

## LABORATORY FOR ACOUSTICS

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

|            |   |
|------------|---|
| CLIENT     | Acoustics Design Solutions                |
| ADRESS     | Valtoeren 26<br>1505 RV Zaandam NL        |
| REPORT     | UNIVERSAL ACOUSTICS BENELUX               |
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# INTRODUCTION



REPORT NUMBER # 2 1505-1054-03

DISCRIPTION Laboratory measurements of sound absorption

TEST SPECIMEN Acoustic Pendant Light

COLLECTION Acoustic Design Solutions

MODEL Retro go

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

A handwritten signature in black ink, consisting of a long horizontal line with a stylized, looped flourish in the center.

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.

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# 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

Retro 90

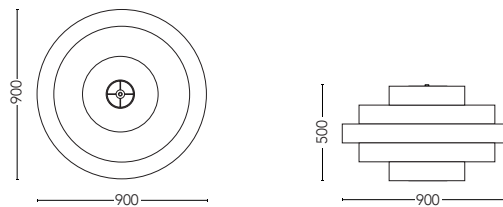
## MATERIAL

Basotect | Open cell melamine foam (9 kg/m<sup>3</sup> of nominal density)

## NOMINAL DIMENSIONS

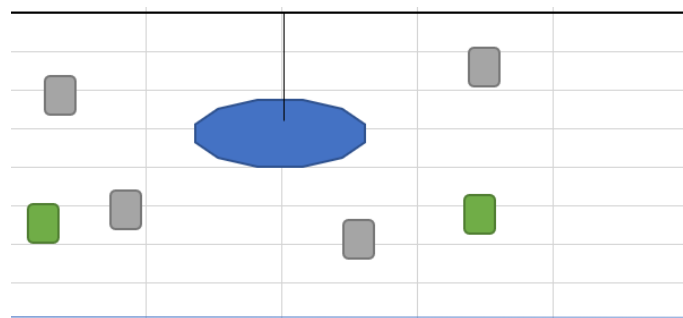
900 x 900 x 500 mm

## 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 3.0 m<sup>2</sup>, according to the following sketch.



## MATERIAL SELECTED AND DELIVERED BY

Acoustic Design Solutions

## APPLICANT MOUNTING PREFORMED BY

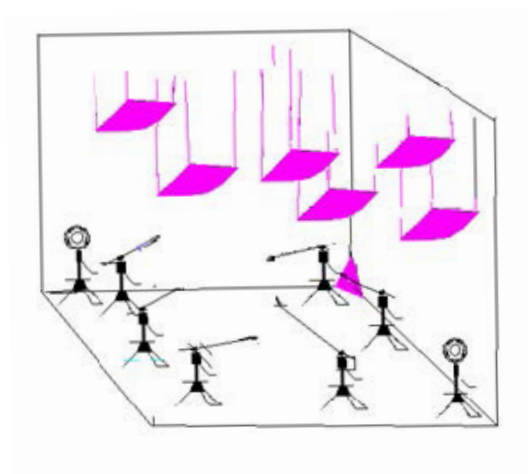
Acoustics Design Solutions

## 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 m<sup>2</sup> (walls, floor and ceiling). The room complies with the requirements of EN ISO 354:2003.



Sketch of the reverberation room

## REVERBERATION ROOM

|              |  |
|--------------|--|
| MICROPHONE   | NTi Audio M2230, SNo. 2175,<br>(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 TEMPERATURE      | $\pm 0,5^{\circ}\text{C}$ |
| AIR HUMIDITY         | $\pm 5\%$                 |
| ATMOSPHERIC PRESSURE | 2 mbar                    |

The sound absorption coefficient ( $\alpha$ ) 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: **RETRO 90**

Area, S, test: 3,05m<sup>2</sup>

Volume of reverberation room: 90,48 m<sup>3</sup>

Empty room t1 : 21,7 °C HR1 : 64 %

P1: 961 mbar

Room with the test specimen t2 : 21,9 °C HR2 : 65 %

P2: 959 mbar

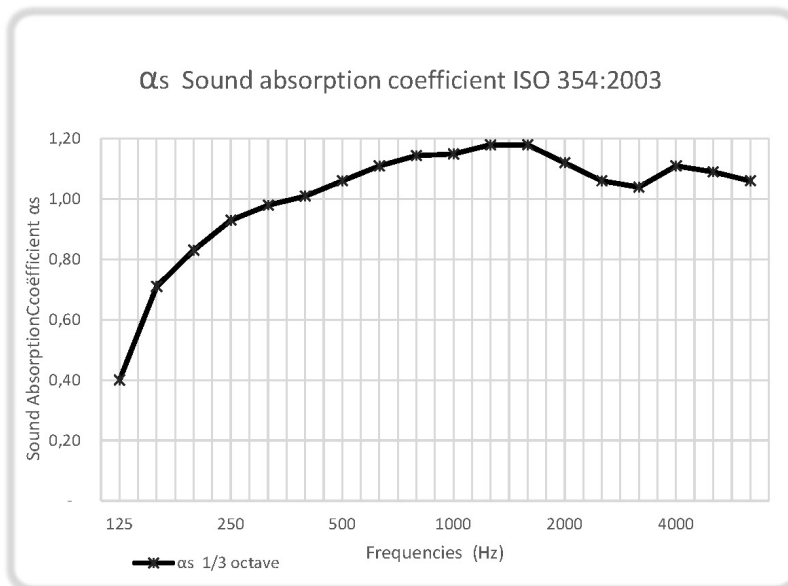
Room: E

Volume: 102

Size 3,05

Date of test 2-10-2019

| Frequency [Hz]: | $\alpha_s$ 1/3 octave | $\alpha_p$ octave |
|-----------------|-----------------------|-------------------|
| 125             | 100                   | 0,65              |
|                 | 125                   |                   |
|                 | 160                   |                   |
| 250             | 200                   | 0,97              |
|                 | 250                   |                   |
|                 | 315                   |                   |
| 500             | 400                   | 1,00              |
|                 | 500                   |                   |
|                 | 630                   |                   |
| 1000            | 800                   | 1,00              |
|                 | 1000                  |                   |
|                 | 1250                  |                   |
| 2000            | 1600                  | 1,00              |
|                 | 2000                  |                   |
|                 | 2500                  |                   |
| 4000            | 3150                  | 1,00              |
|                 | 4000                  |                   |
|                 | 5000                  |                   |



Equivalent sound absorption area 1.0 m<sup>2</sup>

$\alpha_s$  Sound absorption coefficient according to ISO 354

$\alpha_p$  Practical sound absorption coefficient according to ISO 11654

Rating according to ISO 11654:  
**Weighted sound absorption coefficient**  
 $a_w = 1$

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

## REMARKS



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

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