**Applus⁺ laboratories**

ilac-MRA  ENAC ENSAYOS Nº 9/LE766

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|---|---|
| Bellaterra: | 31st of May, 2017 |
| File number: | 17/14409-897 |
| Client reference: | **SOPREMA IBERIA, S.L.U.** |
| | C/ Ferro, 7 – Pol. Ind. Can Pelegrí |
| | 08755 Castellbisbal (Barcelona) |

# TEST REPORT

The present document is a translation of the original test report in Spanish file number **17/14409-897**. In case of dispute, the valid document is the original Spanish version. This translation is issued the 1st of June, 2017

**Requested test:** Laboratory measurement of airborne sound insulation, in accordance with the standard UNE-EN ISO 10140-2:2011, of a specimen of high-density polymer-based membrane commercial reference **TECSOUND 100**

**Date of test:** 25th of April, 2017

**Test carried out by:** Xavier Roviralta (Acoustics Laboratory - LGAI Technological Center)

Xavier Roviralta
Technical Manager of Acoustics
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## 1.- SCOPE OF THE TEST

Laboratory measurement of airborne sound insulation, in accordance with the standard UNE-EN ISO 10140-2:2011, of a specimen of high-density polymer-based membrane commercial reference **TECSOUND 100**.

## 2.- MEASUREMENT EQUIPMENT

The equipment used in the acoustic measurements is the following:

- Spectrum analyser id no.: 170701 (Bruel&Kjaer mod. Pulse LAN-XI)
- Microphone calibrator id no.: 103032 (Bruel&Kjaer mod. 4231)
- Diffuse field microphones id no.: 103128 and 103131 (Bruel&Kjaer mod. 4943)
- Rotating microphone booms id no.: 170691 and 170692 (Ntek mod. MB-01)
- Omnidirectional sound sources id no.: 170260 and 170261 (CESVA mod. BP012)
- Noise generator with power amplifier id no.: 103125 (CESVA mod. AP600)
- Equalizer id no.: 170092 (INTER mod. EQ-9231)
- Thermo-hygrometer and barometer id no.: 170539 (Oregon Scientific mod. WMR88)
- Tape measurer id no.: 103095 (Stanley mod. Powerlock)
- Distance meter id no.: 170136 (Stanley mod. TLM130)

## 3.- TEST PROCEDURE AND EVALUATION

### 3.1. TEST METHOD

Test carried out in accordance with the standard UNE-EN ISO 10140-2:2011, "Measurement of airborne sound insulation", which is part 2 of the set of standards UNE-EN ISO 10140 "Laboratory measurement of sound insulation of building elements".

Two horizontally or vertically adjacent rooms are used, one being designated the source room and the other the receiving room. The test element is mounted in an opening in the partition between those rooms. In the source room, a diffuse sound field is generated with a level enough to measure, in the receiving room, a sound pressure level at least 6 dB higher (preferably more than 15 dB) than the background noise level, at any frequency band. If this is not fulfilled, corrections specified in the standard UNE-EN ISO 10140-4:2011 shall be applied.

The average sound pressure levels in the source room and in the receiving room are measured, according to the procedure specified in the standard UNE-EN ISO 10140-4:2011.
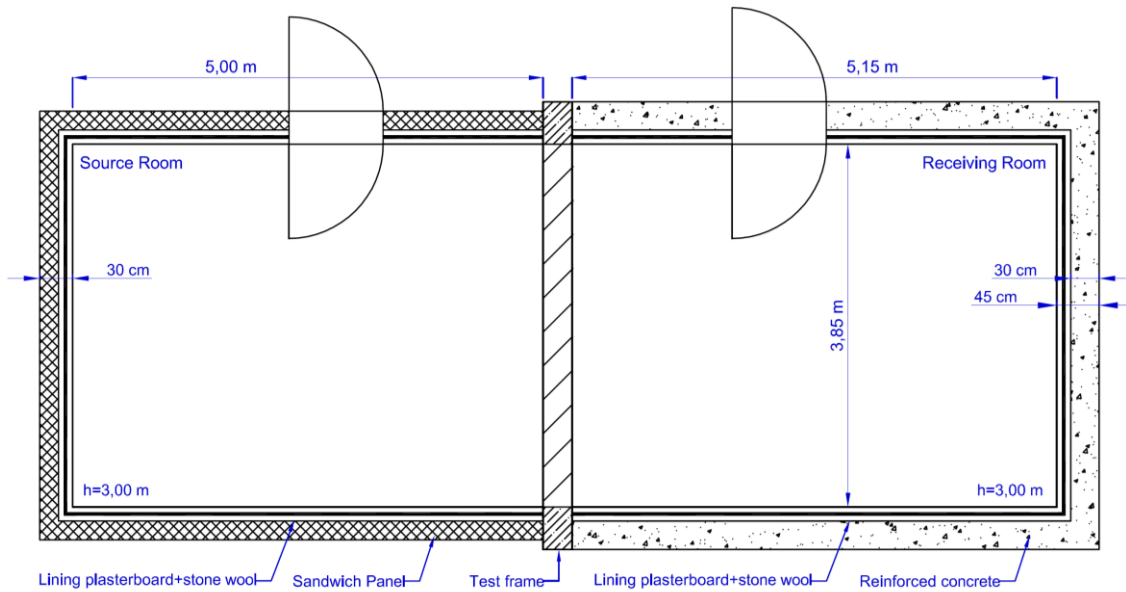
**Schematic sketch of the test rooms**

The **sound reduction index, R**, is calculated using:

$$R = L_1 - L_2 + 10 \lg \left(\frac{S}{A}\right) \text{ [dB]}$$

where:

- $L_1$ is the energy average sound pressure level in the source room (dB)
- $L_2$ is the energy average sound pressure level in the receiving room (dB)
- S is the area of the free test opening in which the test element is installed (m$^2$)
- A is the equivalent sound absorption area in the receiving room (m$^2$)

The equivalent absorption area, *A*, in square meters, from the reverberation time using the Sabine formula is calculated by the following equation:

$$A = \left(\frac{0,16 \cdot V}{T}\right) \text{ [m}^2\text{]}$$

where:

- V is the receiving room volume (m$^3$)
- T is the receiving room reverberation time (s)

## 3.2. WEIGHTED SOUND REDUCTION INDEX, $R_w$

The **weighted sound reduction index**, **$R_w$**, is defined in the standard ISO 717-1 as the value, in decibels, of the reference curve (see table 3.1) at the frequency of 500 Hz, after shifting it according to the method laid down in this document.

To evaluate the results of a measurement of R (airborne sound insulation in one-third octave bands), the reference curve is shifted in steps of 1 dB (positive or negative) towards the measured curve until the sum of the unfavourable deviations is as large as possible but no more than 32 dB. Only frequencies within the range of 100 to 3150 Hz are taken into account. An unfavourable deviation at a particular frequency occurs when the result of measurement is less than the reference curve.

| Freq. (Hz) | 100 | 125 | 160 | 200 | 250 | 315 |
|---|---|---|---|---|---|---|
| Ref. | 33 | 36 | 39 | 42 | 45 | 48 |
| Freq. (Hz) | 400 | 500 | 630 | 800 | 1000 | 1250 |
| Ref. | 51 | 52 | 53 | 54 | 55 | 56 |
| Freq. (Hz) | 1600 | 2000 | 2500 | 3150 | 4000 | 5000 |
| Ref. | 56 | 56 | 56 | 56 | - | - |

**Table 3.1. Values of the reference curve**

## 3.3. ADAPTATION TERMS (C; $C_{tr}$)

As defined in the standard ISO 717-1, the adaptation term is the value, in decibels, that can be added to the global rating ($R_w$,...) to take into account the features of peculiar spectrums.

These terms are introduced by the standard to take into account the different spectrums of noise sources (such as pink noise and traffic noise) and to evaluate sound insulation curves with excessive low values in a single frequency band.

In the next informative table, several cases are presented and which adaptation terms can be used:

| Suitable Adaptation Term | Type of noise source |
|---|---|
| C (Adaptation term for pink noise) | Living Activities (talking, music, radio, TV)<br>Children playing<br>Railway traffic at medium and high speed<br>Highway road traffic (> 80 Km/h)<br>Jet aircraft (short distances)<br>Factory emitting mainly middle and high frequency noise |
| C_tr (Adaptation term for traffic noise) | Urban road traffic<br>Railway traffic at low speed<br>Aircraft (propeller driven) and jet aircraft (large distance)<br>Disco music<br>Factory emitting mainly low frequency noise |

**Table 3.2. Adaptation terms and its suitable use**

## 3.4.   A-WEIGHTED SOUND REDUCTION INDEX CALCULATION, $R_A$

The **A-weighted sound reduction index, $R_A$**, of a building element is the global rating, in dBA, of the sound reduction index, R, for an incident A-weighted normalized pink noise. In the Annex A of the *Documento Básico "DB-HR Protección frente al ruido" del Código Técnico de la Edificación*, $R_A$ is defined by the following formula from the values of sound reduction index R obtained by laboratory testing:

$$R_A = -10 \, Log \sum_{i=1}^{n} 10^{(L_{Ar,i} - R_i)/10} \text{ [dBA]}$$

where:

- $R_i$ is the sound reduction index in the i frequency band, in dB.
- $L_{Ar,i}$ is the value of A-weighted pink noise spectrum in the i frequency band, in dBA.
- i covers all the one-third octave frequency bands from 100 Hz to 5 kHz.

| Frec. (Hz) | 100 | 125 | 160 | 200 | 250 | 315 |
|---|---|---|---|---|---|---|
| $L_{Ar,i}$ | -30,1 | -27,1 | -24,4 | -21,9 | -19,6 | -17,6 |
| Frec. (Hz) | 400 | 500 | 630 | 800 | 1000 | 1250 |
| $L_{Ar,i}$ | -15,8 | -14,2 | -12,9 | -11,8 | -11,0 | -10,4 |
| Frec. (Hz) | 1600 | 2000 | 2500 | 3150 | 4000 | 5000 |
| $L_{Ar,i}$ | -10,0 | -9,8 | -9,7 | -9,8 | -10,0 | -10,5 |

**Table 3.3: A-weighted normalized pink noise spectrum**

## 3.5. UNCERTAINTY OF RESULTS

The uncertainty associated to the test has been calculated and is available to the petitioner.

## 4.  TEST ELEMENT DESCRIPTION

The main characteristics of the test element are provided by the test petitioner and listed below (references are specified by the test petitioner).

| | |
|---|---|
| **Manufacturer** | SOPREMA IBERIA, S.L.U. |
| **Model / Reference** | *TECSOUND 100* |
| **Supplied by** | SOPREMA IBERIA, S.L.U. |
| **Date of reception** | 30th of March, 2017 |
| **Type of specimen** | Membrane |
| **Area, *S*, of test element (test opening)** | 1,77 m$^2$ – 1180 x 1500 mm (width x height) |
| **Thickness of test element** | 5 mm |
| **Mass per unit area, *m*** | 10 kg/m$^2$ |
| **Composition** | High-density polymer-based membrane, asphalt-free. |
| **Assembly conditions** | The membrane is installed into the test opening by means of two wooden frames (34x34 mm battens) (see Figure 1). The membrane is fixed to one of the frames by staples. The union between membrane and wooden frames is sealed with silicone (both faces). The joining perimeter between wooden frames and test opening is sealed with silicone in the receiving room side and with Perennator TX-2001 S putty in the source room side |
| **Sectional drawing** | See Figure 1 |
| **Test arrangement** | According to the specifications in section 6 of the standard EN-ISO 10140-2 |
| **Type of assembly** | Assembly carried out in a test opening on a high sound insulation filler wall. Filler wall built on a reinforced concrete frame (test frame), placed in the opening between the test rooms |
| **Test element assembly (carried out by/date)** | Applus Laboratories – LGAI Technological Center / 24th and 25th of April, 2017 |

**Images 1 to 3 Test element: *TECSOUND 100* membrane**



**Images 4 to 6 Test element assembly: membrane with wooden frame and perimeter sealing**

**Images 7 and 8 Test element installed into the test opening: view from the source and receiving room**
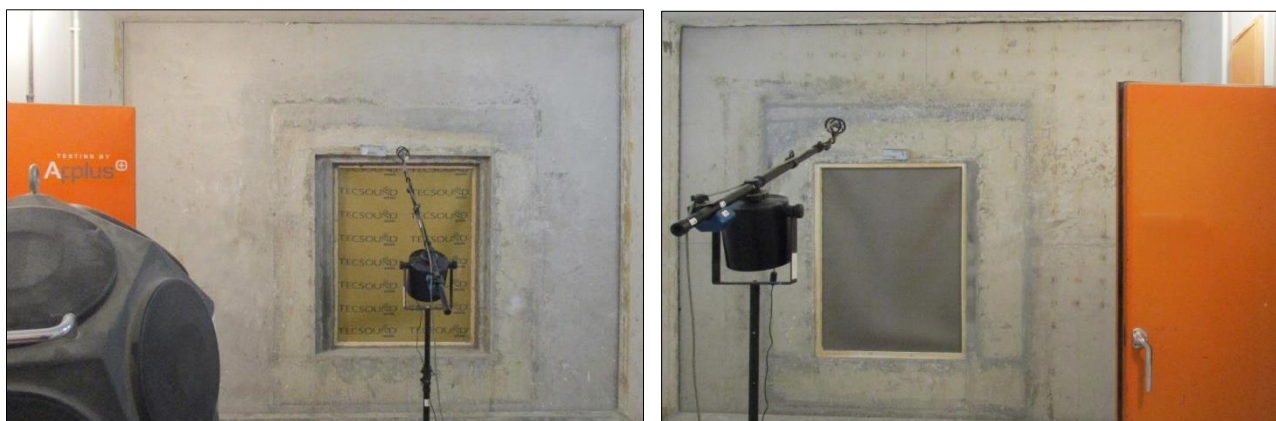


**Images 9 and 10 Test element ready to be tested: source room and receiving room, respectively**

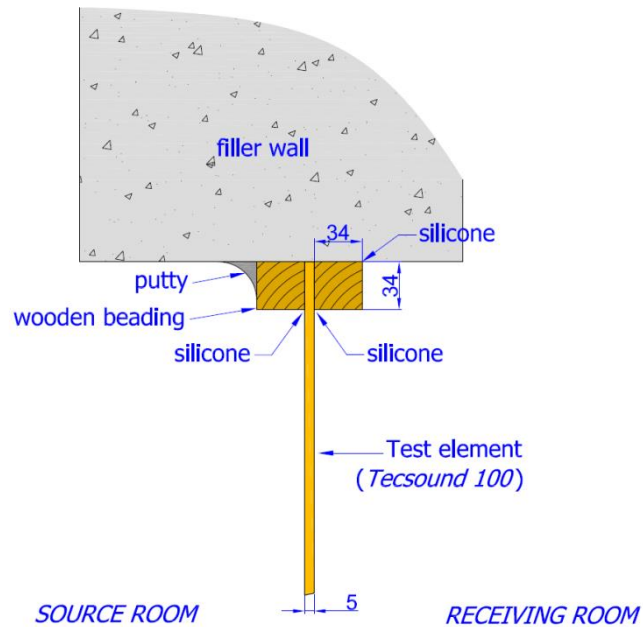The following figure shows a sectional drawing of the test element.



**Figure 1 Sectional drawing of the test element (dimensions are mm)**

## 5. TEST ENVIRONMENT

|  | **Source Room** | **Receiving Room** |
|---|---|---|
| **Volume** | 58,2 m³ | 59,6 m³ |
| **Climatic conditions** | Temperature: 20,5 ±0,8 ºC | Temperature: 20,6 ±0,8 ºC |
|  | Humidity: 49 ±6 % | Humidity: 49 ±6 % |
|  | Static pressure: 989 ±9 hPa ||

## 6. RESULTS

**Sound reduction index, _R_, in accordance with ISO 10140-2**

**Client: SOPREMA IBERIA, S.L.U.**

**Test element:**
Specimen of high-density polymer-based membrane commercial reference **TECSOUND 100**
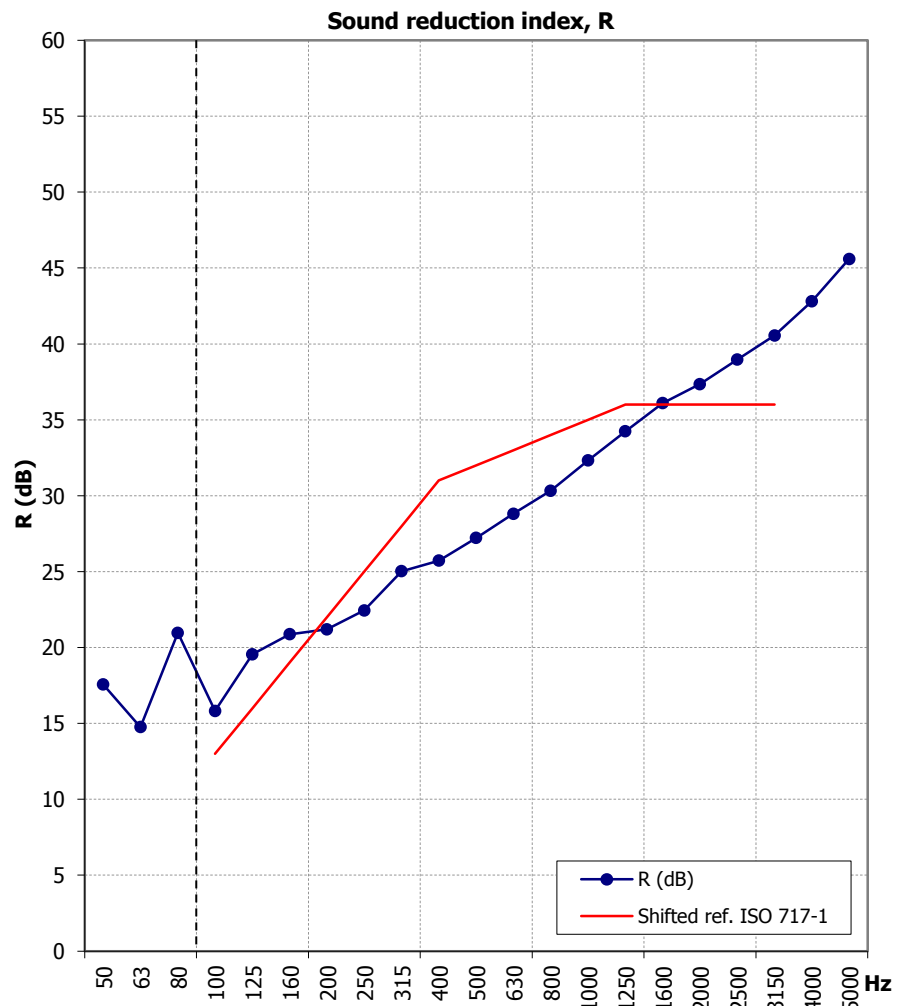
**Mass per unit area, _m_**: 10 kg/m$^2$

**Area, _S_, of test element:** 1,77 m$^2$ (1180 x 1500 mm)

**Date of test:** 25th of April, 2017

| Frequency (Hz) | R (dB) |
|---|---|
| (*) 50 | 17,6 |
| (*) 63 | 14,8 |
| (*) 80 | 21,0 |
| 100 | 15,8 |
| 125 | 19,6 |
| 160 | 20,9 |
| 200 | 21,2 |
| 250 | 22,4 |
| 315 | 25,0 |
| 400 | 25,7 |
| 500 | 27,2 |
| 630 | 28,8 |
| 800 | 30,3 |
| 1000 | 32,3 |
| 1250 | 34,2 |
| 1600 | 36,1 |
| 2000 | 37,4 |
| 2500 | 39,0 |
| 3150 | 40,6 |
| 4000 | 42,8 |
| 5000 | 45,6 |

(*) View **NOTE** on next page

**Sound reduction index, R**



Legend: R (dB); Shifted ref. ISO 717-1

| ISO 717-1 | Weighted sound reduction index , **R$_w$** (C; C$_{tr}$): | **32 (-1; -4) dB** |
|---|---|---|
| CTE DB-HR | A-weighted sound reduction index, **R$_A$**: | **31,7 dBA** |

The results reported in this document relate only to the sample, product or item delivered to LGAI Technological Center the appointed day having been tested under the conditions established in this document.

**NOTE:**

In the frequency bands of 50, 63 and 80 Hz, indicated with $^{(*)}$, the results are outside of our ENAC accreditation schedule. In these bands, the sound field in the test rooms may not be diffuse (especially with the room volumes considered, below 100 m$^3$).

The excitation of the room modes is highly dependent on the source locations. The sound reduction index depends strongly on which room modes are excited. Thus, test results may become dependent on the test facility.

To compensate the lack of diffusivity in the test rooms, at low-frequency measurements the number of loudspeaker positions has been increased to three.