

TEST REPORT No. 110915-622 A-E

CLIENT: **SUSENSIONES ELÁSTICAS DEL NORTE, S.L. (SEÑOR)**
Polígono industrial El Garrotal, Parcela 10 - Módulos 4 y 5
14700 Palma del Río (Córdoba) España

AIM: **Laboratory measurement of improvement of airborne sound insulation**

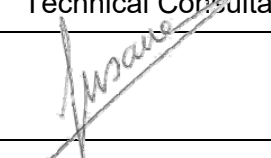
STANDARDS: **EN ISO 10140-1:2021-Annex G**
EN ISO 10140-2:2021

TEST SPECIMEN: **NON-ACOUSTIC DIRECT WALL LINING:**

- 45 mm mineral wool
- SE-ACC-FTD 47 fastening accessory (SEÑOR)
- 45 mm profile
- CLIP profile
- SE-BEP-3x48 sealing tape (SEÑOR)
- 12,5 mm plasterboard
- 4 mm bituminous membrane
- 12,5 mm plasterboard

ORIGINAL REPORT ISSUE DATE: **09/01/2025**

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Technical Consultant

Susana Lopez de Aretxaga

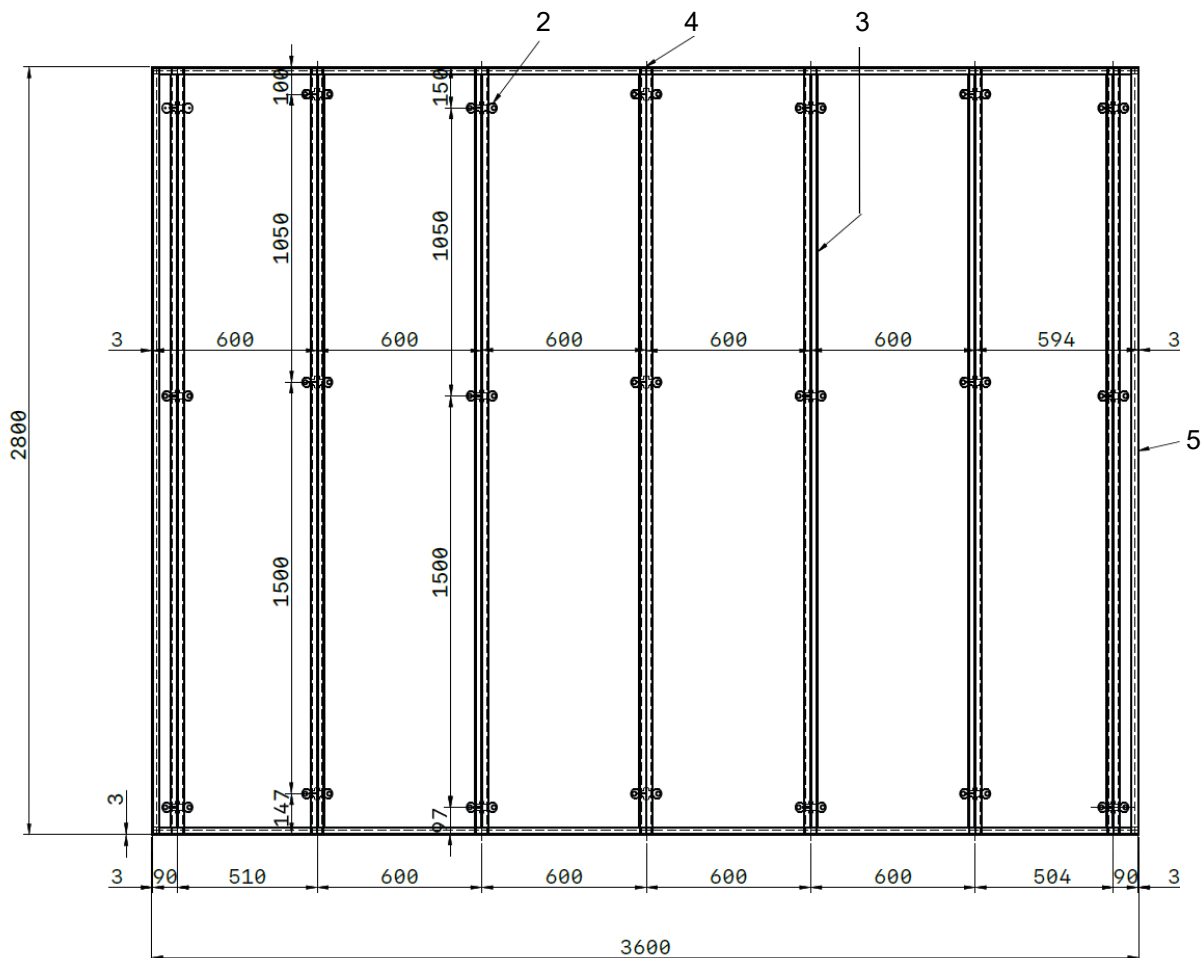


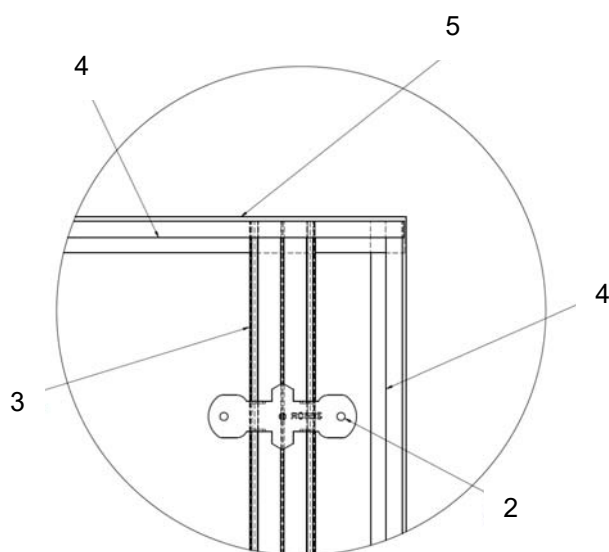
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Description of materials and assembly details:

- CLIP profile: PLACO PERFIL CLIP galvanized steel profile, 24x19,5 mm. Assembly according to sketch 3.
- SE-BEP-3x48 sealing tape (SENOR): Reticulated polyethylene self-adhesive tape (3 mm thick x 48 mm wide). Adhered to perimeter CLIP profile.
- SE-ACC-FTD 47 fastening accessory (SENOR): Description according to sketch 4. Assembly according to sketch 3.
- 45 mm profile: PLACO F-530 galvanized steel profile, 45x18 mm. Assembly according to sketch 3.
- 45 mm mineral wool: URSA TERRA 45 P mineral wool (45 mm thick and 17 kg/m³).
- 12,5 mm plasterboard: PLACO BA 13 laminated gypsum board (12,5 mm thick and 8,1 kg/m²). Assembly according to sketches 5 and 6.
- 4 mm bituminous membrane: ViscoLAM 65 high density viscoelastic membrane (4 mm and 6,5 kg/m²). Each other butt jointed sections, against SE-BEP sealing tape, with staggered joints to those of the laminated gypsum boards and adhered to the inner laminated gypsum boards with CRC Fast Stick multipurpose adhesive.





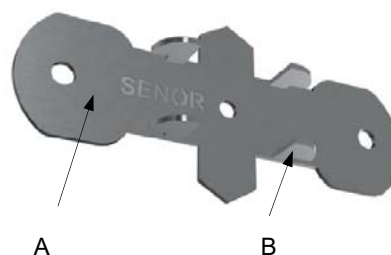
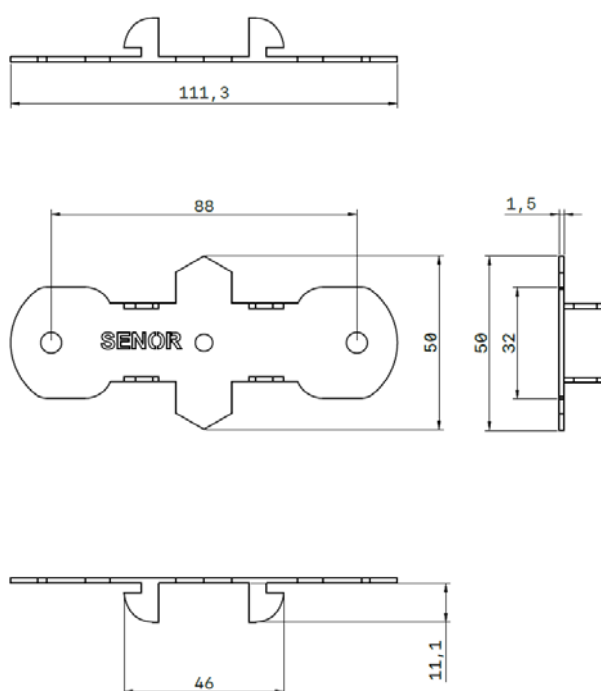
45 mm profile
+
SE-ACC-FTD 47
fastening accessory



CLIP profile

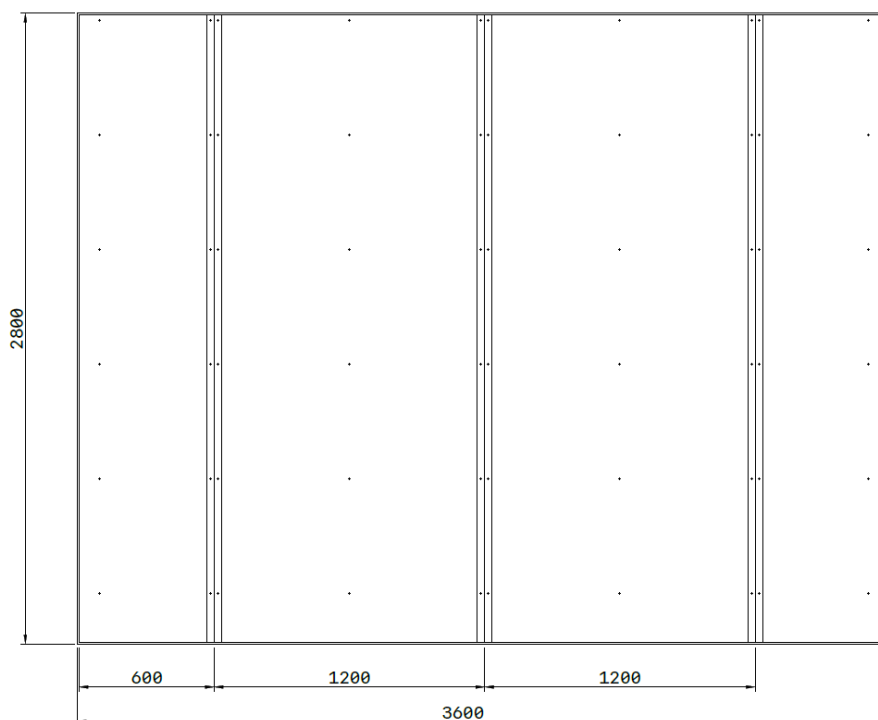
- Dampers mechanically fixed at 2 points to the wall
- CLIP profile mechanically fixed to perimeter each 30 cm.
- 45 mm profiles fitted in dampers and CLIP profile and mechanically fixed at 1 point to the lower and upper CLIP profile.

Sketch 3 - Cotes in mm



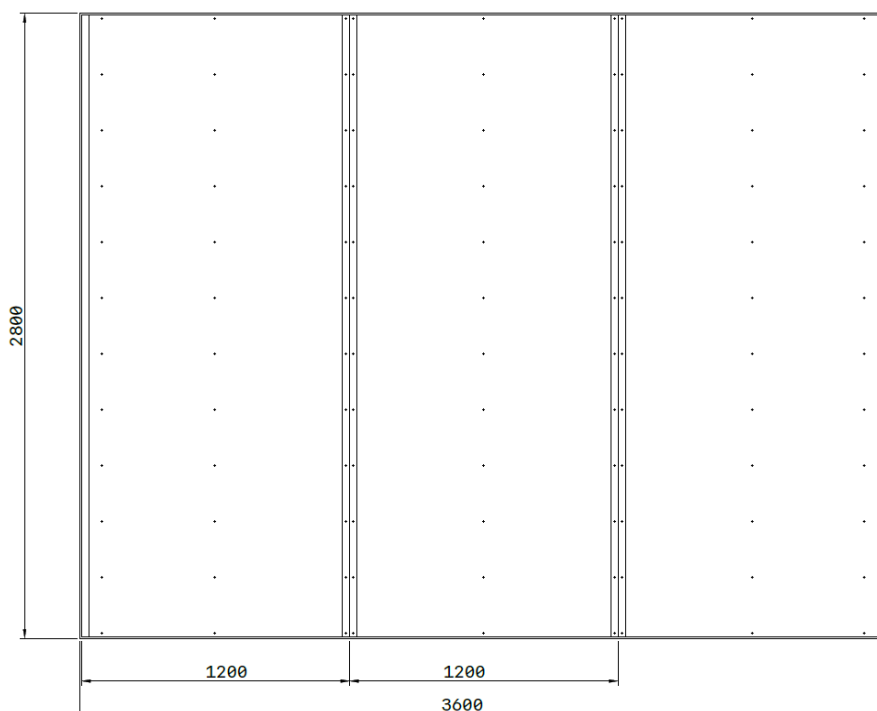
- A. BASE FTD plate made of high-performance galvanized steel, 1,5 mm thick
- B. CLIP STOP made of high-performance galvanized steel; 1,5 mm thick

Sketch 4 - Cotes in mm



- Each other butt jointed boards and against SE-BEP strip, mechanically fixed to profiles each ~50 cm.
- Sealing of joints between boards with joint strip and PLACO PR 1 joint paste.

Sketch 5 (inner layer) - Cotes in mm



- Each other butt jointed boards, mechanically fixed each ~ 25 cm.
- Clearance of ~5 mm between boards and support frame. Sealing of joints between boards and perimeter joint between boards and frame with joint strip and PLACO PR 1 joint paste

Sketch 6 (outer layer) - Cotes in mm



Photos of assembly of the wall-lining



Photos of wall-lining on wall in the test rooms

Material delivered by: SENOR and DANOSA, each company its referenced material in the test specimen description, and by PLACO, the wall lining material (boards, profiles, screws, tape and compound).

Mounting in the test opening:

Wall lining installed on standard wall built in a prefabricated reinforced concrete support frame, 40 cm thick and with internal dimensions of 2,8 m high x 3,6 m long.

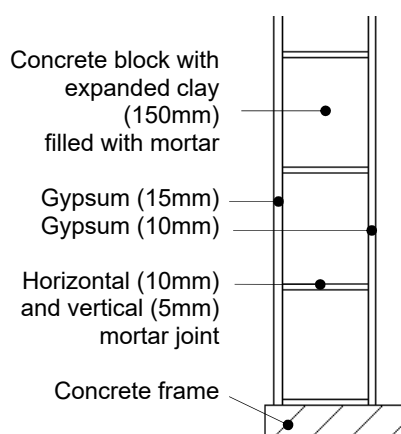
Assembly performed by: SENOR

Assembly end date: 20th June 2024

Standard wall:

Lined filled block wall, of 300 kg/m² estimated superficial mass (*).

(*) Filling and mortar joints included.



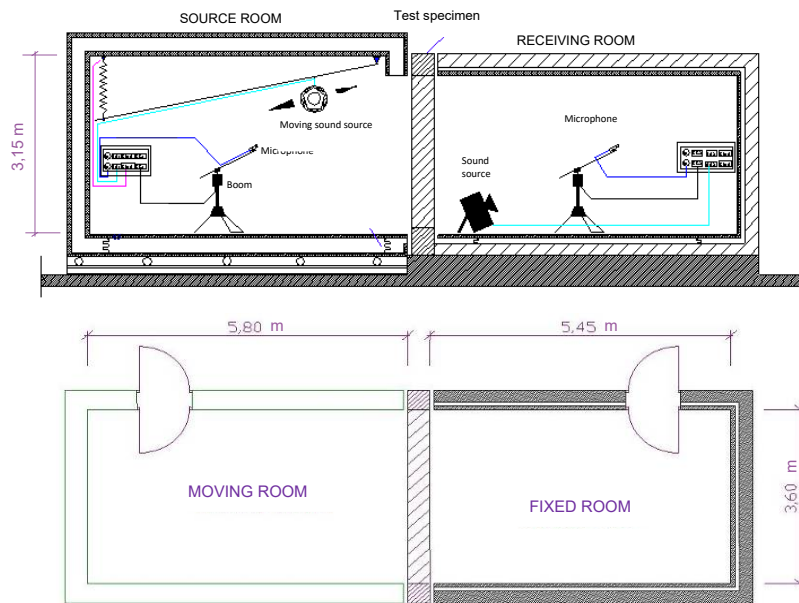
Block: 500 mm long x 190 high x 150 mm thick & 14,2 kg (estimated superficial mass: 149 kg/m²)

Sketch and photos of standard wall

Standard basic element, 'Heavy wall', according to EN ISO 10140-5:2021, Annex B. Provided by the laboratory in its final condition. 10 mm gypsum side oriented to tested lining.

2. TEST FACILITIES

The test is performed in the horizontal transmission rooms, composed of a source and a receiving room. The receiving room is formed by a concrete outer enclosure 20 cm thick and a concrete inner enclosure 10 cm thick, both acoustically disconnected. The source room, 40 cm of thickness, is formed by a double enclosure of metal profile and gypsum board, both acoustically disconnected. The mobility of the source room allows the assembly of the test specimens outside and its later movement into the test room. The rooms comply with the requirements of EN ISO 10140-5:2021.



Sketch of horizontal transmission acoustic rooms

3. EQUIPMENT AND TEST CONDITIONS

Microphones	Brüel&Kjær 4943; Serial No. 3188436	Brüel&Kjær 4943; Serial No. 3188435
Preamplifiers	Brüel&Kjær 2669; Serial No. 1948764	Brüel&Kjær 2669; Serial No. 2025844
Sound sources	Brüel&Kjær 4296; Serial No. 2071420	CERWIN VEGA; N° 012446
Booms	Brüel&Kjær 3923; Serial No. 2036584	Brüel&Kjær 3923; Serial No. 2036591
Analyzer	Nor850-MF1; Serial No. 8501186	
Amplifier	LAB 300; Serial No. 970-967	
Equalizer	Sony, SRP-E100; Serial No. 400238	
Calibrator	Brüel&Kjær 4231; Serial No. 2061477	
Atmospheric conditions meter	Source room: Rotronic BL-1D; Serial No. A21050029 Measurement uncertainty: T ($\pm 0,7$ °C), H (± 4 %), P (± 2 mbar) T: Air temperature; H: Relative humidity; P: Static pressure	Receiving room: Rotronic BL-1D; Serial No. A19060062 Measurement uncertainty: T ($\pm 0,7$ °C), H (± 4 %), P (± 5 mbar)

4. TEST PROCEDURE AND EVALUATION

4.1 Determination of the sound reduction improvement

The improvement of airborne sound insulation of a lining is defined by the sound reduction improvement index, ΔR . For its determination, the airborne sound insulation test of the basic element (heavy wall) without and with the lining is carried out according to EN ISO 10140-2:2021.

The sound reduction improvement index, ΔR , of a lining placed on a basic element, at one-third octave frequency bands from 100 to 5000 Hz, is obtained according to standard EN ISO 10140-1:2021-Annex G, from the difference between the sound reduction indices of the basic element with and without the lining:

$$\Delta R = R_{\text{with}} - R_{\text{without}}$$

R_{with} : Sound reduction index of the basic element with lining

R_{without} : Sound reduction index of the basic element without lining

4.2 Determination of the airborne sound insulation

The sound reduction index, R , is obtained according to EN ISO 10140-2:2021 using the following formula:

$$R = L_1 - L_2 + 10 \cdot \log S/A$$

L_1 : Average sound pressure level in the source room

L_2 : Average sound pressure level in the receiving room

S : Test specimen area

A : Equivalent sound absorption area in the receiving room

The measurement of the average sound pressure levels L_1 and L_2 , is performed by emitting equalized white noise using a moving omnidirectional sound source. The sound field in the source and receiving rooms is sampled using a moving microphone with a sweep radius of 1 m and a traverse period of 16 s/cycle during 32 s. of measure. Background noise in the receiving room is measured according to the same measurement process of sound field in the receiving room.

The equivalent sound absorption area is evaluated from the reverberation time measured in the receiving room, using Sabine's formula:

$$A = 0,16 \cdot V/T$$

A : Equivalent sound absorption area in the receiving room

T : Reverberation time in the receiving room

V : Receiving room volume

Reverberation time in the receiving room is determined by using two positions of the sound source and three fixed microphone positions for each source position distributed at 120° in the microphone path.

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.CM-AA-61-E: "Procedure for the determination of the airborne sound insulation into the horizontal and vertical transmission rooms".
- PE.MC-AA-06-M: "Procedure to manage the test specimens for acoustic tests in laboratory".

5. RESULTS

The following results are presented:

110915-622-MRA: Sound reduction improvement index of *Lining on the standard basic element 'heavy wall'*:

- Sound reduction improvement index, ΔR , in decibels, for the one-third-octave band from 100 Hz to 5000 Hz, in table and graph.
- Weighted sound reduction improvement index, $\Delta R_{w,heavy}$, calculated according to EN ISO 717-1:2020, on the standard heavy wall:

$$\Delta R_{w,heavy} = R_{w,ref,with} - R_{w,ref,without}$$

$$R_{ref,with} = R_{ref,without} + \Delta R$$

$R_{ref,without}$ defined in EN ISO 717-1:2020, Annex E.

- A-weighted improvement of sound reduction indices between 100 and 3150 Hz, $\Delta(R_w+C)_{heavy}$ and $\Delta(R_w+C_{tr})_{heavy}$, calculated in an equivalent way.
- A-weighted improvement of sound reduction indices between 100 and 5000 Hz, $\Delta R_A = \Delta(R_w+C_{100-5000})_{heavy}$ and $\Delta R_{A,tr} = \Delta(R_w+C_{tr,100-5000})_{heavy}$, calculated in an equivalent way.

Additionally, are presented:

- Sound reduction index of the standard wall with lining, R_{with} , for the one-third-octave band from 100 Hz to 5000 Hz.
- Sound reduction index of the standard wall without lining, $R_{without}$, for the one-third-octave band from 100 Hz to 5000 Hz.
- Global indices R_w (C; C_{tr}), R_A and $R_{A,tr}$ for the both elements mentioned above.

110915-622-RA: Airborne sound insulation of *Lining + 'heavy wall'*:

- Sound reduction index, R , for the one-third octave band from 100 to 5000 Hz, in table and graph.
- Global indices R_w (C; C_{tr}), R_A and $R_{A,tr}$.

The global indices R_w (C; C_{tr}), R_A and $R_{A,tr}$ are calculated as follows:

- R_w : Weighted sound reduction index, calculated according to EN ISO 717-1:2020, from the sound reduction index, R .
- C y C_{tr} : Spectrum adaptation terms from 100 to 3150 Hz, calculated according to EN ISO 717-1:2020, which are the values, expressed in decibels, to be added to the global

magnitude value R_w to consider the characteristics of the pink noise spectrum (C) and traffic noise spectrum (C_{tr}), respectively.

- R_A and $R_{A,tr}$: Global indices calculated according to the expression of *Documento Básico "DB-HR Protección frente al ruido" - Código Técnico de la Edificación (CTE)*, from the sound reduction index, R , obtained by laboratory measurement:
 - R_A : A-weighted sound reduction index, from 100 to 5000 Hz, expressed to one decimal place.
 - $R_{A,tr}$: A-weighted sound reduction index for exterior traffic noise, from 100 to 5000 Hz, expressed to one decimal place.

Sound reduction improvement index of a lining on standard heavy wall according to EN ISO 10140-1:2021-Annex G

Laboratory measurements according to EN ISO 10140-2:2021

CLIENT: **SUSPENSIONES ELÁSTICAS DEL NORTE, S.L. (SENOR)**

TEST DATE: 26/06/2024

RESULT No.: 110915-622-MRA

TEST SPECIMEN: **NON-ACOUSTIC DIRECT WALL LINING**

- 45 mm mineral wool
- SE-ACC-FTD 47 fastening accessory (SENOR)
- 45 mm profile
- CLIP profile
- SE-BEP-3x48 sealing tape (SENOR)
- 12,5 mm plasterboard
- 4 mm bituminous membrane
- 12,5 mm plasterboard

Estimated superficial mass: 23 kg/m²

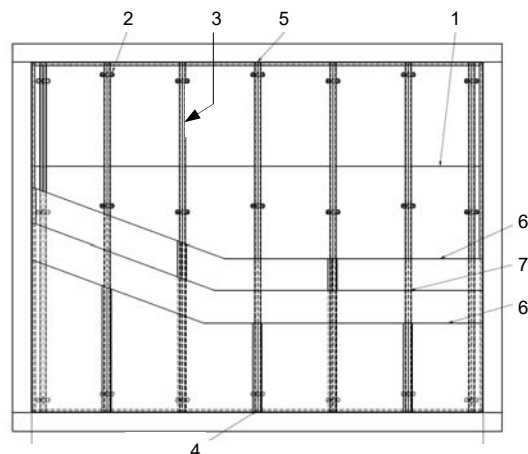
Test specimen area: 10,08 m²

Standard heavy wall: Lined filled concrete block wall (300 kg/m²), tested on 13/06/2024 (R_{without})

V_{src} : 66,6 m³; T_{src} : 20,8 °C; H_{src} : 65 %; P_{src} : 953 mbar

V_{rec} : 55,2 m³; T_{rec} : 20,6 °C; H_{rec} : 69 %; P_{rec} : 953 mbar

V: volume; src: source room; rec: receiving room

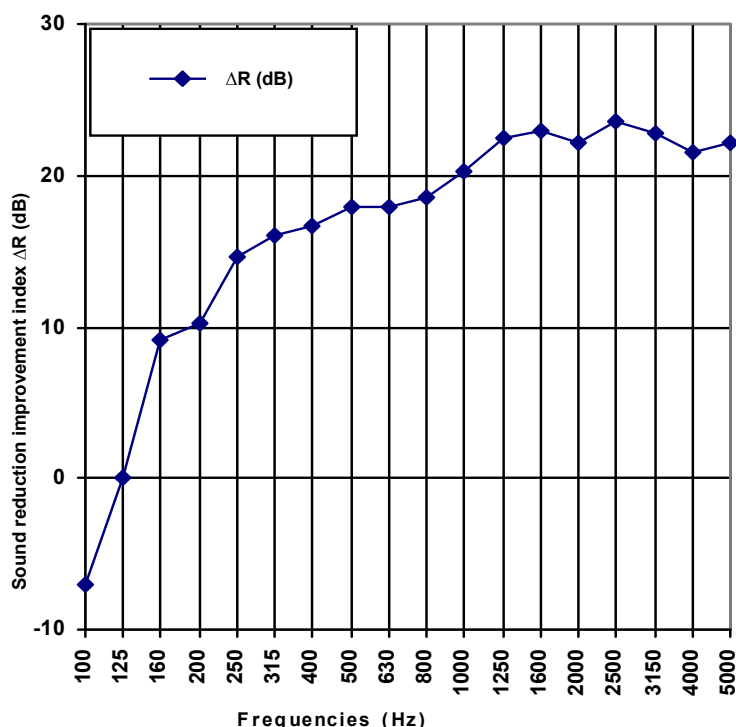


1. 45 mm mineral wool
2. SE-ACC-FTD 47 fastening accessory
3. 45 mm profile

4. CLIP profile
5. SE-BEP-3x48 sealing tape
6. 12,5 mm plasterboard
7. 4 mm bituminous membrane

f (Hz)	R_{with} (dB)	R_{without} (dB)	ΔR (dB)
100	33,6	40,6	-7,0
125	36,4	36,3	0,1
160	41,8	32,7	9,1
200	45,4	35,1	10,3
250	50,7	36,1	14,6
315	53,7	37,7	16,0
400	57,8	41,2	16,6
500	61,9	43,9	18,0
630	65,8	47,8	18,0
800	69,0	50,4	18,6
1000	72,2	52,0	20,2
1250	76,7	54,2	22,5
1600	78,0	55,0	23,0
2000	77,7	55,5	22,2
2500	76,2	52,6	23,6
3150	75,6	52,8	22,8
4000	74,9	53,4	21,5
5000	76,5	54,3	22,2

$R_{w(C)}; C_{tr,with}$: 60(-3;-10) dB	$R_{w(C)}; C_{tr,without}$: 48(-1;-5) dB
$R_{A,with}$: 58,0 dBA	$R_{A,without}$: 47,3 dBA
$R_{A,tr,with}$: 50,4 dBA	$R_{A,tr,without}$: 43,4 dBA



Rating according to EN ISO 717-1:2020:

$\Delta R_{w,heavy}$: 11 dB / $\Delta(R_w+C)_{heavy}$: 8 dB / $\Delta(R_w+C_{tr})_{heavy}$: 4 dB

$\Delta R_A = \Delta(R_w+C_{100-5000})_{heavy}$: 8 dB / $\Delta R_{A,tr} = \Delta(R_w+C_{tr,100-5000})_{heavy}$: 4 dB



Evaluation based on laboratory measurement results obtained by an engineering method

Sound Insulation according to EN ISO 10140-2:2021 Laboratory Measurements

CLIENT: **SUSPENSIONES ELÁSTICAS DEL NORTE, S.L. (SENOR)**

TEST DATE: 26/06/2024

RESULT No: 110915-622-RA

TEST SPECIMEN:

NON-ACOUSTIC DIRECT WALL LINING

- 45 mm mineral wool
- SE-ACC-FTD 47 fastening accessory (SENOR)
- 45 mm profile
- CLIP profile
- SE-BEP-3x48 sealing tape (SENOR)
- 12,5 mm plasterboard
- 4 mm bituminous membrane
- 12,5 mm plasterboard

ON LINED BLOCK WALL

Estimated superficial mass: 323 kg/m²

Test specimen area: 10,08 m²

V_{src}: 66,6 m³ V_{rec}: 55,2 m³

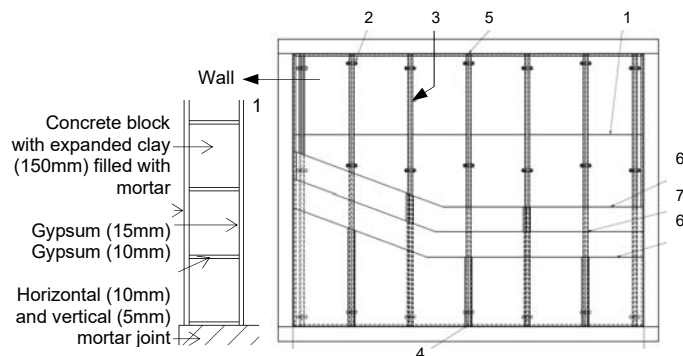
T_{src}: 20,8 °C T_{rec}: 20,6 °C

H_{src}: 65 % H_{rec}: 69 %

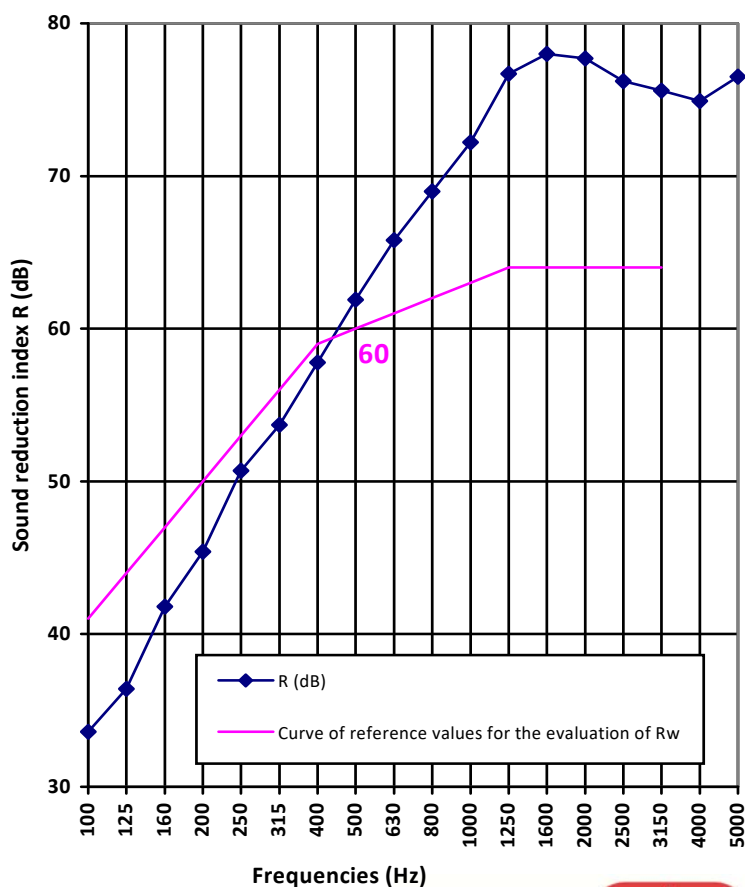
P_{src}: 953 mbar P_{rec}: 953 mbar

V: volume; src: source room; rec: receiving room

f (Hz)	R (dB)
100	33,6
125	36,4
160	41,8
200	45,4
250	50,7
315	53,7
400	57,8
500	61,9
630	65,8
800	69,0
1000	72,2
1250	76,7
1600	78,0
2000	77,7
2500	76,2
3150	75,6
4000	74,9
5000	76,5



1. 45 mm mineral wool
2. SE-ACC-FTD 47 fastening accessory
3. 45 mm profile
4. CLIP profile
5. SE-BEP-3x48 sealing tape
6. 12,5 mm plasterboard
7. 4 mm bituminous membrane



Rating according to EN ISO 717-1:2020: **R_w (C;C_{tr}): 60 (-3; -10) dB**

Rating according to DB-HR:

R_A: 58,0 dBA

R_{A,tr}: 50,4 dBA



Evaluation based on laboratory measurement results obtained by an engineering method