

Sound Absorption TEST REPORT 300-VELA, Noise-Lab

Report No.: 300-LYD-19-105



**DANISH
TECHNOLOGICAL
INSTITUTE**

Technological Institute
Gregersensvej 3
P.O.Box 141
DK-26300 Hoeje Taastrup
Tlf.: +45 7220 2000
<http://dti.dk>

Initials: BBJN
TI-order: 924273

Customer: Company: Acupanels International ApS
Address: Tietgensgade 7 B
City: 7400 Herning

Component: Object: AcuPanels
Mounting: The 11 panels were laid out flat on the concrete floor in the reverberation test room.

TestArea 15.8 m²
Dates: Received: 01-04-20 Tested: 17-04-20

Procedure: Noise-Lab TP 11 (Id.: 7384)

Standards: DS/EN ISO 354:2003. Acoustics - Measurements of sound absorption in a reverberation room.
DS/ISO 20189 :2018 , DS/EN ISO 11654:1997

Result of test: 1/1 octave Sound Absorption coefficients α_s :

Hz	125	250	500	1000	2000	4000
α_s	0.0	0.1	0.2	0.6	1.1	0.8

Weighted Sound Absorption Coefficient
Sound Absorption class

0.4 (H)
D

Details and figures are given in report and Enclosures.

Terms: The test has been performed according to the conditions laid down by DANAK (The Danish Accreditation), www.danak.dk, and the general terms and conditions of Danish Technological Institute. The results from DTI's work in this report, i.e. analyses, assessments and instructions may only be used or reported in their entirety. The customer may not mention or refer to DTI or DTI's employees for advertising or marketing purposes unless DTI has granted its written consent in each case.

Notes: 24-06-2020: Description corrected. Added enclosure 3.

Division/Centre: Danish Technological Institute
Energy & Climate / NoiseLab

Head of NoiseLab: Birger Bech Jessen
Co-Reader:

Digital Signature:



DANAK
TEST Reg. nr. 300

1. TEST PROGRAM

This test report comprises results from the following test:

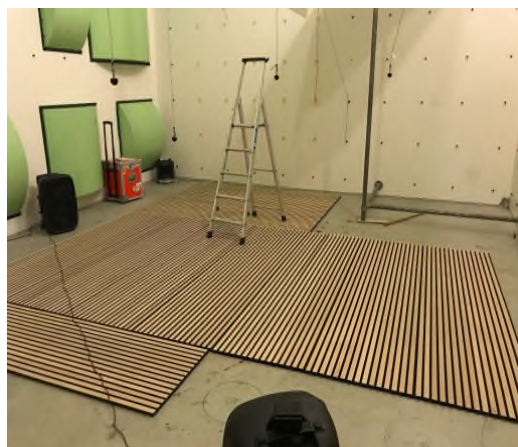
Determination of sound absorption coefficients and calculation of weighted values based on reverberation time measurements in a highly reverberant room.

2. TEST OBJECT AND MOUNTING

Wall Panel made of foam PET polyester fiber of thickness 9 mm, covered by wooden veneer of width 27 mm and thickness 11 mm, stabled to the mat and spaced 13 mm from each other. Module size length 240 cm * width 60 cm. See enclosure 3.

Mounting:

The 11 panels were laid out flat on the concrete floor in the reverberation test room.



3. METHOD

The determination of the sound absorption coefficient is based on measurements of the change of reverberation times, measured in a highly reverberant room with and without the test specimens placed in this room.

Measurements are made in 1/3-octave levels from 50 Hz to 10 kHz, with an usable range between 100 Hz to 5000 Hz. Results are given in 1/3 and 1/1-octave levels, and frequency weighted single values are calculated.

The calculation of absorption coefficient is
$$\alpha_s = \frac{55,3 \cdot V}{c \cdot S} \cdot \left(\frac{1}{T_2} - \frac{1}{T_1} \right) - \frac{4V}{S} \cdot (m_2 - m_1)$$

Where

α_s is the absorption coefficient at given frequency band, V is Volumen of test room [m³], c is speed of sound [m/s], S is surface area of test room [m²], T1 and T2 is measured reverberation time [sec], T1 with test object, T2 empty room, and m is damping coefficient of air when measuring with and without test object.

The damping coefficient is given as emperical values in standard DS/ISO 9613-1:1993. By aiming for same thermal conditions of air temperature and humidity, the damping coefficients cancel out. If this condition has not been possible an estimated correction may be added, which normally is very small and only relevant fot the highest frequencies.

4. MEASUREMENT SYSTEMS

Description	Manufacturer	Type	ID #
Precision sound level meter	Brüel & Kjær	2270G	159822
Reverberation software	Brüel & Kjær	BZ7227	109375
Microphone	Brüel & Kjær	4189	160040
Calibrator	Brüel & Kjær	4231	148739
Loudspeaker	Thornton	EVN12W	162942
Loudspeaker	Thornton	EVN12W	178192
Reverberation room	Teknologisk Institut	TI 811	79737
Temp/Humidity/Barometer	TSI	VelociCalc 9565 P	79650
Microphone positioning system	Teknologisk Institut	Teknologisk Institut	-

All measurement systems are calibrated according to DANAK certification no.300.

5. TEST CONDITIONS

Date	17-04-2020
Temperature °C	21 °C
Humidity % RH	41 %RH

The materials to be tested are acclimatized in the measurement room until stable air temperature and air humidity are reached. This may last several hours for soft and thick materials and furnitures.

The stability are ensured using a logging system for temperature and humidity.

Just after these measurements are done the test materials are removed from the test room and the measurement of the empty test room is made.

Measurements are made in minimum at 6 microphone positions with 3 measurements in each position, and using two sound sources. The software calculate the ensemble average of alle the measurements.

Control of raw data is made by plotting and comparing position-levels and statistic parameters like standard deviation etc.

6. Measurement uncertainty

According to EN 16487:2014 the uncertainty of the absorption coefficient α_p for 1/1-octave values are within a 90% confidence interval of:

Frequency Hz	125	250	500	1000	2000	4000	Hz
Uncertainty	±0.23	±0.23	±0.11	±0.10	±0.10	±0.13	-

7. TEST RESULTS

NOTE: The test results solely apply to the tested object(s).

7.1 Reverberations times

1/3-octave measurement data.

Freq.	T1 Object	T2 Empty
100	7.40	6.63
125	4.97	5.08
160	5.49	5.36
200	6.14	5.44
250	6.16	4.96
315	6.75	5.08
400	6.46	4.45
500	6.79	3.86
630	7.09	3.35
800	7.15	2.92
1k	6.85	2.30
1.25k	6.24	1.88
1.6k	5.59	1.56
2k	4.72	1.41
2.5k	3.87	1.35
3.15k	2.93	1.28
4k	2.37	1.24
5k	1.92	1.17

1/1-octave values calculated from 1/3-octave data

Freq.	T1 Object	T2 Empty
125	5.95	5.69
250	6.35	5.16
500	6.78	3.89
1k	6.75	2.37
2k	4.73	1.44
4k	2.41	1.23



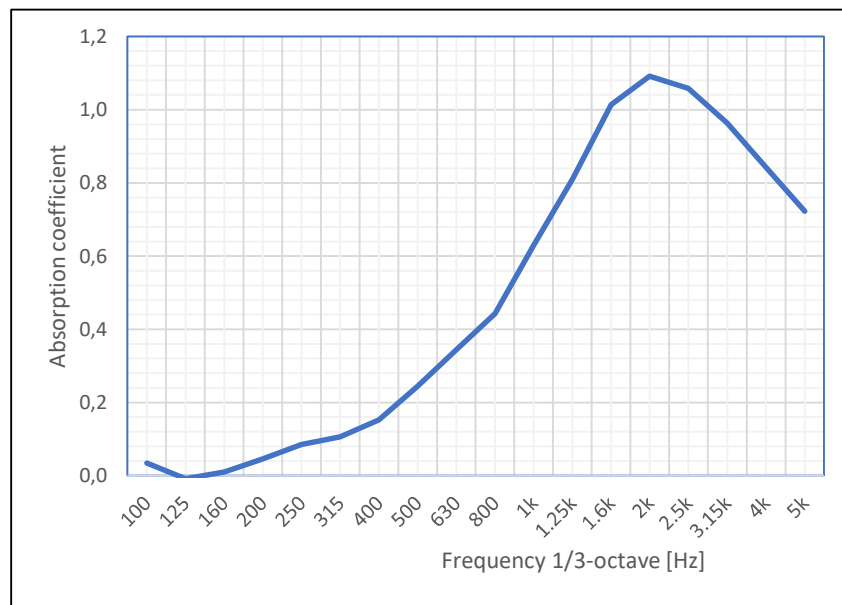
Measurement of sound absorption coefficient acc. DS/EN ISO 354:2003

Client: Acupanels International ApS Tietgensgade 7 B 7400 Herning
Date of meas. 17-04-2020
Test object AcuPanels

Mounting The 11 panels were laid out flat on the concrete floor in the reverberation test room.

TestArea 15.84 m² Sab
Room volume 215 m³ Room surface area 238 m³

Freq. Hz	α_s
100	0.03
125	-0.01
160	0.01
200	0.05
250	0.09
315	0.11
400	0.15
500	0.24
630	0.34
800	0.44
1k	0.63
1.25k	0.81
1.6k	1.01
2k	1.09
2.5k	1.06
3.15k	0.96
4k	0.84
5k	0.72



Signed: 26-05-2020

Ms.Sc. Senior Consult Birger Bech Jessen



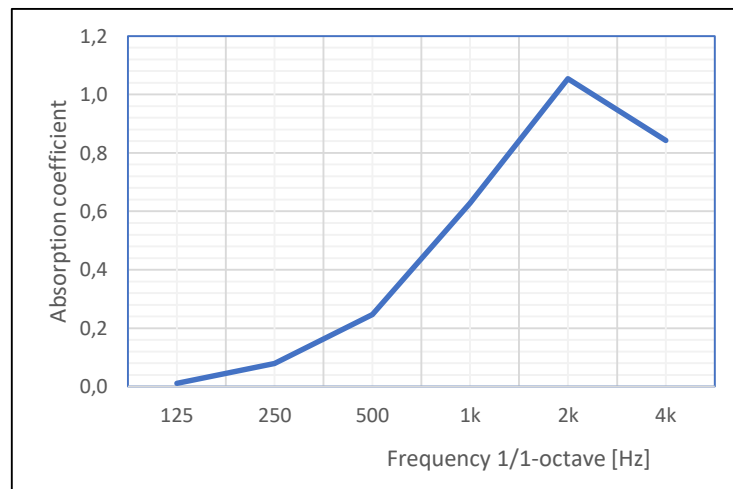
Measurement of sound absorption coefficient acc. DS/EN ISO 354:2003

Client: Acupanels International ApS Tietgensgade 7 B 7400 Herning
Date of meas. 17-04-2020
Test object AcuPanels

Mounting The 11 panels were laid out flat on the concrete floor in the reverberation test room.

Prøveareal: 15.84 m² Sab
Room volume 215 m³
Room surface area 238 m²

Freq. Hz	α_s
125	0.01
250	0.08
500	0.25
1k	0.63
2k	1.05
4k	0.84



Calculated single values according to DS/EN ISO 11654:1997

Weighted Sound Absorption Coefficient α_w	0.4 (H)
Sound Absorption class	D

Signed: 26-05-2020

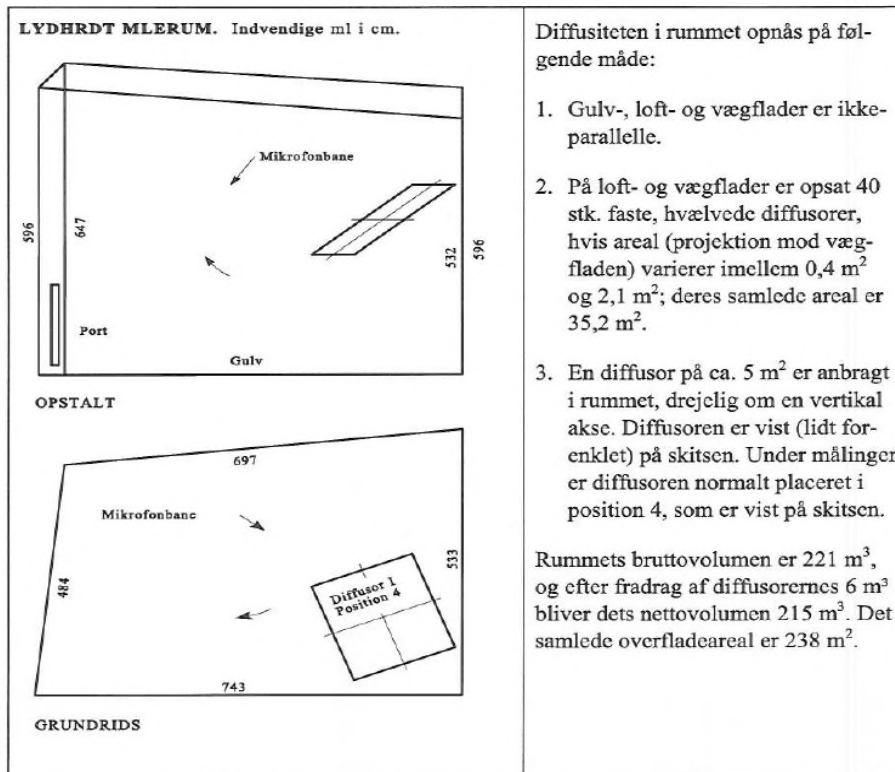
Ms.Sc. Senior Consult Birger Bech Jessen

3. Lydhårdt rum, Taastrup

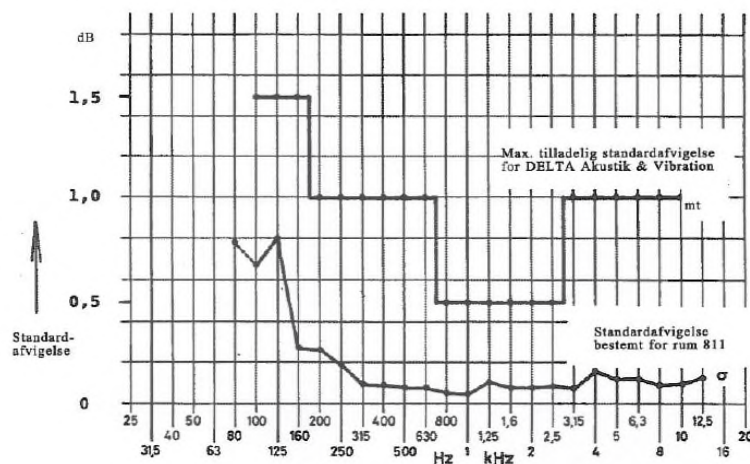
Beskrivelse af rum 811

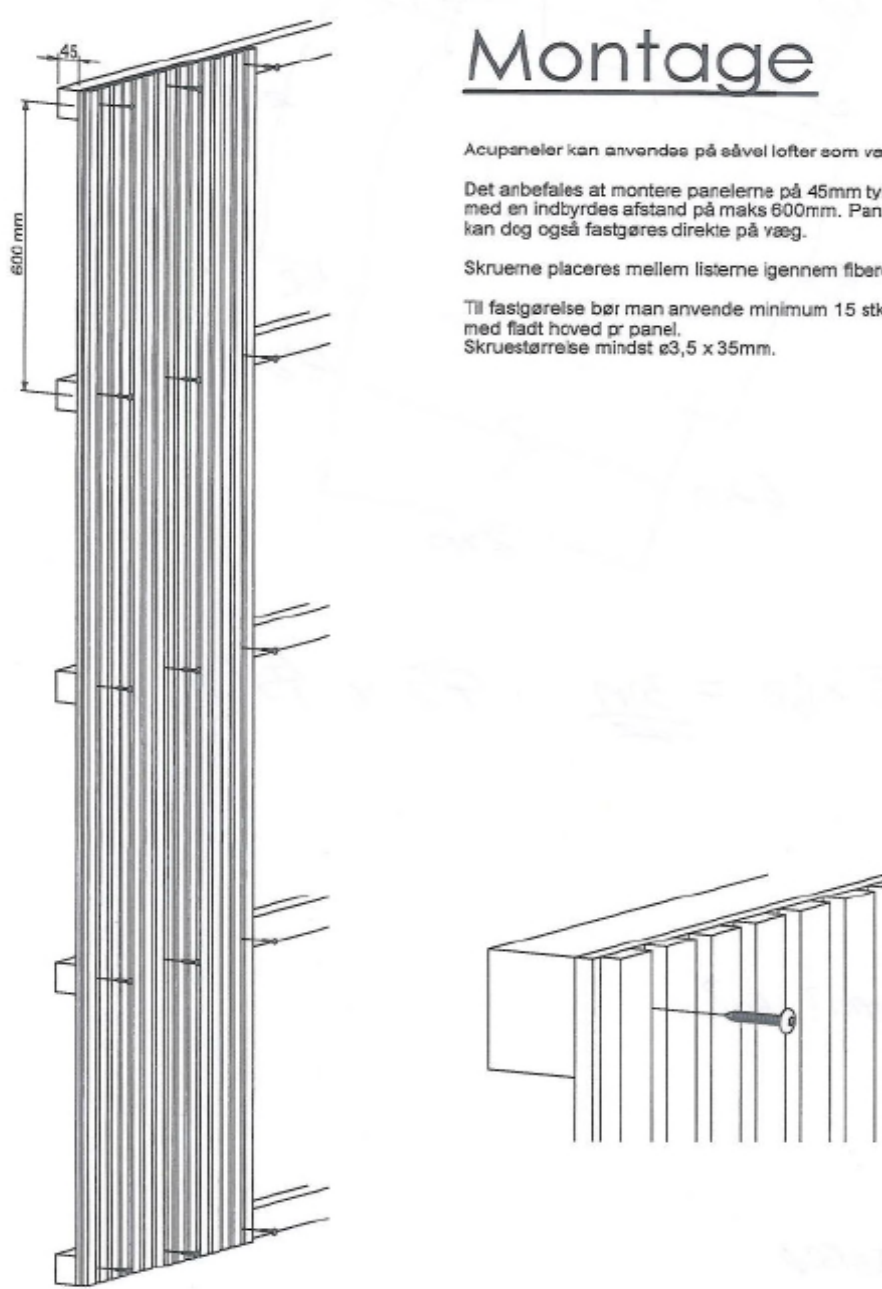
DELTA Akustik & Vibrations rum 811 er et lydhårdt målerum opbygget i 18-20 cm beton. De indvendige mål fremgår af nedenstående skitse.

Der benyttes et roterende mikrofonsystem, hvis bane ligeledes fremgår af skitsen.



De beregnede standardafvigelse σ samt de maksimalt tilladelige standardafvigelse σ_{mt} (fra Annex A) er vist grafisk nedenstående. Det ses, at DELTA Akustik & Vibrations rum 811 tilfredsstillere kriteriet i Annex A med en rigelig sikkerhedsmargin.





Montage

Acupaneler kan anvendes på såvel lofter som vægge.

Det anbefales at montere panelerne på 45mm tykke strøer med en indbyrdes afstand på maks 600mm. Panelerne kan dog også fastgøres direkte på væg.

Skrueene placeres mellem listerne igennem fiberdugen.

Til fastgørelse bør man anvende minimum 15 stk skruer med fladt hoved pr panel.
Skruestørrelse mindst $\varnothing 3,5 \times 35$ mm.

Acupaneler

2/2

Enclosure 3: Dimensions of panel components.

