ACOUSTIC STUDY

DETERMINATIVE STUDY ON THE ACOUSTIC ABSORPTION VALUESOF THE **DUO** AND **SLIM** PANELS BY JG GROUP

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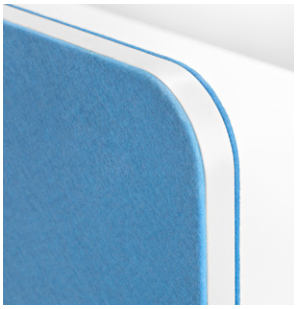
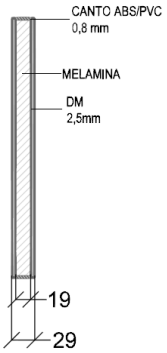
DESCRIPTION OF THE PANELS

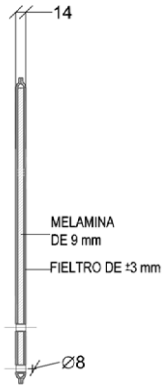
The upholstered panels to be tested act as a partition between personal spaces at workstations. These panels possess the innovation of acoustic upholstery that provides them with certain acoustic properties, acting as a screen and noise absorber.

The **DUO** panel is made up of a 19mm-thick melamine chipboard panel with a 2.5mm-thick sheet of MDF covering each surface, finished with a 0.8mm-thick felt covering.





The **SLIM** panel is made up of an 8mm-thick melamine board, covered on each side by 3mm-thick woven felt fabric.



The difference in thickness and density between both finished fabrics means that some small differences in the final results can be anticipated.

The surface fabric has useful properties for sound diffraction, and in helping to generate a diffuse field of reduced energy.

DESCRIPTION OF THE MEASUREMENTS

Six measurements were made for each of the room configurations (empty, bare melamine panel, DUO panel and SLIM panel). The measurements were made on 29 December 2014 at the JG GROUP premises, using a CESVA SC-310 type 1 sound level meter with its corresponding type approval and initial and periodical verification tests. The room is of a small size, with a volume of 44.4m3 and a total surface area of 86.3m2, made up of different materials. The average background noise during the measurements was around L_{eqA}=32.4 dBA.

RESULTS OBTAINED

The reverberation time, according to the Sabine formula, is related to the overall absorption of the testing room and its volume.

$$T_{60} = 0{,}163 \cdot \frac{V}{S_{eq}}$$

where;

T_{60}: Reverberation time, for a given frequency, is the number of seconds that it takes the mean sound pressure level in a closed area (that has originally been in a stable state) to drop to 60 dB after the source of noise has been cut off.

V : Volume of the testing room, in m^3.

S_{eq} : Equivalent area, total absorption of the sound in the enclosed area in metric Sabins.

$$S_{eq} = \alpha \cdot A$$

where;

S_{eq} : Equivalent area, total absorption of the sound in the enclosed area in metric Sabins.

α: Absorption rate, different for each material, dimensionless; $0 < \alpha < 1$.

A : Absorption area, in m2.

The average mean reverberation times in the different configurations (empty room, melamine panel, DUO panel and SLIM panel) are shown in the following table.

	Empty room	Melamine	S-DUO	SLIM
Hz (1/3)	T60 (s)	T60 (s)	T60 (s)	T60 (s)
50	1.63	1.59	1.58	1.50
63	1.79	1.71	1.76	1.69
80	1.71	1.65	1.64	1.55
100	1.42	1.38	1.37	1.29
125	1.83	1.77	1.79	1.63
160	2.25	2.12	2.21	1.93
200	1.42	1.38	1.36	1.32
250	1.33	1.28	1.27	1.20
315	1.33	1.29	1.22	1.17
400	1.46	1.41	1.30	1.14
500	1.67	1.60	1.39	1.24
630	1.54	1.49	1.24	1.01
800	1.25	1.21	1.02	0.82
1000	1.08	1.05	0.89	0.74
1250	1.21	1.17	0.94	0.78
1600	1.21	1.17	0.94	0.77
2000	1.33	1.28	1.03	0.83
2500	1.38	1.32	1.04	0.81
3150	1.42	1.35	1.06	0.83
4000	1.42	1.36	1.06	0.84
5000	1.42	1.35	1.05	0.83

Panel	Empty	Melamine	S-DUO	SLIM
RT60 (s)	1.35	1.31	1.15	1.00

From the first series of data on reverberation times, the equivalent absorbent area from the empty room can be obtained.

Hz (1/3)	Room S_{eq} of the room (m^2)
50	4.34
63	3.84
80	4.08
100	4.98
125	3.80
160	3.02
200	4.96
250	5.21
315	5.25
400	4.79
500	4.17
630	4.52
800	5.61
1000	6.50
1250	5.80
1600	5.79
2000	5.21
2500	5.02
3150	4.87
4000	4.89
5000	4.85

Panel	Melamine	S-DUO	SLIM
S (m^2)	2.18	2.48	4.29

Starting with the values obtained from the reverberation time measurements and the areas introduced in the subsequent measurements, the acoustic absorption values are obtained for the different materials being tested.

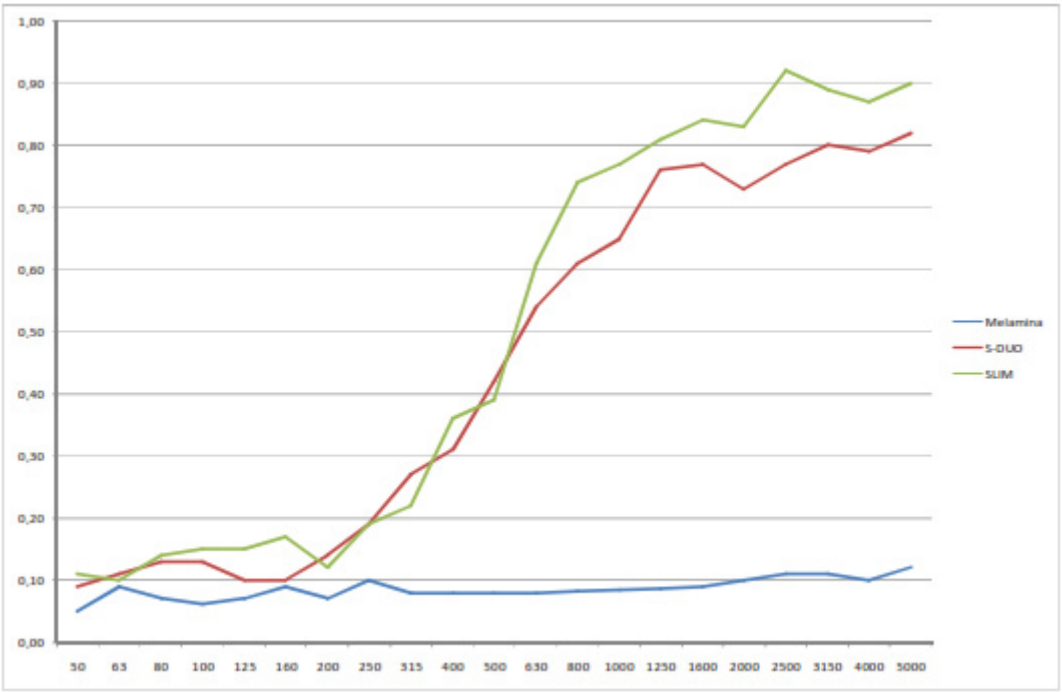
The calculated acoustic absorption values are presented in the following table.

	α_i		α_i		α_i	
	Melamine		S-DUO		SLIM	
Hz	1/3	1/1	1/3	1/1	1/3	1/1
50	0.05		0.09		0.11	
63	0.09	0.07	0.11	0.11	0.10	0.12
80	0.07		0.13		0.14	
100	0.06		0.13		0.15	
125	0.07	0.07	0.10	0.11	0.15	0.16
160	0.09		0.10		0.17	
200	0.07		0.14		0.12	
250	0.10	0.08	0.19	0.20	0.19	0.18
315	0.08		0.27		0.22	
400	0.08		0.31		0.36	
500	0.08	0.08	0.42	0.42	0.39	0.45
630	0.08		0.54		0.61	
800	0.08		0.61		0.74	
1000	0.09	0.08	0.65	0.67	0.77	0.77
1250	0.09		0.76		0.81	
1600	0.09		0.77		0.84	
2000	0.10	0.10	0.73	0.76	0.83	0.86
2500	0.11		0.77		0.92	
3150	0.11		0.80		0.89	
4000	0.10	0.11	0.79	0.80	0.87	0.89
5000	0.12		0.82		0.90	

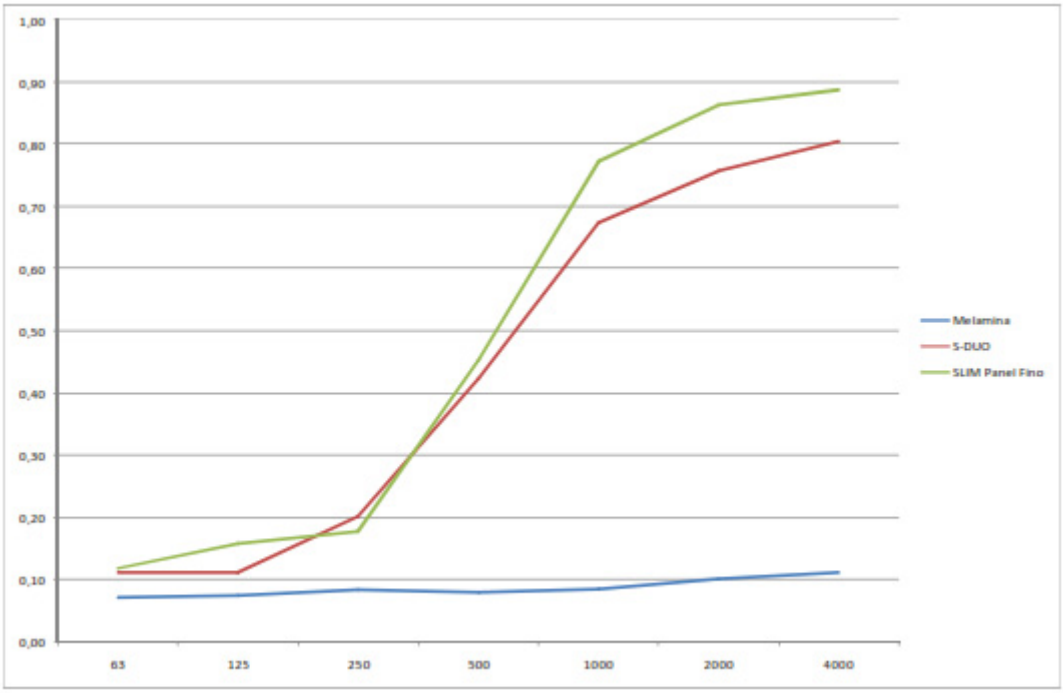
The resulting average overall absorption values are as follows:

Panel	Melamine	S-DUO	SLIM
α_i	0.09	0.51	0.57

The graphical representation of these values is shown below, broken down by 1/3-octave bands.



broken down by full-octave bands.



ACOUSTIC PROBLEMS IN OFFICES: EVALUATION OF THE DATA OBTAINED AND DISCUSSION

In workplaces, an acceptable sound environment is recommended in order to minimise errors, distractions, communication interference or psychological disturbances.

In the case of noise generated by people, this would be difficult to minimise, as it would be necessary to **do something about the means of propagation and the environment** (reducing in reverberation time, increasing acoustic absorption). The latest trends in offices are heading towards open spaces with large volumes and large, smooth, glazed surfaces. These characteristics increase the **reverberation time** of rooms, and may be a nuisance to the people inside them.

In relation to **reverberation time** in offices, the recommendation is that the following values (in seconds) are not exceeded. The interior sound levels at a given location may be gently reduced, introducing absorbent material into the room and **reducing the reverberated sound field**.

$$\Delta L = 10 \cdot \log \frac{T_O}{T_f}$$

where;

ΔL: Improvement in the sound level, in decibels.

T_O: Initial reverberation time.

T_f: Final reverberation time.

Based on the acoustic absorption results obtained, and in comparison with the bare melamine panels, some conclusions may be inferred.

At **low frequencies**, the behaviour is very similar, and we cannot say that either of the two panels is highly absorbent.

At **medium frequencies**, the structure and felt covering improves the performance of both panels compared to the uncovered material. The SLIM panel distinguishes itself with somewhat superior values at frequencies of 800 to 1250 Hz. The levels in this section are **medium-high (0.5<α<0.8)**

At **high frequencies**, the absorption is much greater than that of the uncovered panels, and the differences remain between the S-DUO and SLIM panels. Their behaviour is very favourable above 2000 Hz, with **high absorption values (α<0.80)**.

The UNE-EN ISO 11654 standard establishes a **classification of absorption characteristics**; thus, the weighted coefficient of sound absorption, αWp, remains at 0.4 (M)(H) for both panels. The notation (M)(H) refers to the behaviour at medium and high frequencies being above the reference curve (favourable behaviour). With this value, the material would be classified as **class D - Absorbent**.

α_{Wp} value	Acoustic absorption class (based on EN ISO 11654)	Absorption class (based on VDI 3755/2000)
0.90; 0.95; 1.00	A	extremely absorbent
0.80; 0.85	B	extremely absorbent
0.60; 0.65; 0.70; 0.75	C	very absorbent
0.30; 0.35; 0.40; 0.45; 0.50; 0.55	D	absorbent
0.15; 0.20; 0.25	E	low absorbency
0.05; 0.10	not classified	reflective

Note: the parameters α_{Wp}, α_m, *and* α_i do not represent the same thing.

The range of office desk partitions can contribute to **sensitively reducing underlying noise levels and reverberation time** within the space, as well as improving the intelligibility of conversations. They provide adequate absorption at **medium and high frequencies** - those which are most common in office environments.

In comparison with melamine partitions, the advantages are clear for the ranges studied, and this suggests the possibility of incorporating absorbent material **without having to carry out refurbishment work.**

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APPENDIX: PHOTOGRAPHS OF THE TESTS