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TEST REPORT No. 300259

Place and date of issue: Bellaria-Igea Marina - Italy, 26/11/2012

Customer: CAIMI BREVETTI S.p.A. - Via Giacomo Brodolini, 25/27 - 20834 NOVA MILANESE (MB) - Italy

Date test requested: 12/07/2012

Order number and date: 57039, 16/07/2012

Date specimen received: 12/11/2012

Test date: 13/11/2012

Purpose of test: measurement in reverberation room of the sound absorption coefficient " α_s " and weighted sound absorption coefficient " α_w " of a suspended ceiling in accordance with standard UNI EN ISO 354:2003

Test site: Istituto Giordano S.p.A. - Via Erbosa, 78 - 47043 Gatteo (FC) - Italy

Specimen origin: sampled and supplied by the Customer

Identification of specimen received: No. 2012/2355

Specimen name*

The test specimen is called "MITESCO two-faced modular panels installed with a rear air space of 200 mm".



LAB N° 0021

This test report consists of 10 sheets and 1 annex.

This document is the English translation of the test report No. 300259 dated 26/11/2012 issued in Italian.

Date of translation: 21/05/2013.

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Description of specimen*

The test specimen is a suspended ceiling, open on all 4 sides, formed by fitting together 16 MITESCO two-faced modular panels and having the physical characteristics specified in the following table.

| | |
|--|------------------------|
| Measured length of specimen | 3537 mm |
| Measured width of specimen | 3182 mm |
| Measured thickness of air space beneath specimen | 200 mm |
| Specimen effective sound-absorbing area (3537 × 3182 mm) | 11,25 m ² |
| Measured length of two-faced modular panel | 1587 mm |
| Measured width of two-faced modular panel | 438 mm |
| Maximum measured thickness of two-faced modular panel | 37 mm |
| Surface area of two-faced modular panel (1587 × 438 mm) | 0,70 m ² |
| Measured weight of two-faced modular panel | 2,338 kg |
| Mass per unit area of two-faced modular panel (2,338 kg ÷ 0,70 m²) | 3,34 kg/m ² |

More specifically, each two-faced modular panel comprises:

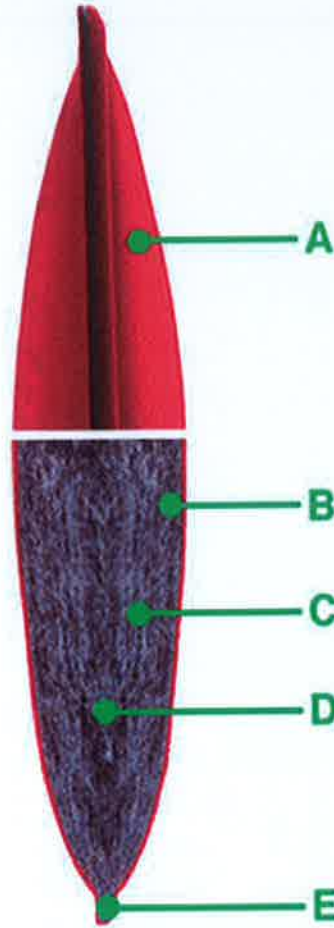
- polyester-fabric facing, nominal thickness 0,75 mm and nominal mass per unit area 300 g/m², bonded to the padded core using PE-based adhesive, nominal quantity 50 g/m²;
- padded core of variable-density polyester fibre, maximum nominal thickness 35 mm and nominal mass per unit area 2,65 kg/m²;
- 2 rows of holes arranged close to the panel's shortest side, each comprising 5 holes, drilled to enable insertion of the plastic support brackets hinged to the panel, nominal size 145 × 25 mm.

In order to recreate the air gap beneath the specimen, each two-faced modular panel rests on brackets, nominal size 200 × 200 × 200 mm, made from perforated steel sheet, nominal thickness 1 mm and nominal percentage of open area 56 %.

The Customer-manufactured specimen was installed in the reverberation room by Istituto Giordano staff.



(*) according to that stated by the Customer, apart from characteristics specifically stated to be measurements.



Key

| Symbol | Description |
|--------|---|
| A | Polyester-fabric facing |
| B | Layer of high-density polyester fibre |
| C | Layer of medium-density polyester fibre |
| D | Layer of low-density polyester fibre |
| E | Stiff edge |





Specimen photo

Normative References

The test was carried out in accordance with standard UNI EN ISO 354:2003 dated 01/12/2003 "Acustica - Misura dell'assorbimento acustico in camera riverberante" (*"Acoustics. Measurement of sound absorption in a reverberation room"*).



Test apparatus

The following equipment was used to carry out the test:

- Behringer "EPX2000" 2000 W power amplifier;
- Behringer DEQ2496 digital 1/3-octave equaliser;
- 2 omnidirectional speakers;
- 01 dB-Stell Symphonie 2-channel real-time analyser;
- 01 dB-Stell Cal21 acoustic calibrator for microphone calibration;
- G.R.A.S. Sound & Vibration 40AR 1/2" random-incidence microphone;
- G.R.A.S. Sound & Vibration 26AK microphone preamplifiers;
- Kern VB 150 K 50LM electronic platform scale;
- Sola Tri-Matic 5 m/19 mm metric tape measure;
- Bosch DLE 50 Professional laser rangefinder;
- Delta Ohm HD206-2/HD206S1 temperature and humidity logger with combined probe;
- complementary accessories.

Test method

The test was carried out using detailed internal procedure PP016 revision 7 dated 06/12/2011 "Misura dell'assorbimento acustico in camera riverberante (metodo del rumore interrotto)" (*"Measurement of sound absorption in a reverberation room (interrupted noise method)"*).

The test environment consists of a parallelepiped-shaped reverberation room with a rectangular base whose dimensions are given in the following table:

| | |
|---|----------------------|
| Plan-view dimensions | 8,111 × 6,744 m |
| Height "H" | 4,003 m |
| Base surface area "S_b" | 54,7 m ² |
| Total surface area "S_t" | 228,3 m ² |
| Volume of room | 218,9 m ³ |
| Net volume of room "V" | 218,8 m ³ |



All surfaces of the test room were treated in such a way as to produce maximum sound reverberation; in addition, 14 slightly-curved diffusing elements having an overall surface area, including both faces, of approx. 40 m² were arranged and oriented randomly.

After conditioning for at least 12 hours inside the measuring rooms, the specimen was installed on the floor in the middle of the reverberation room. It was also ensured that the sides of the specimen were not parallel to the walls of the reverberation room and were situated at a distance of not less than 1 m from said walls and every microphone position.

The test involves measuring reverberation times of the empty reverberation room "T₁" and reverberation room containing the specimen "T₂" in order to determine said specimen's sound absorption coefficient "α_s". The reverberation time "T" corresponds to the time taken in seconds for the sound pressure level to decay 60 dB after the sound has stopped.

Measurements were taken in 1/3 -octave bands within the range 100 Hz to 5000 Hz using the interrupted noise method.

The test utilised a pink-noise generator, power amplifier and two dodecahedral omnidirectional speakers, operating simultaneously for each one of the six microphone positions, such as to measure six decays in sound pressure level for each frequency band.

The sound absorption coefficient "α_s" was calculated using the following equations:

$$\alpha_s = \frac{A}{S}$$

$$A = A_2 - A_1 = 55,3 \cdot V \cdot \left(\frac{1}{c_2 \cdot T_2} - \frac{1}{c_1 \cdot T_1} \right) - 4 \cdot V \cdot (m_2 - m_1)$$

$$c_2 = 331 + 0,6 \cdot t_2$$

$$c_1 = 331 + 0,6 \cdot t_1$$

where: α_s = sound absorption coefficient;

A = equivalent sound absorption area of the test specimen, in square metres;

S = the area, in square metres, covered by the test specimen;



A_2 = equivalent sound absorption area, in square metres, of the reverberation room after the test specimen has been introduced;

A_1 = equivalent sound absorption area, in square metres, of the empty reverberation room;

V = effective volume, in cubic metres, of the empty reverberation room;

c_2 = propagation speed of sound in air, in metres per second, of the reverberation room after the test specimen has been introduced;

T_2 = reverberation time, in seconds, of the reverberation room after the test specimen has been introduced;

c_1 = propagation speed of sound in air, in metres per second, of the empty reverberation room;

T_1 = reverberation time, in seconds, of the empty reverberation room;

m_2 = sound power attenuation coefficient, in reciprocal metres, calculated according to standard UNI ISO 9613-1:2006 dated 07/09/2006 "Acoustics - Attenuation of sound during propagation outdoors - Part 1: Calculation of the absorption of sound by the atmosphere", using the climatic conditions present in the reverberation room since the test specimen was introduced;

m_1 = sound power attenuation coefficient, in reciprocal metres, calculated according to standard UNI ISO 9613-1:2006 using the climatic conditions present in the empty reverberation room during the measurement;

t_2 = air temperature, in degrees Celsius, in the reverberation room after introducing the test specimen;

t_1 = air temperature, in degrees Celsius, in the empty reverberation room.

The test was performed immediately after completion of specimen preparation.



Uncertainty of measurement

Uncertainty of measurement was determined in accordance with standard UNI CEI ENV 13005:2000 dated 31/07/2000 "Guida all'espressione dell'incertezza di misura" ("Guide to the expression of uncertainty in measurement"), by calculating for each frequency the number of effective degrees of freedom " ν_{eff} " and expanded uncertainty "U" of the sound absorption coefficient " α_s ", using a coverage factor "k" representing a confidence level of 95 %.

Uncertainty of measurement of the weighted sound absorption coefficient " $U(\alpha_w)$ " is calculated with a coverage factor $k = 2$ representing a confidence level of 95 %.

Classification has been determined on the basis of value " α_w ", obtained by rounding off the measurement, in line with clause 2.6 ILAC-G8:03/2009 "Guidelines on the reporting of compliance with specification", having met the requirements specified in the test standard regarding measurements, equipment and rounding off.

Environmental conditions during test

| | Test without specimen | Test with specimen |
|--------------------------------|-----------------------|--------------------|
| Date performed | 13/11/2012 | 13/11/2012 |
| Atmospheric pressure | 102600 Pa | 102600 Pa |
| Ambient temperature "t" | 21,4 °C | 21,1 °C |
| Relative humidity | 66,3 % | 67,3 % |



Test results

| | |
|--|----------------------|
| Specimen mounting method | E |
| Volume of reverberation room "V" | 218,8 m ³ |
| Area covered by the test specimen "S" | 11,25 m ² |
| Speed of sound "c₁" at the temperature "t₁" | 343,8 m/s |
| Speed of sound "c₂" at temperature "t₂" | 343,7 m/s |

| Frequency [Hz] | T ₁ [s] | T ₂ [s] | 4 · V · (m ₂ - m ₁) [m ²] | A [m ²] | α _s | v _{eff} | k | U |
|-------------------|-----------------------|-----------------------|---|------------------------|----------------|------------------|------|------|
| 100 | 7,80 | 5,92 | 0,0 | 1,4 | 0,12 | 21 | 2,00 | 0,03 |
| 125 | 7,40 | 5,38 | 0,0 | 1,8 | 0,16 | 21 | 2,00 | 0,03 |
| 160 | 8,01 | 4,18 | 0,0 | 4,0 | 0,36 | 16 | 2,00 | 0,04 |
| 200 | 8,99 | 4,44 | 0,0 | 4,0 | 0,36 | 12 | 2,00 | 0,07 |
| 250 | 9,33 | 3,34 | 0,0 | 6,8 | 0,60 | 12 | 2,00 | 0,06 |
| 315 | 8,45 | 2,58 | 0,0 | 9,5 | 0,84 | 14 | 2,00 | 0,04 |
| 400 | 8,27 | 2,37 | 0,0 | 10,6 | 0,94 | 18 | 2,00 | 0,03 |
| 500 | 7,05 | 2,05 | 0,0 | 12,2 | 1,08 | 13 | 2,00 | 0,05 |
| 630 | 6,01 | 1,99 | 0,0 | 11,8 | 1,05 | 12 | 2,00 | 0,08 |
| 800 | 5,40 | 1,93 | 0,0 | 11,7 | 1,04 | 16 | 2,00 | 0,04 |
| 1000 | 5,32 | 1,91 | 0,0 | 11,8 | 1,05 | 12 | 2,00 | 0,07 |
| 1250 | 4,71 | 1,71 | 0,0 | 13,1 | 1,16 | 14 | 2,00 | 0,09 |
| 1600 | 4,43 | 1,68 | 0,0 | 13,0 | 1,16 | 15 | 2,00 | 0,05 |
| 2000 | 4,04 | 1,58 | 0,0 | 13,6 | 1,21 | 22 | 2,00 | 0,03 |
| 2500 | 3,79 | 1,54 | 0,0 | 13,6 | 1,21 | 19 | 2,00 | 0,03 |
| 3150 | 3,41 | 1,49 | 0,0 | 13,3 | 1,18 | 17 | 2,00 | 0,03 |
| 4000 | 3,11 | 1,42 | 0,0 | 13,5 | 1,20 | 19 | 2,00 | 0,04 |
| 5000 | 2,67 | 1,34 | 0,0 | 13,1 | 1,16 | 16 | 2,00 | 0,04 |



ANNEX "A" TO TEST REPORT No. 300259

Place and date of issue: Bellaria-Igea Marina - Italy, 26/11/2012

Customer: CAIMI BREVETTI S.p.A. - Via Giacomo Brodolini, 25/27 - 20834 NOVA MILANESE (MB) - Italy

Purpose: calculation of the weighted sound absorption coefficient " α_w " in accordance with standard UNI EN ISO 11654:1998 "Acustica - Assorbitori acustici per l'edilizia - Valutazione dell'assorbimento acustico" ("*Acoustics - Sound absorbers for use in buildings - Rating of sound absorption*")

| Frequency [Hz] | α in $\frac{1}{3}$ octaves | α_p^* in octave bands (approximate value at 0,05 with maximum value of 1,00) | Reference curve |
|-------------------|--------------------------------------|--|-----------------|
| 100 | 0,12 | | |
| 125 | 0,16 | 0,20 | |
| 160 | 0,36 | | |
| 200 | 0,36 | | |
| 250 | 0,60 | 0,60 | 0,70 |
| 315 | 0,84 | | |
| 400 | 0,94 | | |
| 500 | 1,08 | 1,00 | 0,90 |
| 630 | 1,05 | | |
| 800 | 1,04 | | |
| 1000 | 1,05 | 1,00 | 0,90 |
| 1250 | 1,16 | | |
| 1600 | 1,16 | | |
| 2000 | 1,21 | 1,00 | 0,90 |
| 2500 | 1,21 | | |
| 3150 | 1,18 | | |
| 4000 | 1,20 | 1,00 | 0,80 |
| 5000 | 1,16 | | |

$$(*) \alpha_{pi} = \frac{\alpha_{i1} + \alpha_{i2} + \alpha_{i3}}{3}$$



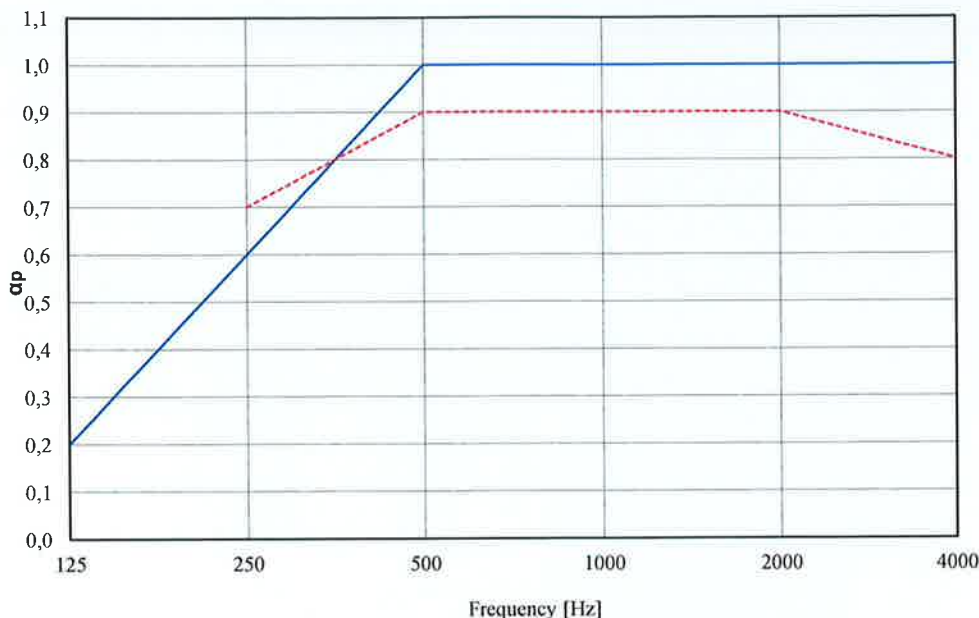
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This annex consists of 2 sheets

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— Test plot - - - - - Reference curve

| | |
|---|-------------|
| Weighted sound absorption coefficient "α_w" Value of the reference curve at 500 Hz rounded in steps of 0,05 | 0,90 |
| Uncertainty of measurement "U(α_w)" | 0,06 |
| Shape indicator* Frequency range in which the "α _p " curve exceeds the shifted reference curve by 0,25 or more | // |
| Sound absorption class** | A |

- (*) L = Low;
M = Medium;
H = High.
- (**) A: α_w = 0,90, 0,95 or 1,00;
B: α_w = 0,80 or 0,85;
C: α_w = 0,60, 0,65, 0,70 or 0,75;
D: α_w = 0,30, 0,35, 0,40, 0,45, 0,50 or 0,55;
E: α_w = 0,15, 0,20 or 0,25;
Not Classified: α_w = 0,00, 0,05 or 0,10.

Notes: evaluation based on laboratory measurement results obtained by an engineering method; for classification criteria please see heading "Uncertainty of measurement".


 Test Technician (Geom. Omar Gianni) Head of Acoustics and Vibrations Laboratory (Dott. Ing. Roberto Baruffa)

Managing Director
 L'AMMINISTRATORE DELEGATO
 Dott. Ing. Vincenzo Iommi

