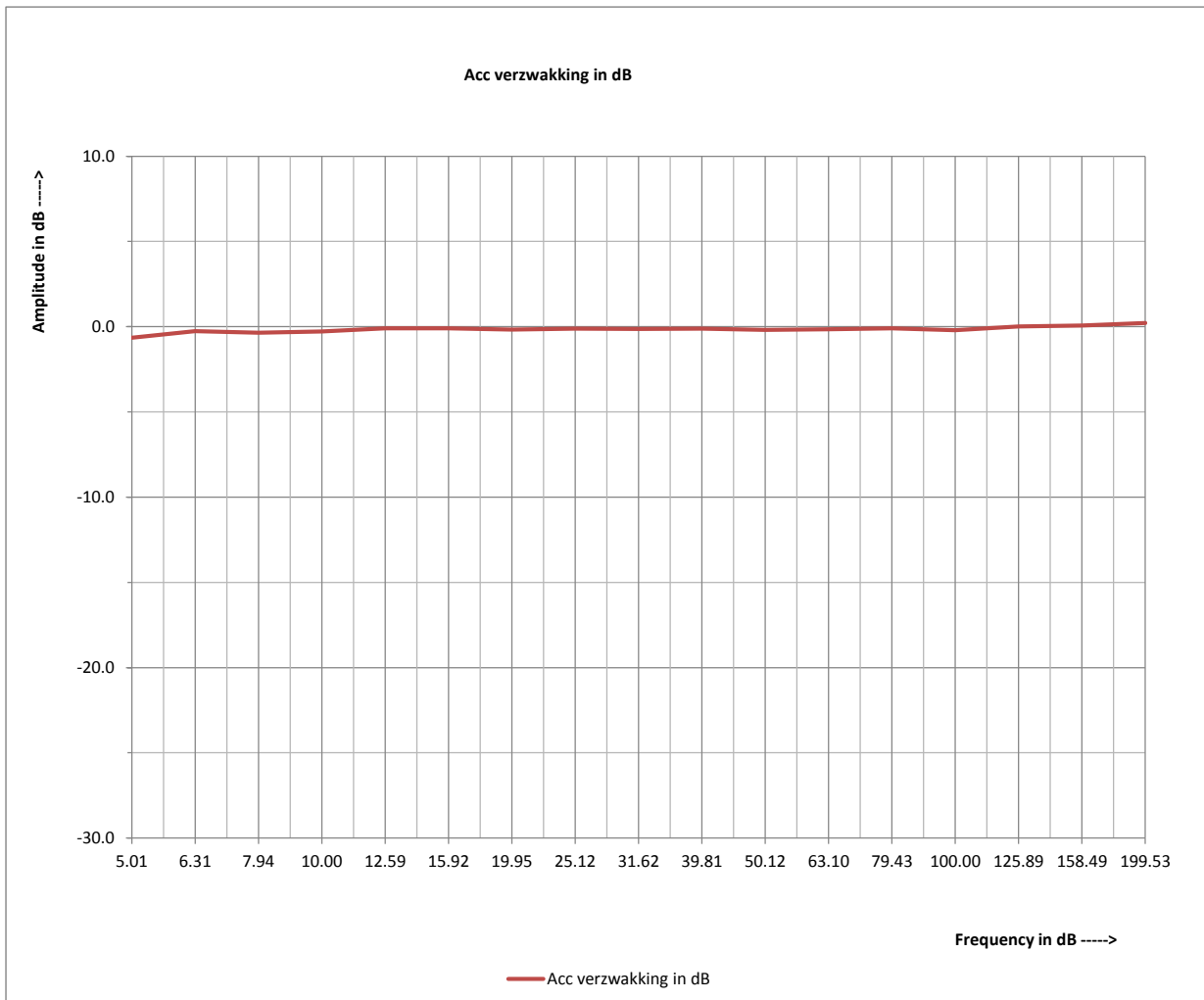
Acceleration attenuation graphic in dB.

Measured values out of the DUT

Calculated values based on the Input Acceleration

| Input Freq in Hz | Meas Lzeq in dB | Acc input Input | Acc dB Input | Input Freq in Hz | Deviation Acc verzwakking in dB |
|------------------|-----------------|-----------------|--------------|------------------|---------------------------------|
| 159.16 | 120.1 | 1.00 | 120.0 | 159.16 | 0.1 |
| 5.01 | 99.4 | 0.10 | 100.1 | 5.01 | -0.7 |
| 6.31 | 99.6 | 0.10 | 99.9 | 6.31 | -0.3 |
| 7.94 | 99.5 | 0.10 | 99.9 | 7.94 | -0.4 |
| 10.00 | 108.8 | 0.28 | 109.1 | 10.00 | -0.3 |
| 12.59 | 109.1 | 0.29 | 109.2 | 12.59 | -0.1 |
| 15.92 | 109.3 | 0.29 | 109.4 | 15.92 | -0.1 |
| 19.95 | 118.8 | 0.89 | 119.0 | 19.95 | -0.2 |
| 25.12 | 119.1 | 0.91 | 119.2 | 25.12 | -0.1 |
| 31.62 | 119.3 | 0.94 | 119.4 | 31.62 | -0.1 |
| 39.81 | 119.5 | 0.96 | 119.6 | 39.81 | -0.1 |
| 50.12 | 119.8 | 1.00 | 120.0 | 50.12 | -0.2 |
| 63.10 | 120.0 | 1.02 | 120.2 | 63.10 | -0.2 |
| 79.43 | 120.2 | 1.03 | 120.3 | 79.43 | -0.1 |
| 100.00 | 120.0 | 1.03 | 120.2 | 100.00 | -0.2 |
| 125.89 | 120.1 | 1.01 | 120.1 | 125.89 | 0.0 |
| 158.49 | 120.1 | 1.00 | 120.0 | 158.49 | 0.1 |
| 199.53 | 120.3 | 1.01 | 120.1 | 199.53 | 0.2 |

Acceleration attenuation graphic in dB. The input Acceleration is compared to the measured Lzeq dB value



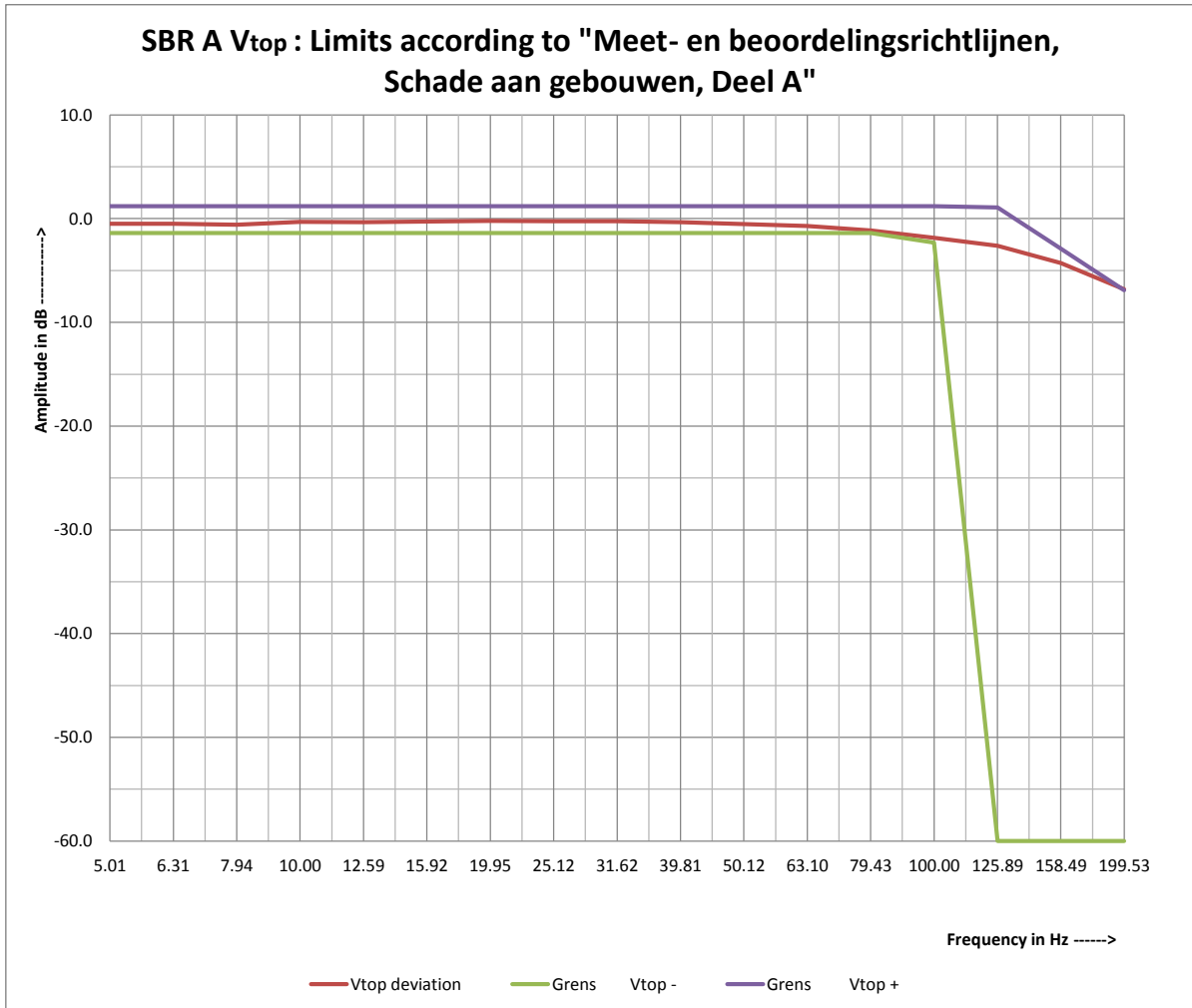
Limits according to "Meet- en beoordelingsrichtlijnen, Schade aan gebouwen, Deel A"

Results of the SBR A filter for Vtop in dB

Calculated values based on the Input acceleration

| Input Freq in Hz | Input Measured | | Deviation ref 159.16 Hz | | | |
|------------------|----------------|---------------------|-------------------------|----------------|--------------|--------------|
| | Vel Peak Input | Meas DUT Vtop in dB | Input Freq in Hz | Vtop deviation | Grens Vtop - | Grens Vtop + |
| 159.16 | 123.0 | 118.8 | 159.16 | -4.2 | -60.0 | -2.9 |
| 5.01 | 133.1 | 132.6 | 5.01 | -0.5 | -1.4 | 1.2 |
| 6.31 | 130.9 | 130.4 | 6.31 | -0.5 | -1.4 | 1.2 |
| 7.94 | 128.9 | 128.3 | 7.94 | -0.6 | -1.4 | 1.2 |
| 10.00 | 136.1 | 135.8 | 10.00 | -0.3 | -1.4 | 1.2 |
| 12.59 | 134.2 | 133.9 | 12.59 | -0.3 | -1.4 | 1.2 |
| 15.92 | 132.4 | 132.1 | 15.92 | -0.3 | -1.4 | 1.2 |
| 19.95 | 140.0 | 139.8 | 19.95 | -0.2 | -1.4 | 1.2 |
| 25.12 | 138.3 | 138 | 25.12 | -0.3 | -1.4 | 1.2 |
| 31.62 | 136.5 | 136.2 | 31.62 | -0.3 | -1.4 | 1.2 |
| 39.81 | 134.7 | 134.3 | 39.81 | -0.4 | -1.4 | 1.2 |
| 50.12 | 133.0 | 132.5 | 50.12 | -0.5 | -1.4 | 1.2 |
| 63.10 | 131.2 | 130.5 | 63.10 | -0.7 | -1.4 | 1.2 |
| 79.43 | 129.3 | 128.2 | 79.43 | -1.1 | -1.4 | 1.2 |
| 100.00 | 127.3 | 125.4 | 100.00 | -1.9 | -2.3 | 1.2 |
| 125.89 | 125.1 | 122.5 | 125.89 | -2.6 | -60.0 | 1.1 |
| 158.49 | 123.1 | 118.8 | 158.49 | -4.3 | -60.0 | -2.9 |
| 199.53 | 121.1 | 114.3 | 199.53 | -6.8 | -60.0 | -6.9 |

Deviation of th Vtop in dB. The measured dB is subtracted from the V top INPUT

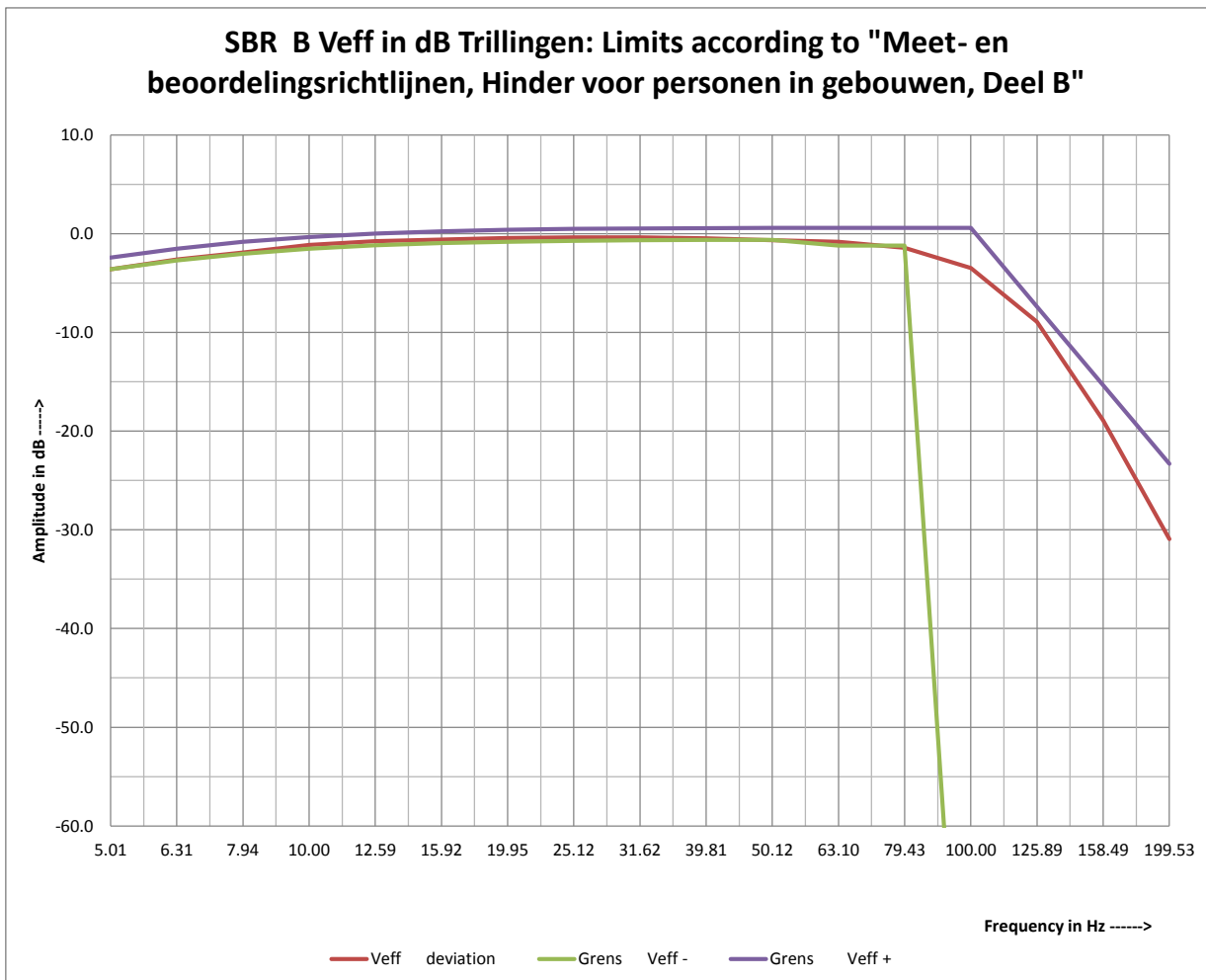


Limits according to "Meet- en beoordelingsrichtlijnen, Hinder voor personen in gebouwen, Deel B"

Results of the SBR B filter for Veff in dB

Calculated values based on the Input Acceleration

| Input Freq in Hz | Input Measured | | Deviation ref 159.16 Hz | | | |
|------------------|------------------|---------------------|-------------------------|----------------|--------------|--------------|
| | Vel dB RMS Input | Meas DUT Veff in dB | Input Freq in Hz | Veff deviation | Grens Veff - | Grens Veff + |
| 159.16 | 120.0 | 101.2 | 159.16 | -18.8 | -100.0 | -15.3 |
| 5.01 | 130.1 | 126.5 | 5.01 | -3.6 | -3.6 | -2.4 |
| 6.31 | 127.9 | 125.3 | 6.31 | -2.6 | -2.7 | -1.5 |
| 7.94 | 125.9 | 124.0 | 7.94 | -1.9 | -2.0 | -0.8 |
| 10.00 | 133.1 | 132.0 | 10.00 | -1.1 | -1.5 | -0.3 |
| 12.59 | 131.2 | 130.5 | 12.59 | -0.7 | -1.2 | 0.0 |
| 15.92 | 129.4 | 128.8 | 15.92 | -0.6 | -0.9 | 0.3 |
| 19.95 | 137.0 | 136.6 | 19.95 | -0.4 | -0.8 | 0.4 |
| 25.12 | 135.3 | 134.9 | 25.12 | -0.4 | -0.7 | 0.5 |
| 31.62 | 133.5 | 133.1 | 31.62 | -0.4 | -0.6 | 0.6 |
| 39.81 | 131.7 | 131.2 | 39.81 | -0.5 | -0.6 | 0.6 |
| 50.12 | 130.0 | 129.4 | 50.12 | -0.6 | -0.6 | 0.6 |
| 63.10 | 128.2 | 127.4 | 63.10 | -0.8 | -1.2 | 0.6 |
| 79.43 | 126.3 | 124.9 | 79.43 | -1.4 | -1.2 | 0.6 |
| 100.00 | 124.3 | 120.8 | 100.00 | -3.5 | -100.0 | 0.6 |
| 125.89 | 122.1 | 113.2 | 125.89 | -8.9 | -100.0 | -7.4 |
| 158.49 | 120.1 | 101.2 | 158.49 | -18.9 | -100.0 | -15.3 |
| 199.53 | 118.1 | 87.2 | 199.53 | -30.9 | -100.0 | -23.3 |

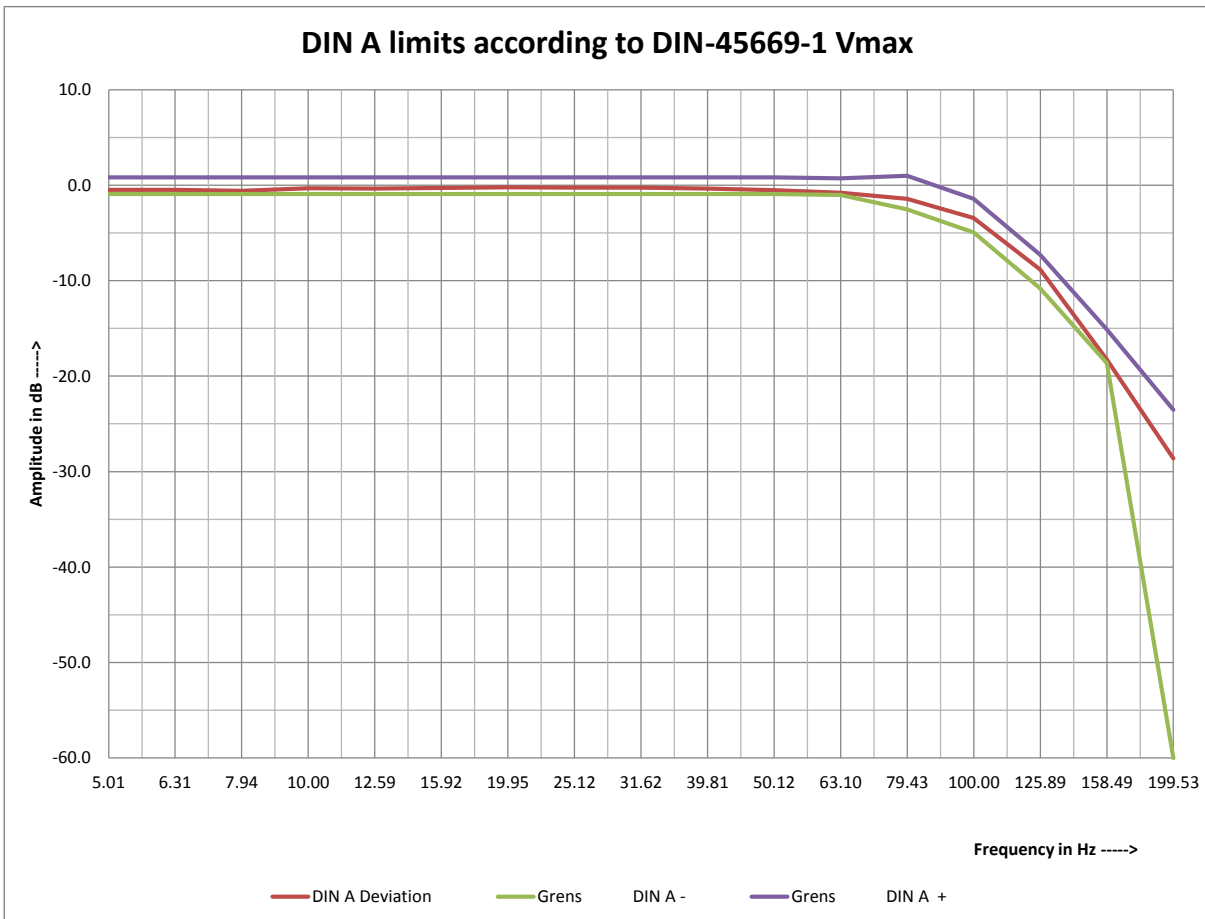


Limits according to DIN-45669-1 Vmax

Results of the DIN A filter for V_{piek} in dB

Calculated values based on the Input Acceleration

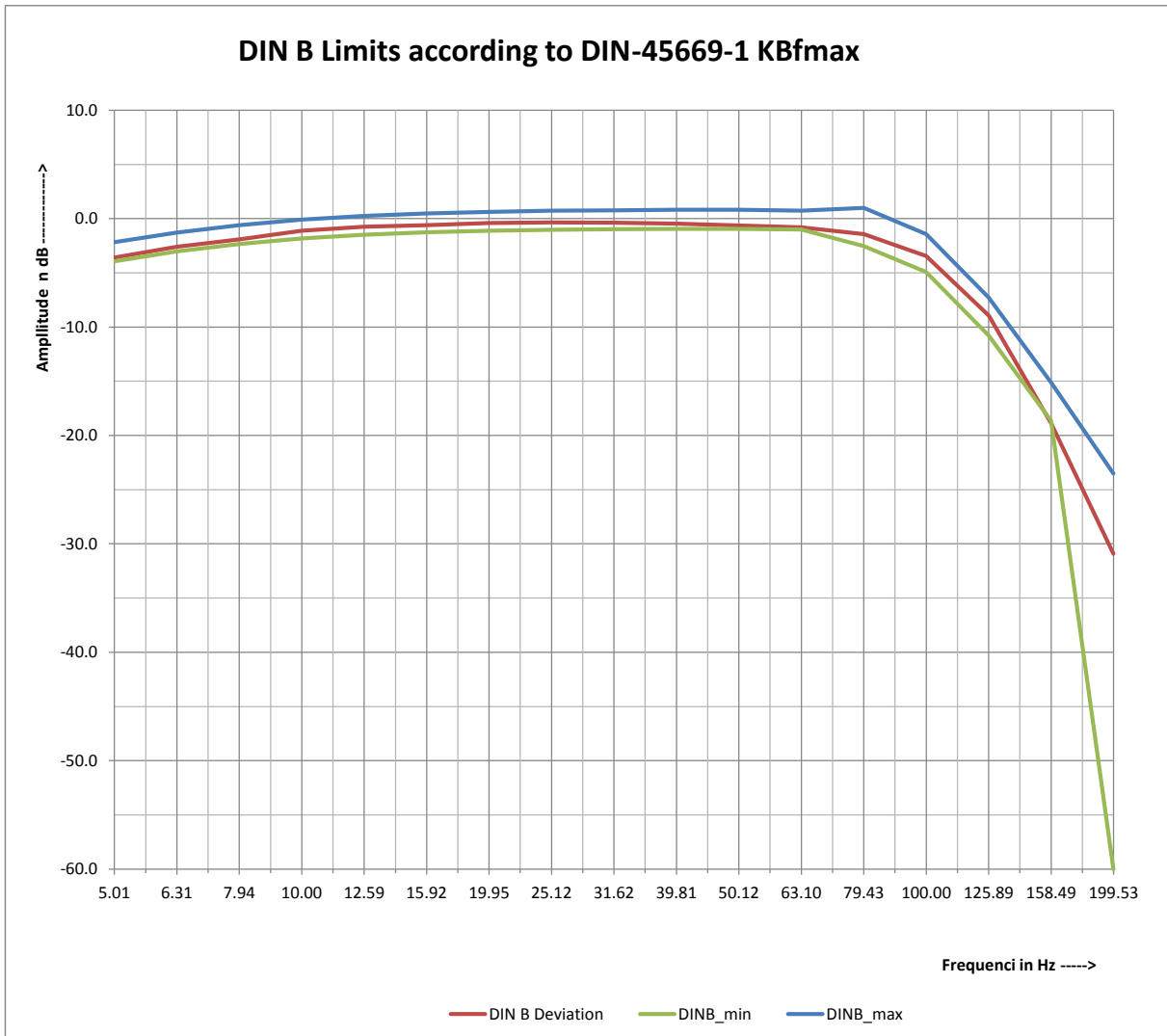
| Input Freq in Hz | Input | | Deviation ref 159.16 Hz | | | |
|------------------|----------------|-------------------------|-------------------------|-----------------|---------------|---------------|
| | Vel Peak Input | Measured Meas DUT in dB | Input Freq in Hz | DIN A Deviation | Grens DIN A - | Grens DIN A + |
| 159.16 | 123.0 | 104.7 | 159.16 | -18.3 | -18.6 | -15.1 |
| 5.01 | 133.1 | 132.6 | 5.01 | -0.5 | -0.9 | 0.8 |
| 6.31 | 130.9 | 130.4 | 6.31 | -0.5 | -0.9 | 0.8 |
| 7.94 | 128.9 | 128.3 | 7.94 | -0.6 | -0.9 | 0.8 |
| 10.00 | 136.1 | 135.8 | 10.00 | -0.3 | -0.9 | 0.8 |
| 12.59 | 134.2 | 133.9 | 12.59 | -0.3 | -0.9 | 0.8 |
| 15.92 | 132.4 | 132.1 | 15.92 | -0.3 | -0.9 | 0.8 |
| 19.95 | 140.0 | 139.8 | 19.95 | -0.2 | -0.9 | 0.8 |
| 25.12 | 138.3 | 138.0 | 25.12 | -0.3 | -0.9 | 0.8 |
| 31.62 | 136.5 | 136.2 | 31.62 | -0.3 | -0.9 | 0.8 |
| 39.81 | 134.7 | 134.3 | 39.81 | -0.4 | -0.9 | 0.8 |
| 50.12 | 133.0 | 132.5 | 50.12 | -0.5 | -0.9 | 0.8 |
| 63.10 | 131.2 | 130.4 | 63.10 | -0.8 | -1.0 | 0.7 |
| 79.43 | 129.3 | 127.9 | 79.43 | -1.4 | -2.5 | 1.0 |
| 100.00 | 127.3 | 123.8 | 100.00 | -3.5 | -4.9 | -1.4 |
| 125.89 | 125.1 | 116.3 | 125.89 | -8.8 | -10.8 | -7.3 |
| 158.49 | 123.1 | 104.8 | 158.49 | -18.3 | -18.6 | -15.1 |
| 199.53 | 121.1 | 92.5 | 199.53 | -28.6 | -60.0 | -23.5 |



Limits according to DIN-45669-1 KBfmax

Results of the DIN B filter for KB in dB

| Input | | | Deviation ref 159.16 Hz | | | |
|------------------|---------------------|----------------------------|-------------------------|--------------------|----------|----------|
| Input Freq in Hz | Vel dB RMS Input | Measured DIN B in dB | Input Freq in Hz | DIN B Deviation | DINB_min | DINB_max |
| 159.16 | 120.0 | 101.2 | 159.16 | -18.8 | -18.6 | -15.1 |
| 5.01 | 130.1 | 126.5 | 5.01 | -3.6 | -3.9 | -2.2 |
| 6.31 | 127.9 | 125.3 | 6.31 | -2.6 | -3.0 | -1.3 |
| 7.94 | 125.9 | 124.0 | 7.94 | -1.9 | -2.3 | -0.6 |
| 10.00 | 133.1 | 132.0 | 10.00 | -1.1 | -1.8 | -0.1 |
| 12.59 | 131.2 | 130.5 | 12.59 | -0.7 | -1.5 | 0.3 |
| 15.92 | 129.4 | 128.8 | 15.92 | -0.6 | -1.3 | 0.5 |
| 19.95 | 137.0 | 136.6 | 19.95 | -0.4 | -1.1 | 0.6 |
| 25.12 | 135.3 | 134.9 | 25.12 | -0.4 | -1.0 | 0.7 |
| 31.62 | 133.5 | 133.1 | 31.62 | -0.4 | -1.0 | 0.8 |
| 39.81 | 131.7 | 131.2 | 39.81 | -0.5 | -0.9 | 0.8 |
| 50.12 | 130.0 | 129.4 | 50.12 | -0.6 | -0.9 | 0.8 |
| 63.10 | 128.2 | 127.4 | 63.10 | -0.8 | -1.0 | 0.7 |
| 79.43 | 126.3 | 124.9 | 79.43 | -1.4 | -2.5 | 1.0 |
| 100.00 | 124.3 | 120.8 | 100.00 | -3.5 | -4.9 | -1.4 |
| 125.89 | 122.1 | 113.2 | 125.89 | -8.9 | -10.8 | -7.3 |
| 158.49 | 120.1 | 101.2 | 158.49 | -18.9 | -18.6 | -15.1 |
| 199.53 | 118.1 | 87.2 | 199.53 | -30.9 | -60.0 | -23.5 |



Test equipment

| Description | Due date | Traceable to |
|-------------------------|-----------------|---------------------|
| Reference accelerometer | May-16 | DAkkS |
| Signal conditioner | May-16 | DAkkS |
| DMM | Feb-16 | RvA |
| DMM | Feb-16 | RvA |
