UNIVERSAL ACOUSTICS BENELUX
LABORATORY FOR ACOUSTICS

MEASUREMENT OF SOUND ABSORPTION IN A REVERBERATION ROOM ACCORDING TO EN ISO 354

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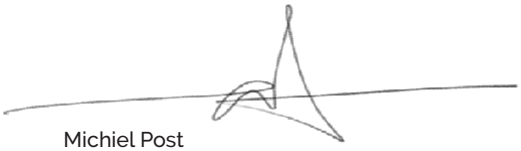
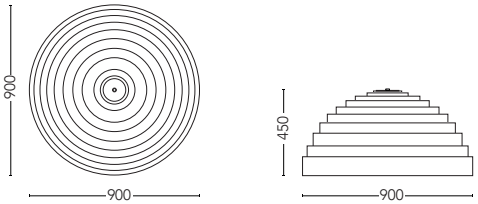
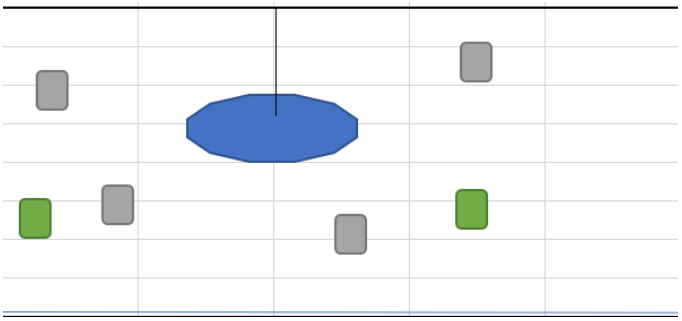
INTRODUCTION

REPORT NUMBER	# 2 1505-1054-01
DISCRIPTION	Laboratory measurements of sound absorption
TEST SPECIMEN	Acoustic Pendant Light
COLLECTION	Acoustic Design Solutions
MODEL	Dome 90
EXECUTION	Melamine foam basic white
USED STANDARD	EN ISO 354:2003. Measurement of sound absorption in a reverberation room
ISSUE DATE	02-12-2012
SIGNATURE	 Michiel Post Technical Consultant
CONTAINS	The technical-ownership of the the ISO 354:2003 accreditation falls to Universal Acoustics BeNeLux, the same way as the technical signatures of this report. The test is performed by personnel of Universal Acoustics BeNeLux. Facilities where measurements are carried out under the scope of ISO 354:20036 accreditation belong to the Acoustics Area of Universal Acoustics BeNeLux.
NUMBER OF PAGES	10

TEST SPECIMEN DISCRIPTION

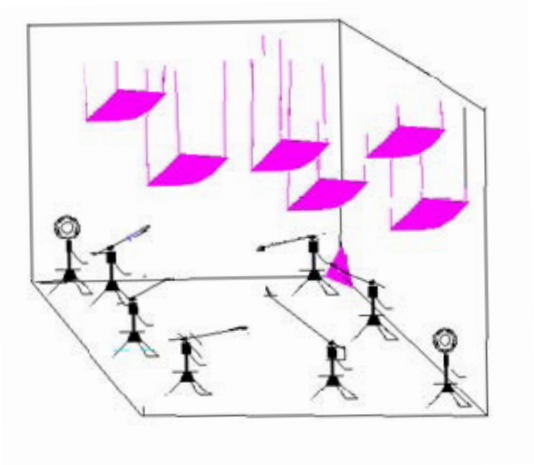
TEST SPECIMEN DESCRIPTION	The products are installed for the laboratory test in the same manner as they are typically installed in practice; - free hanging from the ceiling of the reverberation room
MODEL	Dome 90
MATERIAL	Basotect | Open cell melamine foam (9 kg/m3 of nominal density)
NOMINAL DIMENSIONS	900 x 900 x 450 mm
DRAWING OF THE MODEL	
ARRANGEMENT TEST SPECIMEN	The product was suspended from the ceiling of the testing room at a distance of 800 mm with the material faces exposed to the sound and covering a surface of 2.2 m^2, according to the following sketch.



MATERIAL SELECTED AND DELIVERED BY	Acoustic Design Solutions
APPLICANT MOUNTING PREFORMED BY	Acoustics Design Solutions
DATE OF MOUNTING	26 September 2019

LABORATORY TEST FACILITIES

The test is performed in the reverberation room. This room is a regular parallelepiped of 3.12 x 6.30 x 2.27 meters with a total surface area of 90.48 m2 (walls, floor and ceiling). The room complies with the requirements of EN ISO 354:2003.



Sketch of the reverberation room

EQUIPMENT AND TEST CONDITIONS

REVERBERATION ROOM	
MICROPHONE	NTi Audio M2230, SNo. 2175,
	(User calibrated 2019-02-18 14:07 42.8 mV/Pa)
SOUND SOURCE	NTi Audio Omni Directional Source DS3, SNo. D-1035-A0
CONTROL ROOM	
ANALYZER	XL2, SNo. A2A-05754-E0, FW4.10
CALIBRATOR	Brüel & Kjær 4231; N° 2061476
UNCERTAINTY IN THE MEASUREMENT	
OF ATMOSPHERIC CONDITIONS	
AIR TEMPREATURE	±0,5°C
AIR HUMIDITY	±5%
ATMOSPHERIC PRESSURE	2 mbar

The sound absorption coefficient (s) is calculated for the onethirdoctave band 100 Hz to 5 kHz according to standard EN ISO 354:2003, using the following formula:

$$\alpha_S = A_T / S$$

A_T	Equivalent sound absorption area of test specimen, in square metres.
S	Area covered by the test specimen, in square metres.

The equivalent sound absorption area of test specimen is calculated according to the following formula:

$$A_T = 55{,}3 \cdot V \left(\frac{1}{c_2 \cdot T_2} - \frac{1}{c_2 \cdot T_1} \right) - 4 \cdot V (m_2 - m_1)$$

V	Volume of the empty reverberation room, in cubic metres.
c_1	Propagation speed of sound in air, in metres per second, in the empty reverberation room.
c_2	Propagation speed of sound in air, in metres per second, in the reverberation room with the test specimen installed.
T_1	Reverberation time, in seconds, of the empty reverberation room
T_2	Reverberation time, in seconds, of the reverberation room with the test specimen installed.
m_1 ; m_2	Power attenuation coefficients, in reciprocal metres, calculated according to ISO 9613 1, using the climatic conditions in the reverberation room.

Reverberation time measurements are performed using equalized emission pink noise, in two omnidirectional sound source positions and six fixed microphone positions. For each microphone and source position, the reverberation time is obtained as an average of five decays in each third octave band from 100 Hz to 5 kHz.

Reverberation time measurements of the empty room and of the room with the test specimen installed are carried out consecutively.

Measuring chain is verified just before and after the execution of the test.

The guidelines indicated in the applicable internal procedures have been followed:

- PE.MCAA63E: “Procedure to determine the sound absorption in a reverberation room, according to Standard EN ISO 354”.

- PE.MCAA06M: “Procedure to manage the test specimens for acoustic tests in laboratory”.

The following results are featured for the test specimen:

- Reverberation times measured in the reverberation room without test specimen (T1) and with test specimen (T2).

- Sound absorption coefficient S, per onethird octave band from 100 Hz to 5000 Hz, in table and graph.

- The following parameters, obtained according to Standard EN ISO 11654:1997, from the sound absorption coefficient S in frequency bands:

- Practical sound absorption coefficient, pi, per onethird octave frequency bands from 125 Hz to 4000 Hz.

- Weighted sound absorption coefficient, w.

Sound absorption coefficient ISO 354:2003

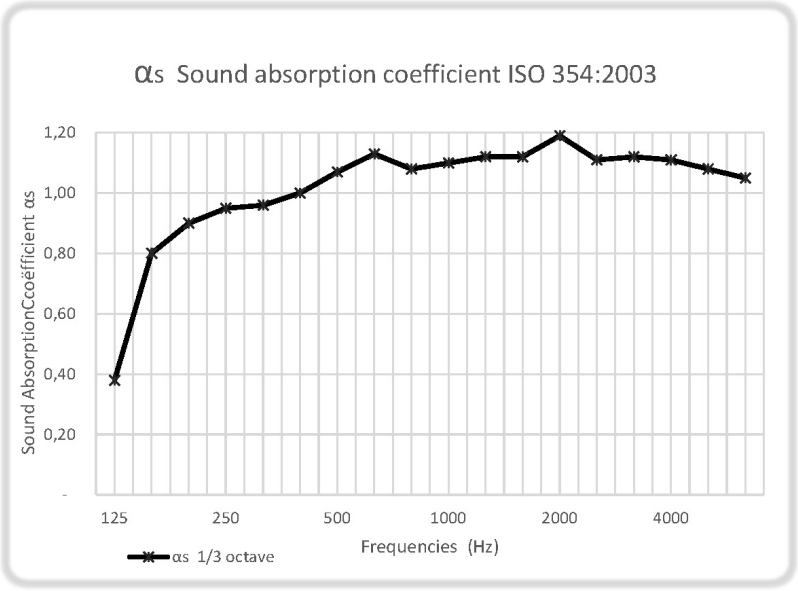
Measurement of sound absorption in reverberation rooms

Applicant: AcousticDesignSolutions
Result No:
Test date: 2nd October, 2019.
Test specimen:
Configuration: Mounting type A.
Model: **DOME 90**

Area, S, test: 2,2 m2
Volume of reverberation room: 90,48 m3
Empty room t1 : 21,7 ºC HR1 : 64 %
P1: 961 mbar
Room with the test specimen t2 : 21,9 ºC HR2 : 65 %
P2: 959 mbar

Room: E
Volume: 102
Size 2,2
Date of test 2-10-2019

	Frequency [Hz]:	αs 1/3 octave	αp octave
	100	0,38	
125	125	0,80	0,69
	160	0,90	
	200	0,95	
250	250	0,96	0,97
	315	1,00	
	400	1,07	
500	500	1,13	1,00
	630	1,08	
	800	1,10	
1000	1000	1,12	1,00
	1250	1,12	
	1600	1,19	
2000	2000	1,11	1,00
	2500	1,12	
	3150	1,11	
4000	4000	1,08	1,00
	5000	1,05	



Equivalent sound absorption area 1.0 m²
αS Sound absorption coefficient according to ISO 354
αp Practical sound absorption coefficient according to ISO 11654

Rating according to ISO 11654:
Weighted sound absorption coefficient
αw = 1

Rating according to ASTM C423:
Noise Reduction Coefficient NRC = 1

REMARKS

The test results exclusively relate to the investigated subjects and conditions described.