# *JOCAVI* – Consultadoria e Design em Acústica, Lda.

## Sintra, Portugal

## DETERMINATION OF SOUND ABSORPTION COEFFICIENTS

### *Convexabsorber*

May 2005

## 1 - DESCRIPTION

As requested by the company *JOCAVI – Consultadoria e Design em Acústica, Lda.* (Centro Empresarial LusoWorld edif. 22, Rua Pé de Mouro, Capa Rota, P-2710 Sintra, Portugal) this Laboratory of Acoustics has proceded to a series of measurements to determine the sound absortion per units ($\alpha_S$) of the system/material commercialy known as **Convexabsorber**.

## 2 - METHOD

### 2.1 – Sample and date

The sample, with a total area of 12.22 m$^2$ (six panels of 1.145 x 1.800 m$^2$ each), as placed on the floor of the reverberation room (Fig 1) and tested on May 5, 2005.
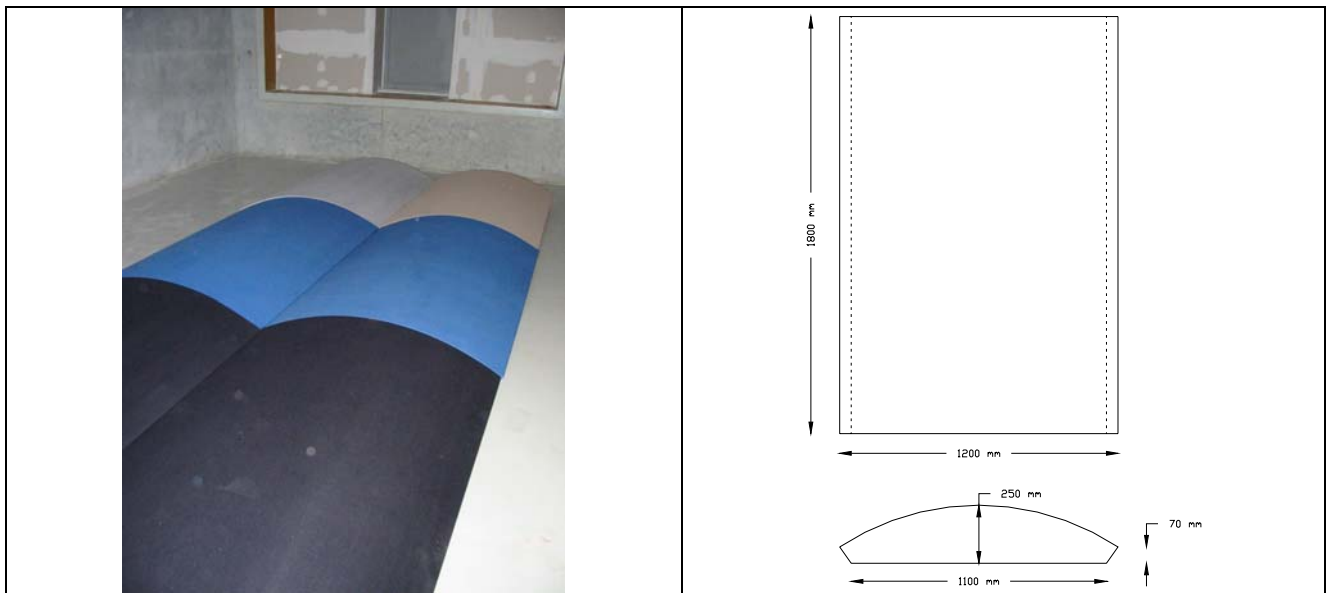


Fig. 1 (left) – Sample and test assembly on the reverberant room; Fig. 2 (right) – Panel's dimensions (according to the manufacter's online catalogue: *www.jocavi.net*).

### 2.2 - Parameters

The determination of the sound absortion per units ($\alpha_S$) was done by measuring the reverberation time of the reverberant room *R1* of the Laboratory of Acoustics of the Institute of Construction of the Faculty of Engineering of the University of Porto with and without the studying sample (in accordance with *EN 20354 / ASTM C423*). The 95% confidence limits for the uncertainty of the sound absorption coefficients limits were also determined.

### 2.3 - Measurement Positions

Twenty-seven (27) measurements were used as followed:
• Three positions of the sound source;

- Three positions for the microphone;
- Three measurements for each microphone position.

## 2.4 - Characteristics of the reverberant room

The receiving reverberant room (R1) has the following dimensions:
   Average length = 7.25 m;   Average width= 5.88 m;   Height = 4.65 m;   Volume = 216 m$^3$

The atmospheric conditions in the receiving room during the measurements were the following:
   Air temperature = 18 ºC          Relative air humidity = 69%

During the measurements the room was empty of persons or any extra objects.

## 2.5 - Equipment

The equipment and the measurement procedure used were in accordance with the applicable standards: Sound level meter *B&K 2260* nº 2168642 (verif. in ISQ - Certified nº 25310/04 of 03/09/2004); Calibrator *B&K 4231* nº 2176164 (verif. in ISQ - Cert. nº 25310/04 of 03/09/2004); ½ inch microphone, *Brüel & Kjaer*, model *4189*; Sound source, *Brüel & Kjaer Type 4224*; Termo-Higrometer *Wm HTA 4200.*

## 3 - RESULTS

Table 1 presents a global analysis of the obtained values for the sound absorption coefficients ($\alpha_{S,average}$) and the average reverberation times (*RT*) of the room with and without the sample in study, for all the normative frequencies (one-third octave bands). The existence of $\alpha_S$ values larger than the unit is due to usual calculation particularities as set in the *EN 20354 / ASTM C423*. The table also presents the values for the uncertainty of the sound absorption coefficients using 95% confidence limits, as in *ASTM C423*. Table 2 presents the values for the global parameters *NRC* (*Noise Reduction Coefficient*) and $\alpha_W$ (*Weighted Sound Absorption Coefficient*, as in *EN 11654*).

Table 1 – Summary of results (*RT*, $\alpha_{S,average}$ and $\Delta\alpha_S$)

($\alpha_S = \alpha_{S,\,average} \pm \Delta\alpha_S$)

| *Convexabsorber* | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Freq. (Hz)** | **100** | **125** | **160** | **200** | **250** | **315** | **400** | **500** | **630** | **800** | **1k** | **1.25k** | **1.6k** | **2k** | **2.5k** | **3.15k** | **4k** | **5k** |
| *RTref$^{average}$*(s) | 12.23 | 12.62 | 11.77 | 11.10 | 11.02 | 12.82 | 12.85 | 12.20 | 11.32 | 10.47 | 9.36 | 8.34 | 7.21 | 6.32 | 5.57 | 4.63 | 3.46 | 2.69 |
| *RTsample$^{average}$*(s) | 3.73 | 2.68 | 2.25 | 2.08 | 2.45 | 2.88 | 2.59 | 2.55 | 2.73 | 2.77 | 2.78 | 2.73 | 2.67 | 2.47 | 2.33 | 2.14 | 1.85 | 1.55 |
| $\alpha_{S,average}$ | 0.53 | 0.84 | 1.03 | 1.12 | 0.91 | 0.77 | 0.88 | 0.89 | 0.79 | 0.76 | 0.72 | 0.70 | 0.68 | 0.71 | 0.71 | 0.72 | 0.72 | 0.78 |
| $\Delta\alpha_S$ | 0.05 | 0.06 | 0.03 | 0.07 | 0.05 | 0.03 | 0.02 | 0.02 | 0.02 | 0.01 | 0.01 | 0.02 | 0.01 | 0.02 | 0.02 | 0.03 | 0.03 | 0.03 |

Table 2 – *NRC* and $\alpha_W$ global parameters.

| | **NRC** | **$\alpha_W$** |
|---|---|---|
| *Convexabsorber* | 0.80 | 0.75 |

By special request of the client, Table 3 shows the obtained values for the sound absortion coefficients ($α_{S,average}$) and the uncertainty ($Δα_S$) using 95% confidence limits, as in *ASTM C423*, for non-normative frequencies. The Fig. 3 shows the measured $α_{S,average}$ in graph form.

Table 3 – Summary of results ($α_{S,average}$ and $Δα_S$) at frequencies other than the normative.
($α_S = α_{S, average} ± Δα_S$)

| Convexabsorber | | | | | | | |
|---|---|---|---|---|---|---|---|
| Freq. (Hz) | 50 | 63 | 80 | | 6,3k | 8k | 10k |
| $α_{S,average}$ | 0.25 | 0.28 | 0.18 | | 0.87 | 0.82 | 1.03 |
| $Δα_S$ | 0.02 | 0.02 | 0.03 | | 0.03 | 0.06 | 0.08 |

Fig. 3 – Sound absortion coefficients ($α_{S,average}$) for *Convexabsorber* presented in the form of a graph at the normative 1/3 octave frequency bands.
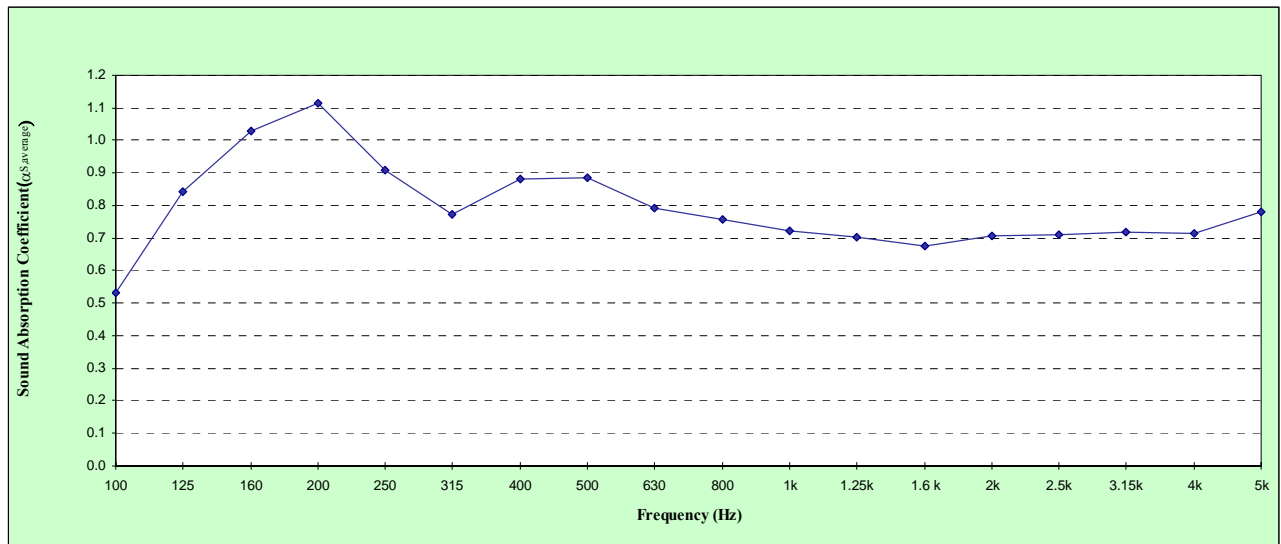


Porto and F.E.U.P., May 24, 2005.

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