

## IMPACT SOUND IMPROVEMENT FOR VIBRATEC ACOUSTIC CEILING CONNECTOR VT-ACC

### ABSTRACT

The impact sound level and the impact sound improvement have been measured in a laboratory for suspended ceiling system, VT-ACC from Vibratec Akustikprodukter AB. The ceiling system was mounted below a reference heavyweight floor made of 160 mm concrete. The system has a fix suspension of approximately 50 mm with 45 mm mineral wool in the gap. Measurements were made with 1, 2 and 3 layers of normal gypsum boards (12.5 mm thickness) respectively.

All measurements have been performed according to SS-EN ISO 10140-3:2010 and evaluated according to SS-EN ISO 717-2:2013. Single number values for all measurements can be found in the table below.

Test sample	$L_{n,w}$ (dB)	$C_{1,50-2500}$	$\Delta L_w$ (dB)	$C_{1,\Delta}$
1. Vibratec VT-ACC, 50 mm suspension with 45 mm mineral wool, 1 layer of 12.5 mm normal gypsum board	63	-4	17	-6
2. Vibratec VT-ACC, 50 mm suspension with 45 mm mineral wool, 2 layers of 12.5 mm normal gypsum board	57	-4	23	-6
3. Vibratec VT-ACC, 50 mm suspension with 45 mm mineral wool, 3 layer of 12.5 mm normal gypsum board	55	-5	25	-5

### 1. CLIENT

Vibratec Akustikprodukter AB, Fagernäsvägen 1, 760 17 Blidö, Sweden  
Contact: Svante Hägerstrand, 0176 – 20 78 84, svante.hagerstrand@vibratec.se

### 2. ASSIGNMENT

To measure the impact sound level and the impact sound improvement for suspended ceiling system VT-ACC from Vibratec. The measurements shall be made according to SS-EN ISO 10140-3:2010 and evaluated according to SS-EN ISO 717-2:2013.

### 3. TEST SAMPLES

The constructions of the test samples are described in Table 1. The test samples were mounted below and into Akustikverkstan's 160 mm heavyweight reference concrete floor. The whole surface was covered, and elastic strips were mounted between test sample and surrounding laboratory structure and also sealed with sealant.



Figure 1: The VT-ACC system. In the tests the hangers were mounted with c/c 800 mm (G) and the profiles were mounted with c/c 600 mm (P).

Sample	Sample description
1	VT-ACC with 1 layer of 12.5 mm normal gypsum board. P: 600 mm, G: 800 mm. 50 mm suspension with 45 mm mineral wool.
2	VT-ACC with 2 layers of 12.5 mm normal gypsum boards. P: 600 mm, G: 800 mm. 50 mm suspension with 45 mm wool.
3	VT-ACC with 3 layers of 12.5 mm normal gypsum board.: 600 mm, G: 800 mm. 50 mm suspension with 45 mm mineral wool.

Table 1: Description of test samples. P describes the c/c distance between primary profiles and G the c/c distance between hangers.

### 4. MEASUREMENT PROCEDURE

The impact sound level measurements were performed according to SS-EN ISO10140-3:2010 with the tapping machine in 5 positions on the concrete floor. The microphone was placed on a rotating boom and the measurement period was 60 seconds, which corresponds to two full revolutions of the rotating boom. The reverberation time in the receiving room was measured using the rotating boom, 16 measurements in total. The measurements were then evaluated according to SS-EN ISO 717-2:2013.

The measurements were performed by Carl Nyqvist in Akustikverkstan's laboratory in Skultorp, Sweden, 2020-12-03 and 2020-12-04.

## 5. MEASUREMENT EQUIPMENT

Table 2 presents the equipment that was used during the measurements. The equipment fulfils the requirements of Class 1 according to SS-EN 61672-1, 60942 and 61260. Date for last calibration is kept in Akustikverkstan's instrument journal. The equipment was control calibrated before and after the measurements.

Equipment	Brand and type	Serial number
Analyzer	Norsonic 150	15030421
Speaker	IMA Kub 1	9
Microphone cartridge	Norsonic 1225	251310
Microphone preamplifier	Norsonic 1209	21195
Calibrator	Norsonic 1256	125626092
Tapping machine	Norsonic 277	2775763
Equalizer	Monacor MEQ-2152	-
Amplifier	Denon POA-2200	-

Table 2: Equipment that was used in the measurements.

## 6. MEASUREMENT RESULTS

The measurement results have been evaluated according to SS-EN ISO 717-2:2013. The weighted impact sound level and the weighted impact sound improvement, together with selected correction terms are presented in Table 3. The measurement results are presented in detail in the attached measurement protocols 20-741-M1 to M6. The impact sound level of the reference floor is presented in measurement protocol 20-741-M7.

The measurement results are only valid for the tested samples.

Test sample	$L_{n,w}$ (dB)	$C_{1,50-2500}$	$\Delta L_w$ (dB)	$C_{1,\Delta}$	Measurement- protocol
1. VT-ACC with 1 layer of 12.5 mm normal gypsum board. P: 600 mm, G: 800 mm. 50 mm suspension with 45 mm mineral wool.	63	-4	17	-6	M1, M2
2. VT-ACC with 2 layers of 12.5 mm normal gypsum boards. P: 600 mm, G: 800 mm. 50 mm suspension with 45 mm mineral wool.	57	-4	23	-6	M3 M4
3. VT-ACC with 3 layers of 12.5 mm normal gypsum board. P: 600 mm, G: 800 mm. 50 mm suspension with 45 mm mineral wool.	55	-5	25	-5	M5, M6

Table 3: Selected one-figure measurement results and corresponding measurement protocols.

## 7. MEASUREMENT PRECISION

The precision of the weighted one-figure numbers is normally within  $\pm 2,2$  dB. Typical precisions for each one-third octave band is shown in Table 4. These values corresponds to the repeatability of one standard deviation for this laboratory, based on ten measurements on the heavyweight reference floor during 2004 to 2015.

<b>50 Hz</b>	<b>63 Hz</b>	<b>80 Hz</b>	<b>100 Hz</b>	<b>125 Hz</b>	<b>160 Hz</b>	<b>200 Hz</b>
$\pm 3.8$ dB	$\pm 3.2$ dB	$\pm 3.1$ dB	$\pm 2.2$ dB	$\pm 2.1$ dB	$\pm 1.5$ dB	$\pm 1.5$ dB
<b>250 Hz</b>	<b>315 Hz</b>	<b>400 Hz</b>	<b>500 Hz</b>	<b>630 Hz</b>	<b>800 Hz</b>	<b>1 kHz</b>
$\pm 1.1$ dB	$\pm 1.4$ dB	$\pm 0.8$ dB	$\pm 1.1$ dB	$\pm 1.1$ dB	$\pm 1.2$ dB	$\pm 1.3$ dB
<b>1,25 kHz</b>	<b>1,6 kHz</b>	<b>2,0 kHz</b>	<b>2,5 kHz</b>	<b>3,15 kHz</b>	<b>4,0 kHz</b>	<b>5,0 kHz</b>
$\pm 1.5$ dB	$\pm 1.9$ dB	$\pm 1.8$ dB	$\pm 2.3$ dB	$\pm 2.3$ dB	$\pm 2.5$ dB	$\pm 2.8$ dB

Table 4: One standard deviation for impact sound level measurements performed on the 160 mm heavyweight reference floor.

The measurement uncertainties for meteorological parameters are shown in Table 5.

Parameter	Uncertainty
Temperature	$\pm 0.5^\circ$ C
Relative humidity	$\pm 3$ percent
Air pressure	$\pm 0.5$ kPa

Table 5: Measurement uncertainty.

## 8. DEVIATIONS FROM STANDARDS

No deviations from the applicable standards were made during these measurements.

This report shall only be reprinted in its entirety. The measurement protocols may however be used separately.

Carl Nyqvist

Reviewed by Anders Grimmehed, 2020-12-16

## APPENDIX 1: INFORMATION ABOUT THE LABORATORY

Test room 3 (Impact sound room) on the laboratory's first floor has a rectangular shape with the dimensions  $L \times B \times H = 4.96 \times 6.25 \times 3.38$  m. The room's volume is  $105 \text{ m}^3$  and the total surface for walls, floor and ceiling is  $138 \text{ m}^2$ .

Test room 2 (used as receiving room in impact sound measurements) has a rectangular shape with the dimensions  $L \times B \times H = 5.0 \times 6.25 \times 3.93$  m. The room's volume is  $123 \text{ m}^3$  and the total surface for walls, floor and ceiling is  $151 \text{ m}^2$ .

The reference floor's size is  $4.0 \times 2.5$  m.

A section for the two rooms together with the location of the reference floor is shown in Figure B1.1.

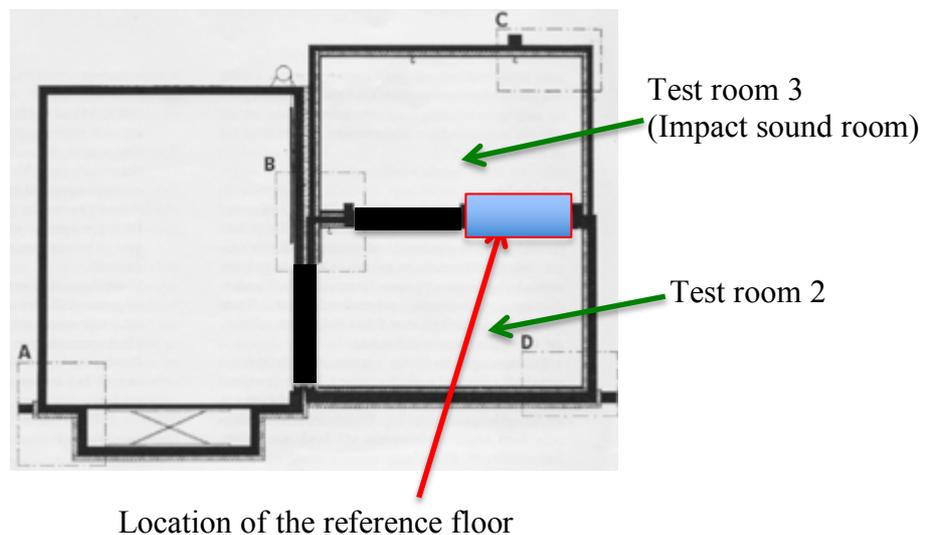


Figure B1.1: Section for Test room 2 and Test room 3 together with the location of the reference floor.

The Laboratory's address is Vallmovägen 11, 541 55 Skövde, Sweden.

## APPENDIX 2: PHOTOS FROM THE MEASUREMENTS



Figure B2.1: Rails mounted.



Figure B2.2: Unmounting of the installation. Shows rails, mineral wool and 2 layers of gypsum board.

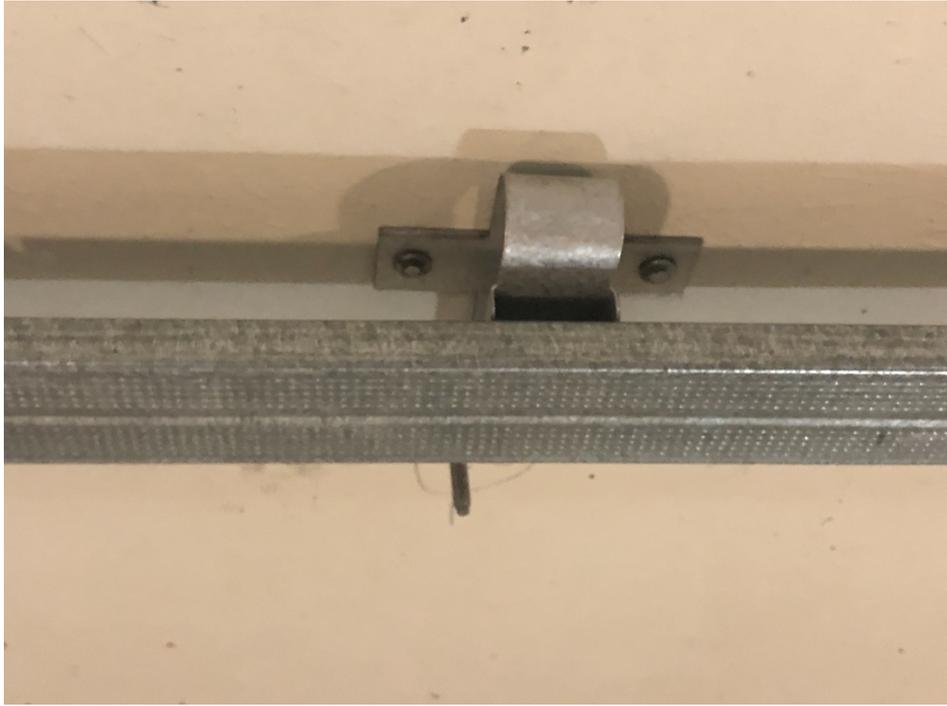


Figure B2.3: Close up of hanger.

## Normalized impact sound pressure levels according to ISO 10140-3

No. of test report: 20-741-M1

Date of report: 2020-12-15

Date of test: 2020-12-03

Name: Carl Nyqvist

Laboratory measurements of impact sound insulation of floors

**Client:** Vibratec Akustikprodukter AB

**Manufacturer:** Vibratec Akustikprodukter AB

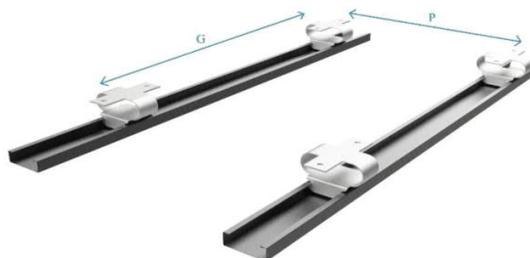
**Test specimen mounted by:** Akustikverkstan

**Test room identification:**

Test room 3 (sending room) to Test room 2 (receiving room)

**Product identification:**

VT-ACC with 1 layer of normal gypsum board



**Description of the specimen:**

VT-ACC with 1 layer of 12.5 mm normal gypsum board. P:600 mm, G: 800 mm. 55 mm suspension with 45 mm mineral wool. Mounted under 160 mm heavyweight reference concrete floor.

**Mass per unit area:** 375 kg/m<sup>2</sup>

**Curing time:** 0 days

**Barometric pressure:** 100,2 kPa

**Temperature - source room:** 17,6 °C

- receiving room: 19,4 °C

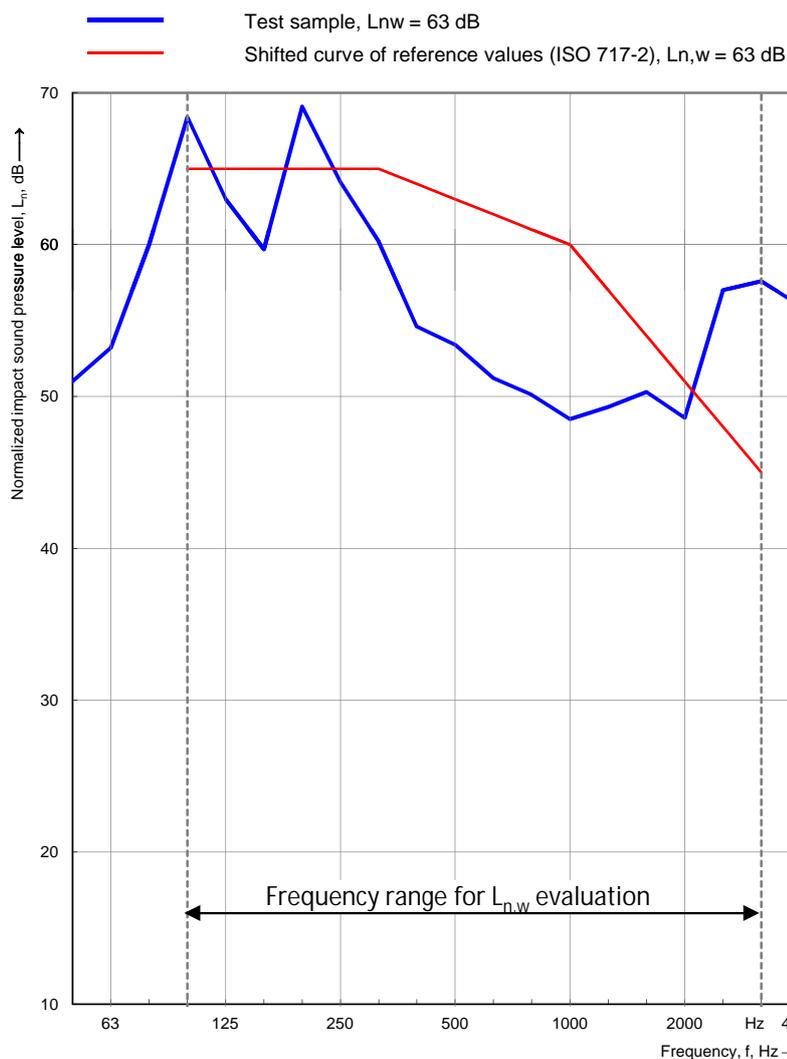
**Air humidity - source room:** 41,8 %

- receiving room: 35,2 %

**Source room volume:** 105 m<sup>3</sup>

**Receiving room volume:** 123,0 m<sup>3</sup>

Frequency f [Hz]	L <sub>n</sub> 1/3 octave [dB]
50	51,0
63	53,2
80	60,0
100	68,4
125	63,0
160	59,7
200	69,1
250	64,1
315	60,2
400	54,6
500	53,4
630	51,2
800	50,1
1000	48,5
1250	49,3
1600	50,3
2000	48,6
2500	57,0
3150	57,6
4000	56,0
5000	54,2



Rating according to ISO 717-2

$$L_{n,w}(C_1) = 63 \text{ ( -4 ) dB}$$

$$C_{1,50-2500} = -4 \text{ dB}$$

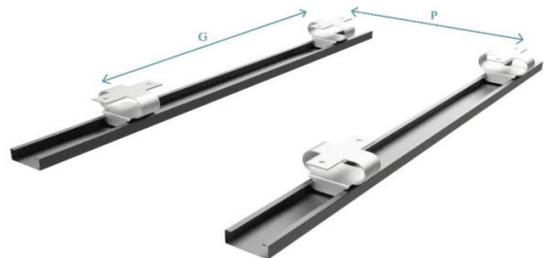
Evaluation based on laboratory measurement results obtained in one-third-octave bands by an engineering method.

## Reduction of impact sound pressure level according to ISO 10140

No. of test report: 20-741-M2  
 Date of report: 2020-12-15  
 Date of test: 2020-12-03  
 Name: Carl Nyqvist

Laboratory measurements of the reduction of transmitted impact noise by floor coverings on a heavyweight standard floor

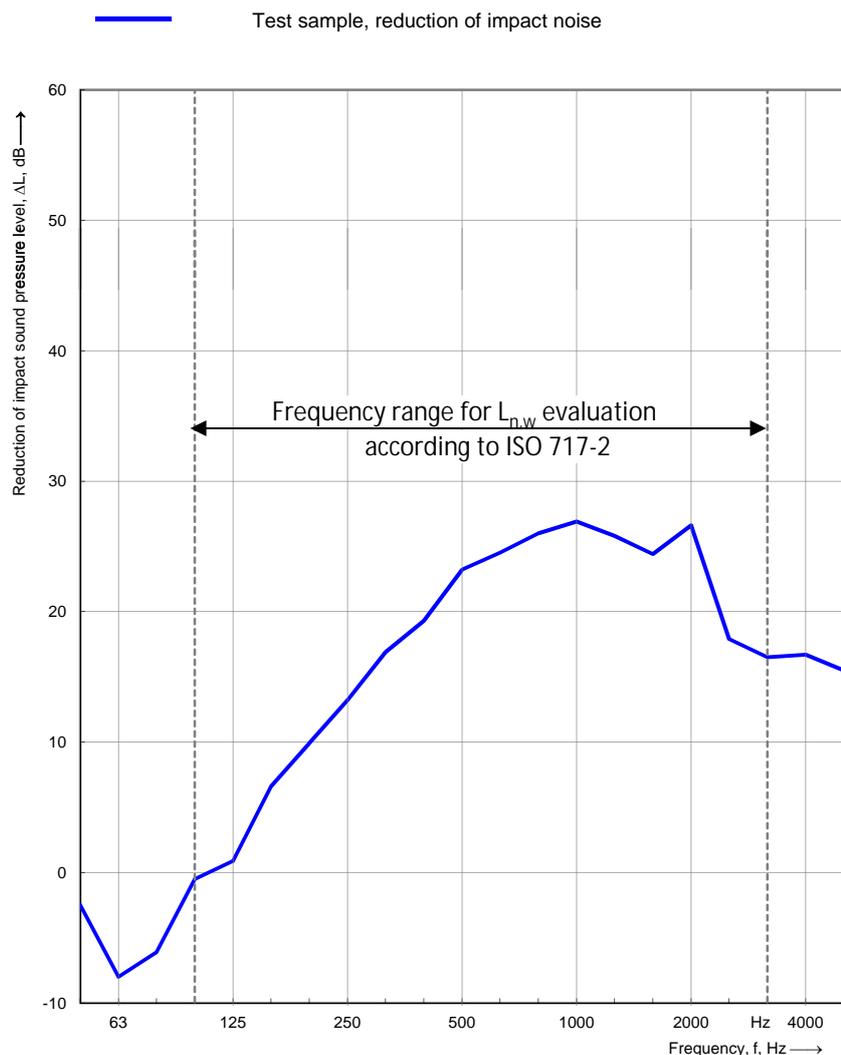
**Client:** Vibratex Akustikprodukter AB  
**Manufacturer:** Vibratex Akustikprodukter AB  
**Test specimen mounted by:** Akustikverkstan  
**Test room identification:**  
 Test room 3 (sending room) to Test room 2 (receiving room)  
**Product identification:**  
 VT-ACC with 1 layer of normal gypsum board



**Description of the specimen:**  
 VT-ACC with 1 layer of 12.5 mm normal gypsum board. P:600 mm, G: 800 mm. 55 mm suspension with 45 mm mineral wool. Mounted under 160 mm heavyweight reference concrete floor.

**Mass per unit area:** 10 kg/m<sup>2</sup>  
**Curing time:** 0 s  
**Barometric pressure:** 100,2 kPa  
**Temperature - source room:** 17,6 °C  
 - receiving room: 19,4 °C  
**Air humidity - source room:** 41,8 %  
 - receiving room: 35,2 %  
**Source room volume:** 105 m<sup>3</sup>  
**Receiving room volume:** 123,0 m<sup>3</sup>

Frequency f [Hz]	L <sub>n,0</sub> 1/3 octave [dB]	ΔL 1/3 octave [dB]
50	48,5	-2,5
63	45,2	-8,0
80	53,9	-6,1
100	67,9	-0,5
125	63,9	0,9
160	66,3	6,6
200	79,0	9,9
250	77,3	13,2
315	77,1	16,9
400	73,9	19,3
500	76,6	23,2
630	75,7	24,5
800	76,1	26,0
1000	75,4	26,9
1250	75,1	25,8
1600	74,7	24,4
2000	75,2	26,6
2500	74,9	17,9
3150	74,1	16,5
4000	72,7	16,7
5000	69,7	15,5



Rating according to ISO 717-2

ΔL<sub>w</sub> = 17 dB

C<sub>i,Δ</sub> = -6 dB

C<sub>i,r</sub> = -5 dB

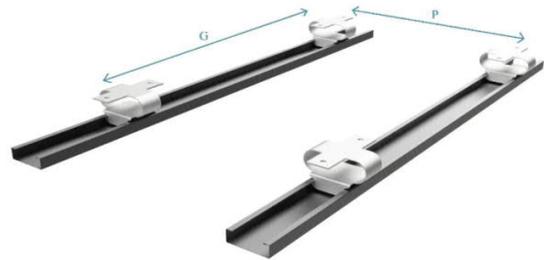
These results are based on test made with an artificial source under laboratory conditions obtained in one-third-octave bands by an engineering method.

## Normalized impact sound pressure levels according to ISO 10140-3

No. of test report: 20-741-M3  
Date of report: 2020-12-15  
Date of test: 2020-12-03  
Name: Carl Nyqvist

Laboratory measurements of impact sound insulation of floors

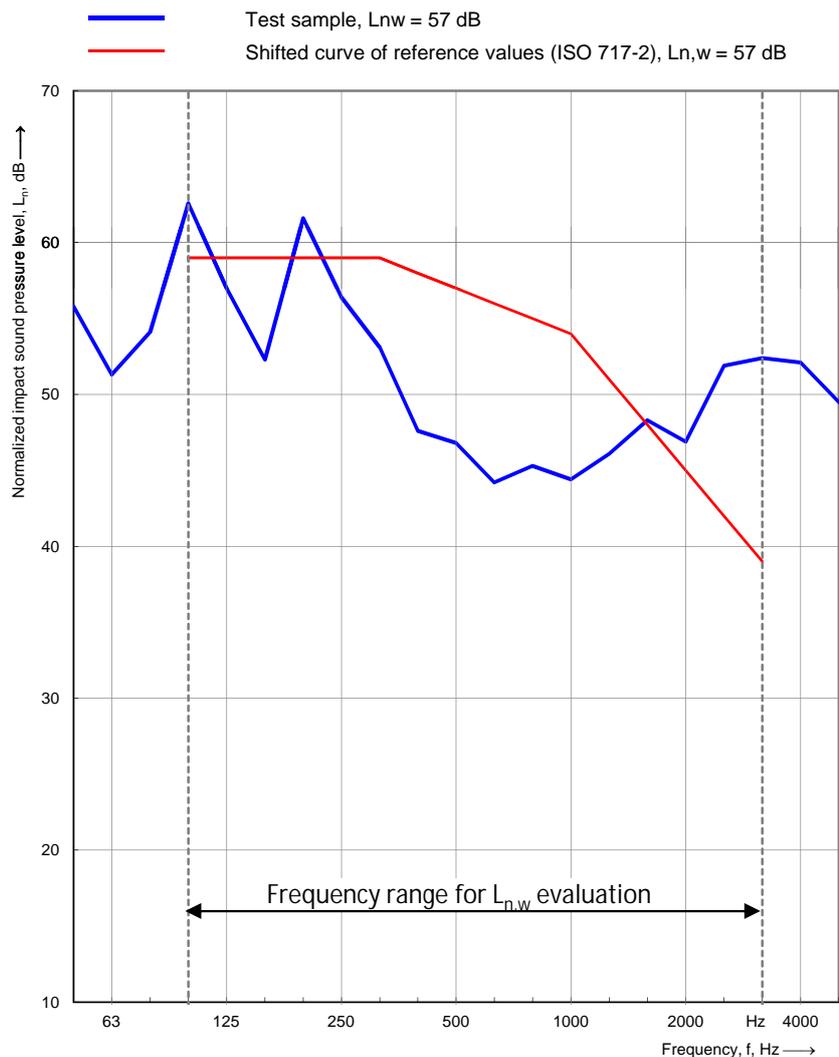
**Client:** Vibratex Akustikprodukter AB  
**Manufacturer:** Vibratex Akustikprodukter AB  
**Test specimen mounted by:** Akustikverkstan  
**Test room identification:** Test room 3 (sending room) to Test room 2 (receiving room)  
**Product identification:** VT-ACC with 2 layers of normal gypsum boards



**Description of the specimen:** VT-ACC with 2 layers of 12.5 mm normal gypsum boards. P:600 mm, G: 800 mm. 55 mm suspension with 45 mm mineral wool. Mounted under 160 mm heavyweight reference concrete floor.

**Mass per unit area:** 384 kg/m<sup>2</sup>  
**Curing time:** 0 days  
**Barometric pressure:** 100,2 kPa  
**Temperature - source room:** 17,5 °C  
**- receiving room:** 19,2 °C  
**Air humidity - source room:** 42,2 %  
**- receiving room:** 35,4 %  
**Source room volume:** 105 m<sup>3</sup>  
**Receiving room volume:** 123,0 m<sup>3</sup>

Frequency f [Hz]	L <sub>n</sub> 1/3 octave [dB]
50	55,8
63	51,3
80	54,1
100	62,6
125	57,0
160	52,3
200	61,6
250	56,4
315	53,1
400	47,6
500	46,8
630	44,2
800	45,3
1000	44,4
1250	46,1
1600	48,3
2000	46,9
2500	51,9
3150	52,4
4000	52,1
5000	49,5



Rating according to ISO 717-2

$$L_{n,w}(C_1) = 57 \text{ ( -5 ) dB}$$

$$C_{1,50-2500} = -4 \text{ dB}$$

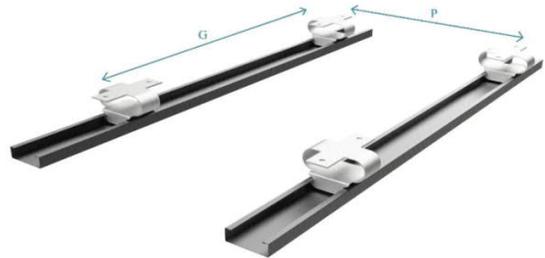
Evaluation based on laboratory measurement results obtained in one-third-octave bands by an engineering method.

## Reduction of impact sound pressure level according to ISO 10140

No. of test report: 20-741-M4  
Date of report: 2020-12-15  
Date of test: 2020-12-03  
Name: Carl Nyqvist

Laboratory measurements of the reduction of transmitted impact noise by floor coverings on a heavyweight standard floor

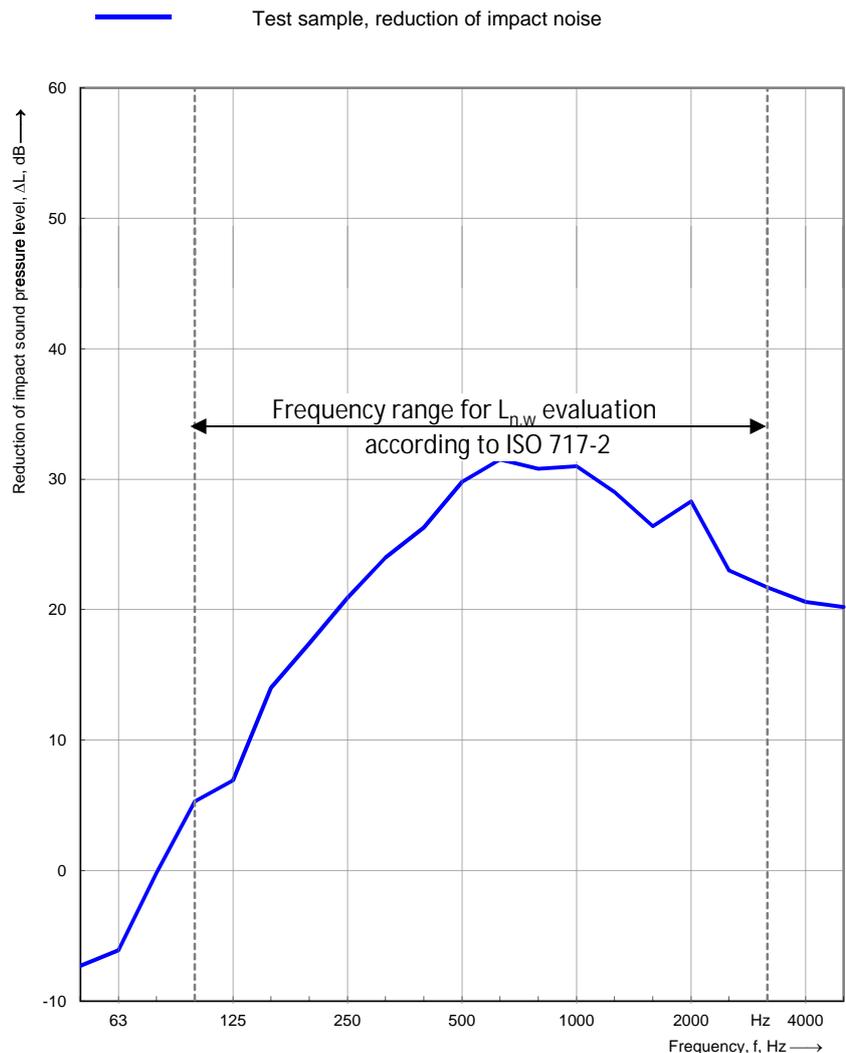
**Client:** Vibratec Akustikprodukter AB  
**Manufacturer:** Vibratec Akustikprodukter AB  
**Test specimen mounted by:** Akustikverkstan  
**Test room identification:** Test room 3 (sending room) to Test room 2 (receiving room)  
**Product identification:** VT-ACC with 2 layers of normal gypsum boards



**Description of the specimen:** VT-ACC with 2 layers of 12.5 mm normal gypsum boards. P:600 mm, G: 800 mm. 55 mm suspension with 45 mm mineral wool. Mounted under 160 mm heavyweight reference concrete floor.

**Mass per unit area:** 19 kg/m<sup>2</sup>  
**Curing time:** 0 s  
**Barometric pressure:** 100,2 kPa  
**Temperature - source room:** 17,5 °C  
**- receiving room:** 19,2 °C  
**Air humidity - source room:** 42,2 %  
**- receiving room:** 35,4 %  
**Source room volume:** 105 m<sup>3</sup>  
**Receiving room volume:** 123,0 m<sup>3</sup>

Frequency f [Hz]	L <sub>n,0</sub> 1/3 octave [dB]	ΔL 1/3 octave [dB]
50	48,5	-7,3
63	45,2	-6,1
80	53,9	-0,2
100	67,9	5,3
125	63,9	6,9
160	66,3	14,0
200	79,0	17,4
250	77,3	20,9
315	77,1	24,0
400	73,9	26,3
500	76,6	29,8
630	75,7	31,5
800	76,1	30,8
1000	75,4	31,0
1250	75,1	29,0
1600	74,7	26,4
2000	75,2	28,3
2500	74,9	23,0
3150	74,1	21,7
4000	72,7	20,6
5000	69,7	20,2



Rating according to ISO 717-2

ΔL<sub>w</sub> = 23 dB

C<sub>l,Δ</sub> = -6 dB

C<sub>l,r</sub> = -5 dB

These results are based on test made with an artificial source under laboratory conditions obtained in one-third-octave bands by an engineering method.

## Normalized impact sound pressure levels according to ISO 10140-3

No. of test report: 20-741-M5

Date of report: 2020-12-15

Date of test: 2020-12-04

Name: Carl Nyqvist

Laboratory measurements of impact sound insulation of floors

**Client:** Vibratec Akustikprodukter AB

**Manufacturer:** Vibratec Akustikprodukter AB

**Test specimen mounted by:** Akustikverkstan

**Test room identification:**

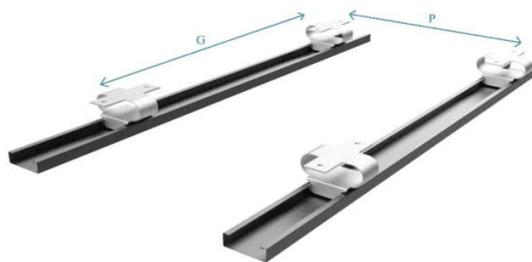
Test room 3 (sending room) to Test room 2 (receiving room)

**Product identification:**

VT-ACC with 3 layers of normal gypsum boards

**Description of the specimen:**

VT-ACC with 1 layers of 12.5 mm normal gypsum boards. P:600 mm, G: 800 mm. 55 mm suspension with 45 mm mineral wool. Mounted under 160 mm heavyweight reference concrete floor.



**Mass per unit area:** 393 kg/m<sup>2</sup>

**Curing time:** 0 days

**Barometric pressure:** 99,7 kPa

**Temperature - source room:** 18,0 °C

- receiving room: 19,0 °C

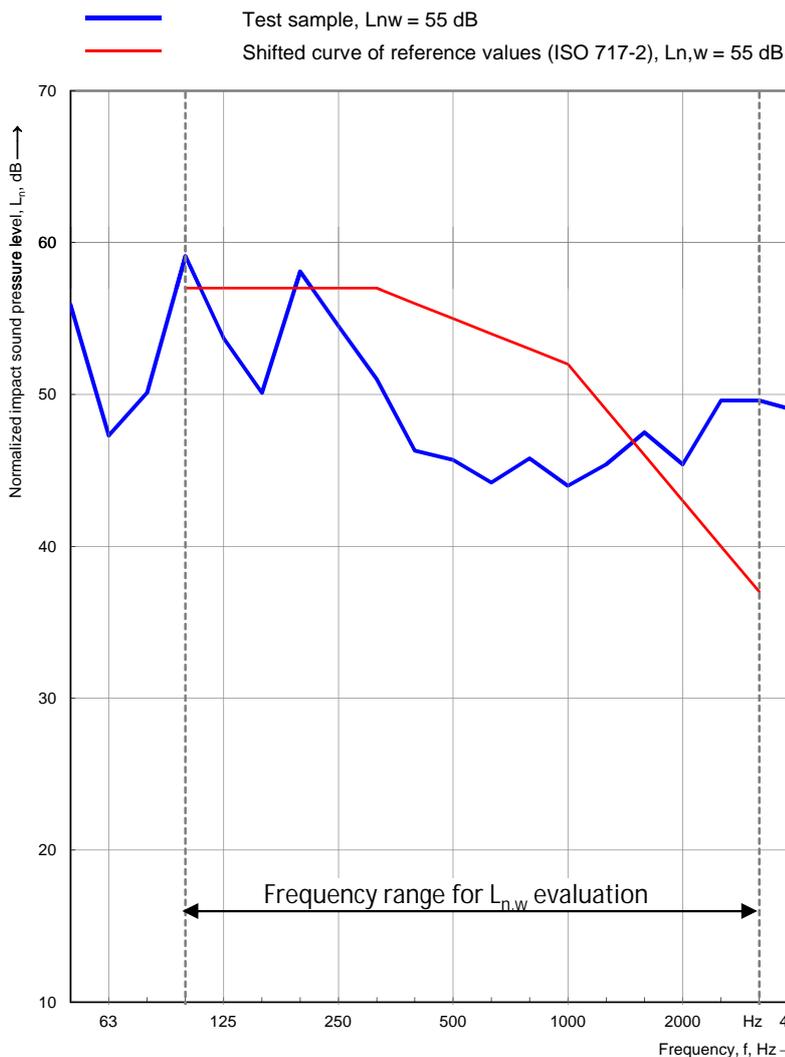
**Air humidity - source room:** 38,4 %

- receiving room: 34 %

**Source room volume:** 105 m<sup>3</sup>

**Receiving room volume:** 123,0 m<sup>3</sup>

Frequency f [Hz]	L <sub>n</sub> 1/3 octave [dB]
50	55,9
63	47,3
80	50,1
100	59,1
125	53,7
160	50,1
200	58,1
250	54,5
315	51,0
400	46,3
500	45,7
630	44,2
800	45,8
1000	44,0
1250	45,4
1600	47,5
2000	45,4
2500	49,6
3150	49,6
4000	48,9
5000	46,6



Rating according to ISO 717-2

$$L_{n,w}(C_1) = 55 \text{ ( -6 ) dB}$$

$$C_{1,50-2500} = -5 \text{ dB}$$

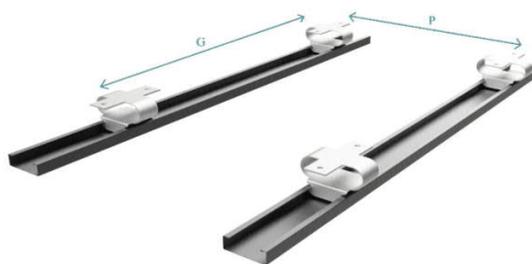
Evaluation based on laboratory measurement results obtained in one-third-octave bands by an engineering method.

## Reduction of impact sound pressure level according to ISO 10140

No. of test report: 20-741-M6  
Date of report: 2020-12-15  
Date of test: 2020-12-04  
Name: Carl Nyqvist

Laboratory measurements of the reduction of transmitted impact noise by floor coverings on a heavyweight standard floor

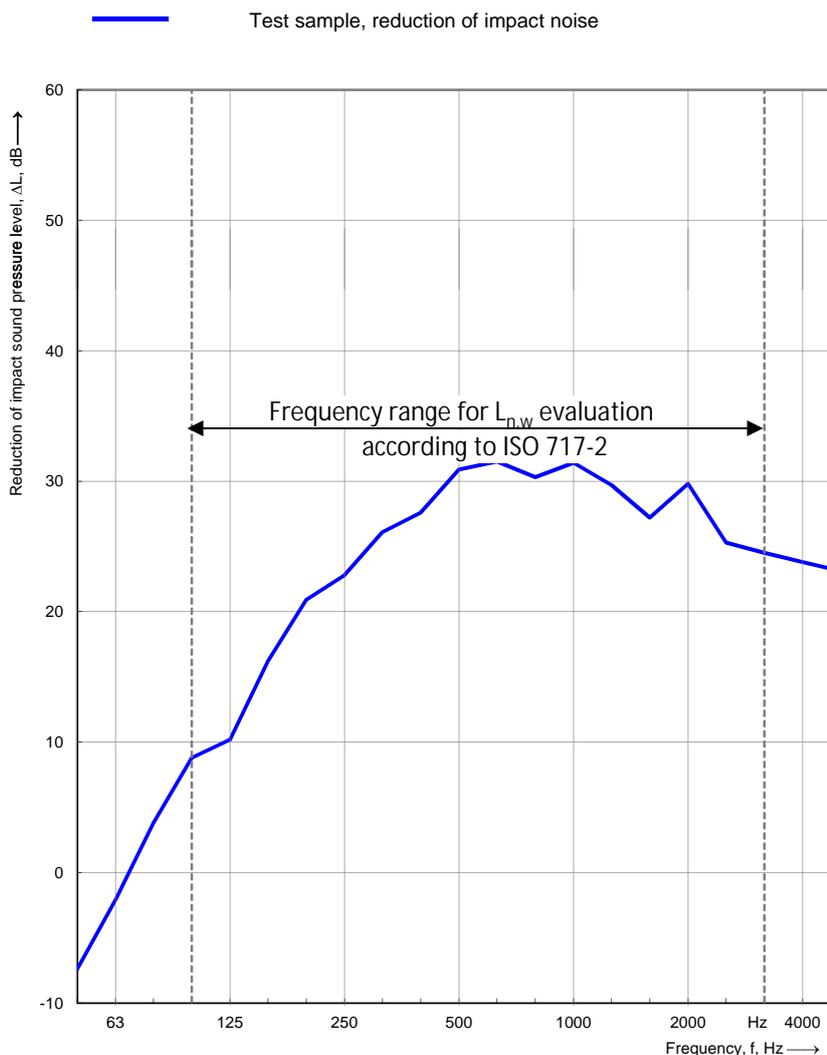
**Client:** Vibratex Akustikprodukter AB  
**Manufacturer:** Vibratex Akustikprodukter AB  
**Test specimen mounted by:** Akustikverkstan  
**Test room identification:** Test room 3 (sending room) to Test room 2 (receiving room)  
**Product identification:** VT-ACC with 3 layers of normal gypsum boards



**Description of the specimen:** VT-ACC with 1 layers of 12.5 mm normal gypsum boards. P:600 mm, G: 800 mm. 55 mm suspension with 45 mm mineral wool. Mounted under 160 mm heavyweight reference concrete floor.

**Mass per unit area:** 28 kg/m<sup>2</sup>  
**Curing time:** 0 s  
**Barometric pressure:** 99,7 kPa  
**Temperature - source room:** 18,0 °C  
**- receiving room:** 19,0 °C  
**Air humidity - source room:** 38,4 %  
**- receiving room:** 34,0 %  
**Source room volume:** 105 m<sup>3</sup>  
**Receiving room volume:** 123,0 m<sup>3</sup>

Frequency f [Hz]	L <sub>n,0</sub> 1/3 octave [dB]	ΔL 1/3 octave [dB]
50	48,5	-7,4
63	45,2	-2,1
80	53,9	3,8
100	67,9	8,8
125	63,9	10,2
160	66,3	16,2
200	79,0	20,9
250	77,3	22,8
315	77,1	26,1
400	73,9	27,6
500	76,6	30,9
630	75,7	31,5
800	76,1	30,3
1000	75,4	31,4
1250	75,1	29,7
1600	74,7	27,2
2000	75,2	29,8
2500	74,9	25,3
3150	74,1	24,5
4000	72,7	23,8
5000	69,7	23,1



Rating according to ISO 717-2

ΔL<sub>w</sub> = 25 dB

C<sub>l,Δ</sub> = -5 dB

C<sub>l,r</sub> = -6 dB

These results are based on test made with an artificial source under laboratory conditions obtained in one-third-octave bands by an engineering method.

## Normalized impact sound pressure levels according to ISO 10140-3

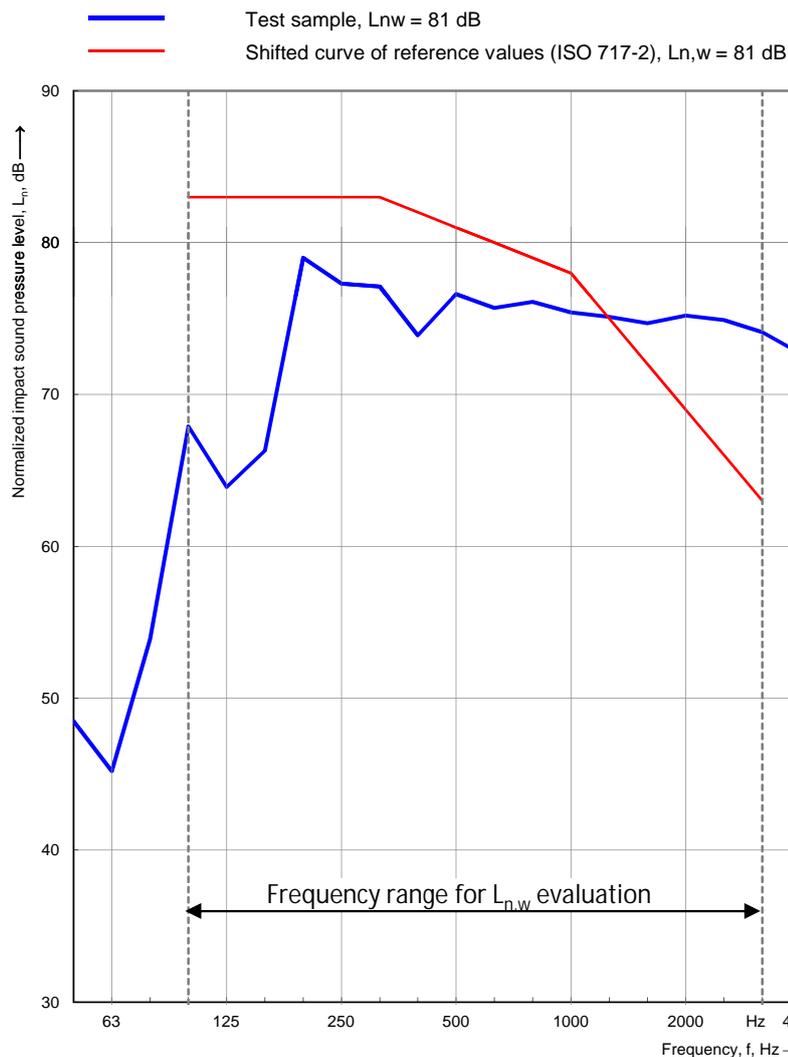
No. of test report: 20-741-M7  
Date of report: 2020-12-15  
Date of test: 2020-12-04  
Name: Carl Nyqvist

Laboratory measurements of impact sound insulation of floors

**Client:** Vibratec Akustikprodukter AB  
**Manufacturer:** -  
**Test specimen mounted by:** Akustikverkstan  
**Test room identification:**  
Test room 3 (sending room) to Test room 2 (receiving room)  
**Product identification:**  
Heavyweight reference floor  
**Description of the specimen:**  
Heavyweight reference floor, 160 mm concrete

**Mass per unit area:** 365 kg/m<sup>2</sup>  
**Curing time:** 0 days  
**Barometric pressure:** 99,7 kPa  
**Temperature - source room:** 17,9 °C  
- receiving room: 18,8 °C  
**Air humidity - source room:** 38,8 %  
- receiving room: 34,4 %  
**Source room volume:** 105 m<sup>3</sup>  
**Receiving room volume:** 103,0 m<sup>3</sup>

Frequency f [Hz]	L <sub>n</sub> 1/3 octave [dB]
50	48,5
63	45,2
80	53,9
100	67,9
125	63,9
160	66,3
200	79,0
250	77,3
315	77,1
400	73,9
500	76,6
630	75,7
800	76,1
1000	75,4
1250	75,1
1600	74,7
2000	75,2
2500	74,9
3150	74,1
4000	72,7
5000	69,7



Rating according to ISO 717-2

$$L_{n,w}(C_i) = 81 \text{ ( -9 ) dB}$$

$$C_{1,50-2500} = -9 \text{ dB}$$

Evaluation based on laboratory measurement results obtained in one-third-octave bands by an engineering method.