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SOUND REDUCTION INDEX OF 4 WALL CONSTRUCTION BY EKOLUTION, RECOMA AND WOOD TUBE

RESULT

The sound reduction index of four wall constructions made of Hemp fibre insulation from Ekolution, paper studs from Wood Tube and Recoma PackWall board has been measured according to SS-EN ISO 10140-2:2021 and evaluated according to SS-EN ISO 717-1:2020. The result is presented in the table below.

Wall construction	R_w (dB)	Measurement protocol
12,5 Recoma board, 70 WT studs with Ekolution HF,12,5 Recoma board	44	M1
2x 12,5 Recoma board, 70 WT studs with Ekolution HF, 2x 12,5 Recoma board	52	M2
2x 12,5 mm plaster board, 12,5 Recoma board, 70 WT studs with Ekolution HF,12,5 Recoma board, 2x 12,5 mm plaster board	56	M3
12,5 mm plaster board, 12,5 Recoma board, 70 WT studs with Ekolution HF, 12,5 Recoma board, 12,5 mm plaster board	53	M4

Table 1: Summary for the tested objects.

Figure 1: Material used in the four wall constructions.

1 CLIENT

Ekolution, Bredgatan 4, 211 30 Malmö, SWEDEN
Contact: Naib Woldemariam, +46 735 19 80 20, naib@ekolution.se

2 ASSIGNMENT

To measure the sound reduction index of four wall constructions from Ekolution, Wood Tube and Recoma according to SS-EN ISO 10140-2:2021 and evaluate according to SS EN ISO 717-1:2020.

3 TEST OBJECTS

The test objects were mounted in the test opening between test room 2 (sending room) and test room 1 (receiving room) in Akustikverkstan's laboratory in Skultorp, Skövde by Akustikverkstan. The area of the test opening is 3,65 x 2,74 m, in total 10 m^2. All test objects were mounted on the sending room side of the acoustic break of the test opening.

All test object consisted of 70 x 45 mm paper studs with centre-to-centre distance 450 mm. The wall was insulated with 70 mm thick hemp fibre from Ekolution and built with 12,5 mm thick Recoma PackWall board. The material used can be seen in figure 1. Test object 3 and 4 was also built with 12,5 mm plaster board. Detailed layer-by-layer construction can be found in table 2.

Measurement protocol	Construction details
M1	12.5 Recoma packwall board 70 WT paper studs (CTC 450 mm), 70 mm hemp fibre insulation 12.5 Recoma packwall board
M2	12.5 Recoma packwall board 12.5 Recoma packwall board 70 WT paper studs (CTC 450 mm), 70 mm hemp fibre insulation 12.5 Recoma packwall board 12.5 Recoma packwall board
M3	12.5 plaster board 12.5 plaster board 12.5 Recoma packwall board 70 WT paper studs (CTC 450 mm), 70 mm hemp fibre insulation 12.5 Recoma packwall board 12.5 plaster board 12.5 plaster board
M4	12.5 plaster board 12.5 plaster board 12.5 Recoma packwall board 70 WT paper studs (CTC 450 mm), 70 mm hemp fibre insulation 12.5 Recoma packwall board 12.5 plaster board 12.5 plaster board

Table 2: Detailed description of the test objects.

All layers of the boards where mounted displaced and the test object was sealed with latex sealant to minimise flanking leakage between the test objects and test opening. Between measurement of each object the different boards where reinstalled.

M3 and M4 where measured at another date with remounted studs, insulation and wall boards.

Pictures from the construction and walls can be found in *Appendix 4, Pictures.*

4 MEASUREMENT PROCEDURE

The measurements were performed according to SS-EN ISO 10140-2:2021 with two speaker positions in the sending room and with the microphone placed on a rotating boom in each measurement room. Each measurement period was 60 seconds. The reverberation time of the receiving room was measured with two speaker positions and four microphone positions.

The measurements were performed in the Akustikverkstan laboratory in Skultorp by Staffan Andersson. M1 and M2 was measured 2023-02-14 and M3 and M4 2023-04-04. More

information about the laboratory can be found in appendix 1. The measurement equipment is described in appendix 2.

5 RESULTS

The measurements have been evaluated according to SS-EN ISO 717-1:2020. The weighted sound reduction indices, R_w, for the test objects are presented in table 2 together with the adaptation terms C, C_{tr} and $C_{50\text{-}3150}$. Detailed results for the measurement are available as measurement protocol *2696-R2-M1* to *M4*. The results are valid only for the tested specimens. The measurement accuracy is described in appendix 3.

Measurement protocol	Wall construction	R_w (dB)	C	C_{tr}	$C_{50\text{-}3150}$
M1	12,5 Recoma board, 70 stud with Ekolution HF,12,5 Recoma board	44	-2	-8	-3
M2	2x 12,5 Recoma board, 70 WT stud with Ekolution HF, 2x 12,5 Recoma board	52	-2	-7	-4
M3	2x 12,5 mm plaster board, 12,5 Recoma board, 70 WT stud with Ekolution HF, 12,5 Recoma board, 2x 12,5 mm plaster board	56	-3	-8	-6
M4	12,5 mm plaster board, 12,5 Recoma board, 70 WT stud with Ekolution HF, 12,5 Recoma board, 12,5 mm plaster board	53	-4	-11	-6

Table 3: Summary of the measurement results with reference to each measurement protocol.

6 COMMENTS AND INTERPRETATIONS

The sound reduction measured in protocol M2 was noticed to be slightly lower than expected, especially between 250 – 630 Hz. The cause of this is unclear.

Staffan Andersson

Reviewed by Johan Jernstedt, 2023-04-17

APPENDIX 1: INFORMATION ABOUT THE TEST FACILITY

Test room 2 on the 1st floor is rectangular with the dimensions of L x W x H = 5.0 x 6.25 x 3.93 m. The volume of the room is 123 m^3 and the total surface area of walls, ceiling and floor is 151 m^2. This room is used as the sending room during the measurements of the sound reduction indices of the walls.

Test room 1 (reverberation room) on the 1st floor has a rectangular form with the dimensions of L x W x H = 4.65 x 5.85 x 7.35 m. The volume of room is 200 m^3 and the total surface area of walls, ceiling and floor is 209 m^2. This room is used as the receiving room during the measurements of the sound reduction indices of the walls.

A section of the two rooms together with the location of the tested wall are shown in figure A1.1. The test opening is 10 m^2 (3.65 x 2.74 m).

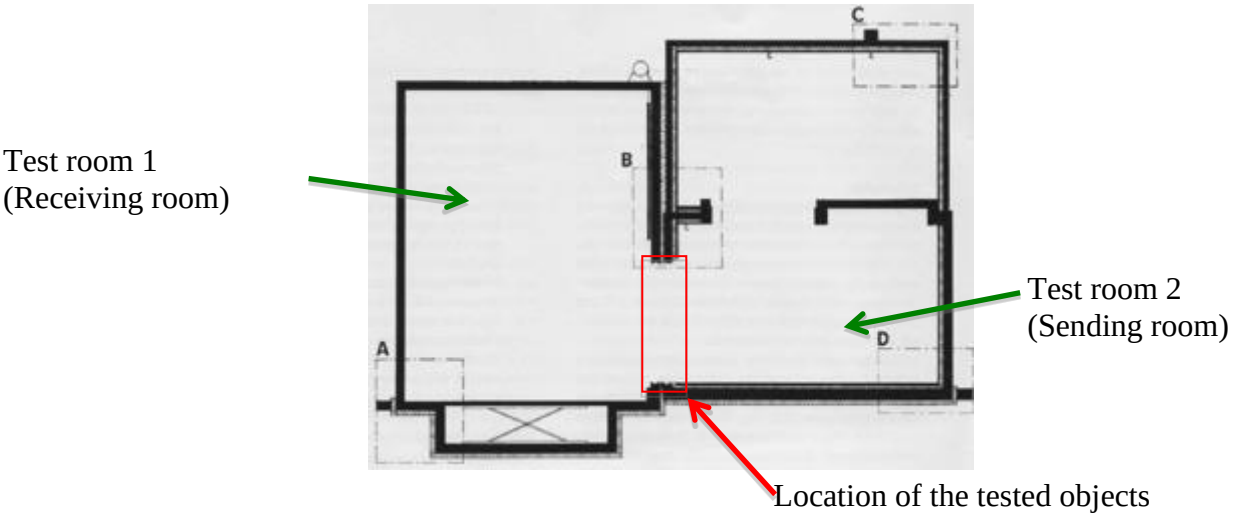


Figure A1.1: Section of the laboratory with the sending room (1st floor) and the reverberation room (1st floor) together with the location of the test specimens.

The walls of Test room 1 are made from 20 cm concrete with a density of 2300-2400 kg/m3. The walls in Test room 2 room are made from bricks (25 cm) with two layers of gypsum board and one layer of wooden fibreboard with 100 mm mineral wool behind. The test opening is acoustically separated in the split line between the rooms.

The laboratory address is Vallmovägen 11, 541 55 Skövde, SWEDEN.

The measured R'_{max} for wall elements in the laboratory are stated in figure A1.2 below.

Frequency (Hz)	Sound reduction (dB) Heavy-weight	Light-weight
50		33.8
63		36.2
80		38.7
100	50	46.8
125	53	49.2
160	53	51.5
200	55	57
250	59	62
315	62.5	65
400	68	68
500	76	73
630	81	77.9
800	83	82
1 000	85	85
1 250	88	85
1 600	92	87.2
2 000	95	94.9
2 500	98	95.2
3 150	98	97
4 000		98.7
5 000		101.7

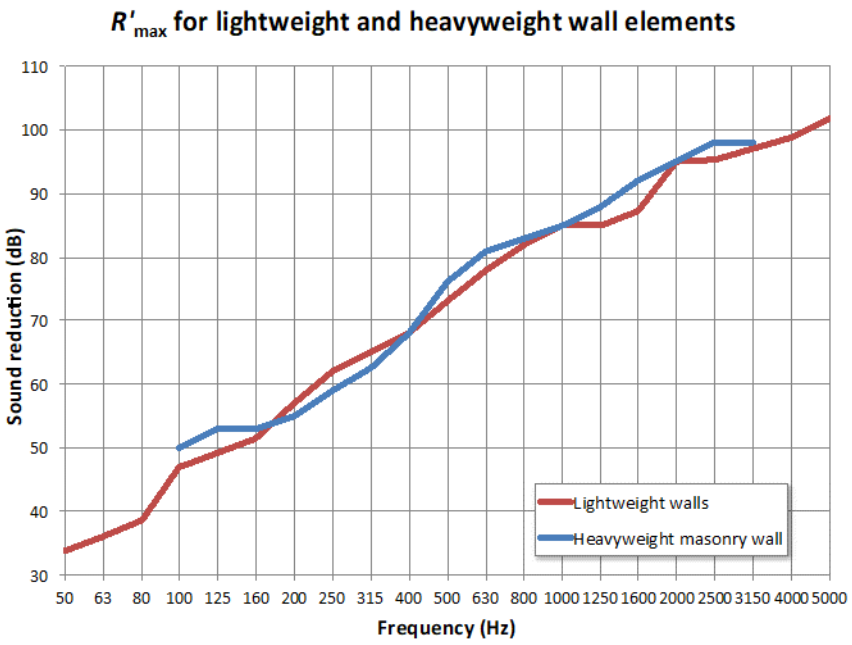


Figure A1.2: Measured R'_{max} for lightweight and heavyweight wall elements.

APPENDIX 2: MEASUREMENT EQUIPMENT

The equipment used during the measurements is presented in Table A2.1. The equipment fulfils class 1 according to IEC 61672-1, 60942 and 61260. Last calibration date is kept in the Akustikverkstan calibration log. A function control using a microphone calibrator is made immediately prior to and after the measurements.

Equipment	Brand and type	Serial number
Analyser	Norsonic 150	15030421
Omnidirectional loudspeaker	IMA Kub 1	8, 9, 10
Microphone cartridges	Norsonic 1225	251310, 271069
Microphone preamplifier	Norsonic 1209	21210, 21195
Microphone calibrator	Norsonic 1256	125626092
Equalizer	Monacor MEQ-2152	-
Amplifier	Denon POA-2200	-

Table A2.1: Used measurement equipment.

APPENDIX 3: MEASUREMENT ACCURACY

The measurement accuracy of the weighted sound reduction index, R_w, is typically within 1.2 dB compared to other testing facilities.

The measurement accuracy of the sound reduction index is frequency dependent and background noise dependent. The measurement uncertainty for single one-third octave bands is shown in Table A3.1. The value represents one standard deviation of the measurement reproducibility.

50 Hz	**63 Hz**	**80 Hz**	**100 Hz**	**125 Hz**	**160 Hz**	**200 Hz**
± 6.8 dB	± 4.6 dB	± 3.8 dB	± 3.0 dB	± 2.7 dB	± 2.4 dB	± 2.1 dB
250 Hz	**315 Hz**	**400 Hz**	**500 Hz**	**630 Hz**	**800 Hz**	**1 kHz**
± 1.8 dB	± 1.8 dB	± 1.8 dB	± 1.8 dB	± 1.8 dB	± 1.8 dB	± 1.8 dB
1.25 kHz	**1.6 kHz**	**2.0 kHz**	**2.5 kHz**	**3.15 kHz**	**4.0 kHz**	**5.0 kHz**
± 1.8 dB	± 1.8 dB	± 1.8 dB	± 1.9 dB	± 2.0 dB	± 2.4 dB	± 2.8 dB

Table A3.1: Measurement accuracy for sound reduction index, without background noise.

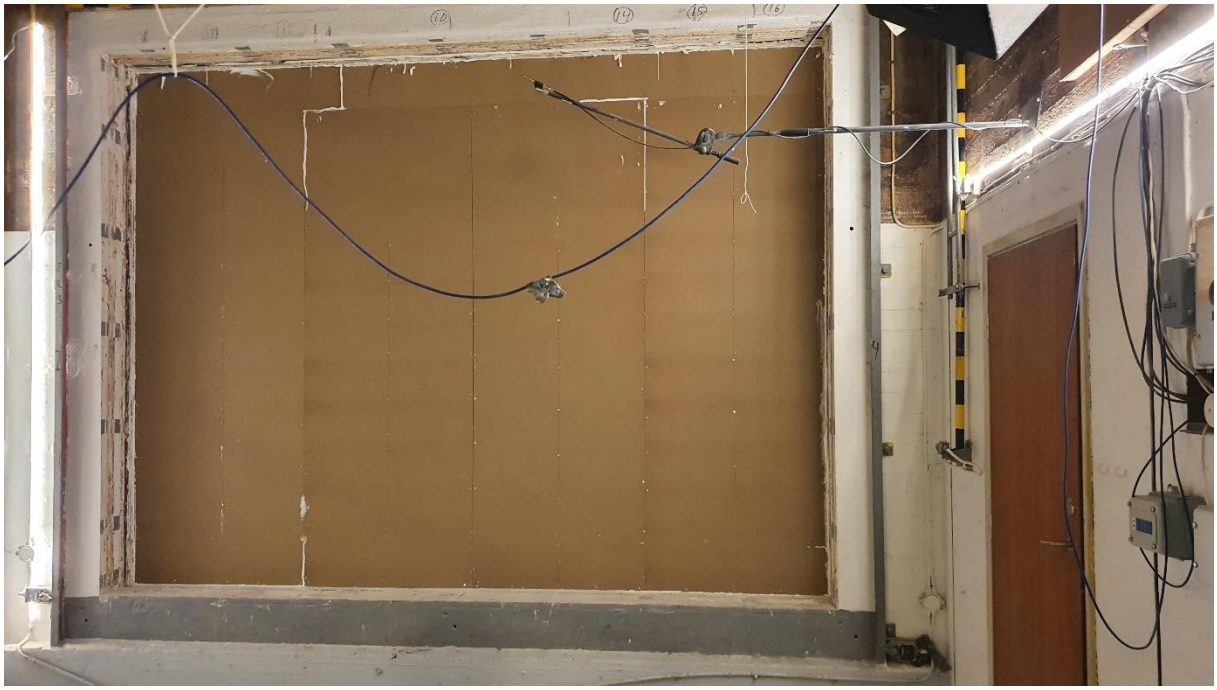
In case of too high background noise levels, the sound reduction index is at least the presented value, giving a one-sided positive uncertainty from background noise.

The measurement accuracy of other parameters is found in table A3.2.

Parameter	Uncertainty
R_w	± 1.2 dB
Temperature	± 0.5° C
Humidity	± 3% units
Static pressure	± 0.5 kPa

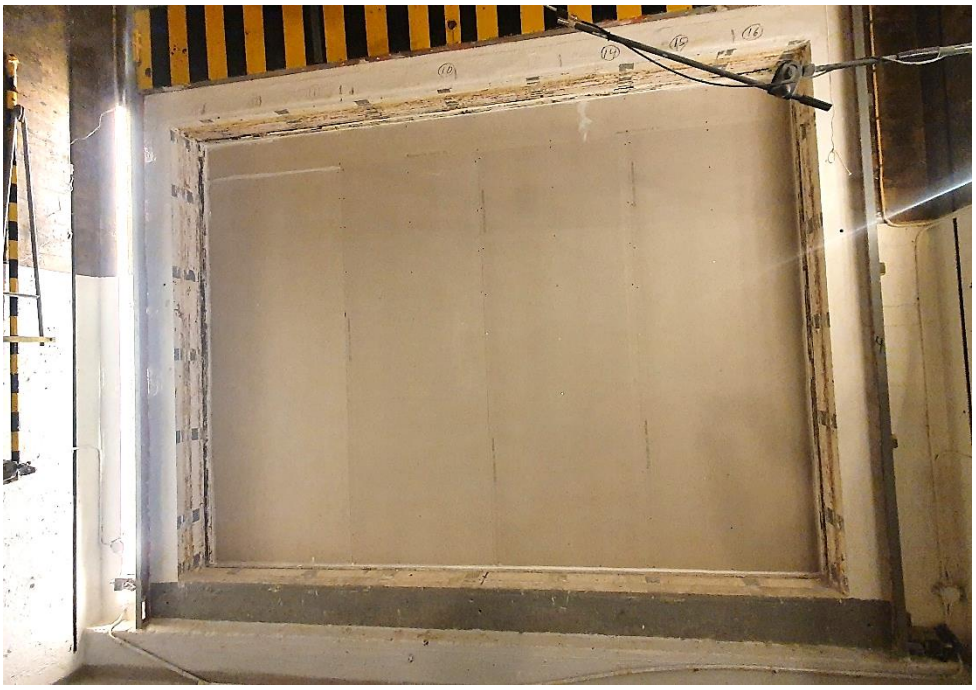
Table A3.2: Measurement uncertainties.

APPENDIX 4: PICTURES



Picture A4.1: Wall construction M1, single layer of Recoma PackWall board, picture taken from receiving room.

Picture A4.2: Wall construction M2, two layers of Recoma Packwall board, picture taken from receiving room.



A4.3: Wall construction M3, 2 layers of plaster board and a single layer Recoma Packwall board, picture taken from receiving room.

Picture A4.4: Wall construction 4, one layer of plaster board, 1 layer of Recoma Packwall board, seen from the receiving room.

Picture A4.5: During construction of studs and insulation, studs by Wood Tube 70 WT (CTC 450) with Ekolution Hemp fibre insulation and Recoma Packwall board.

Picture A4.6: During construction of wall M2 with both layer of Recoma Packwall visible.

Figure A4.7: During construction of M3 and M4, in the picture the studs from Wood tube, insulation from Ekolution and Recoma Packwall boards can be seen.

Figure A4.8: M3 and M4 during construction, seen from the sender room.

AKUSTIKVERKSTAN

Sound reduction index according to ISO 10140-2

Laboratory measurements of airborne sound insulation of building elements

No.of test report: 2696-R2-M1
Date of report: 2023-04-18
Date of test: 2023-02-14
Name: Staffan Andersson

Client: Ekolution
Manufacturer: Ekolution, Wood Tube, Recoma
Test specimen mounted by: Akustikverkstan

Test room identification:

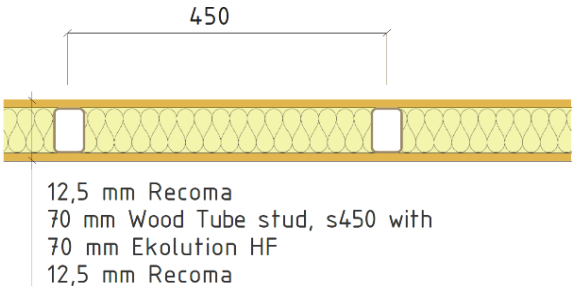
Testroom 2 to Testroom 1

Product identification:

12,5 mm Recoma 900x2500 / 1200x2500, 70 WT studs s450 / 70 HF, 12,5 mm Recoma 900x2500 / 1200x2500

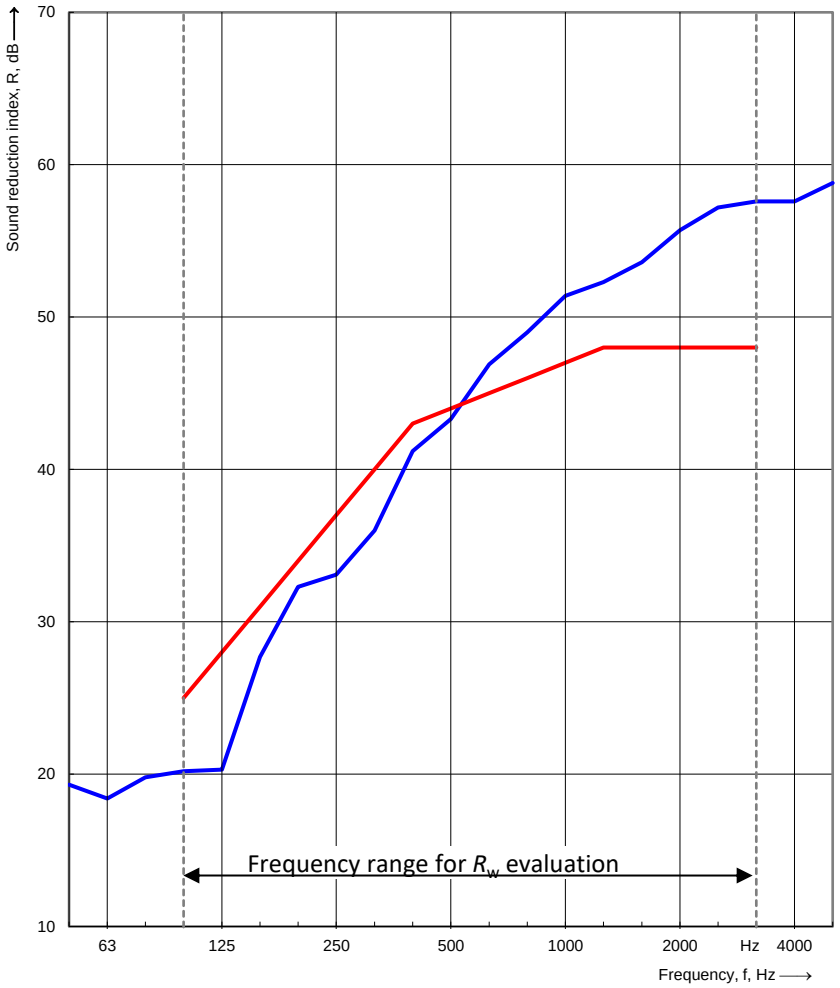
Description of the specimen:

Paper studs 70x45 mm CTC 450 mm. Filled with Hemp fiber insulation 70 mm. One layer of 12,5 mm Recoma packwall board on each side.



Barometric pressure: 100.1 kPa
Size of test opening: 10.00 m^2
Mass per unit area: - kg/m^2
Temperature: 17.0 °C
Air humidity: 40 %
Source room volume: 123 m^3
Receiving room volume: 200.0 m^3

Frequency f [Hz]	R 1/3 octave [dB]
50	≥ 19.3
63	18.4
80	19.8
100	20.2
125	20.3
160	27.7
200	32.3
250	33.1
315	36.0
400	41.2
500	43.3
630	46.9
800	49.0
1000	51.4
1250	52.3
1600	53.6
2000	55.7
2500	57.2
3150	57.6
4000	57.6
5000	58.8



≥ indicates R-value within 15 dB from R'max

Rating according to ISO 717-1

$R_w(C;C_{tr})$ = 44 (-2 ; -8) dB

$C_{50\text{-}3150}$ = -3 dB $C_{50\text{-}5000}$ = -2 dB $C_{100\text{-}5000}$ = -1 dB
$C_{tr,50\text{-}3150}$ = -11 dB $C_{tr,50\text{-}5000}$ = -11 dB $C_{tr,100\text{-}5000}$ = -8 dB
Sum of unfavourable deviations: 27.9 dB

Evaluation based on laboratory measurement results obtained in one-third-octave bands by an engineering method.

Sound reduction index according to ISO 10140-2

Laboratory measurements of airborne sound insulation of building elements

No.of test report: 2696-R2-M2
Date of report: 2023-04-18
Date of test: 2023-02-14
Name: Staffan Andersson

Client: Ekolution
Manufacturer: Ekolution, Wood Tube, Recoma
Test specimen mounted by: Akustikverkstan

Test room identification:

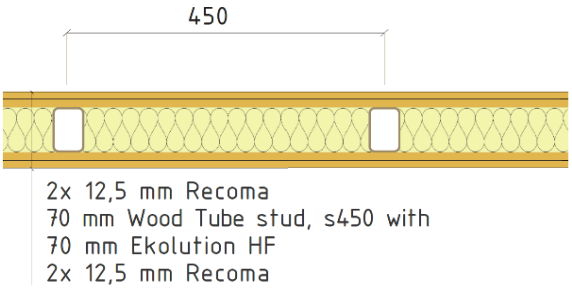
Testroom 2 to Testroom 1

Product identification:

2x 12,5 mm Recoma 900x2500 / 1200x2500, 70 WT studs s450 / 70 HF, 2x 12,5 mm Recoma 900x2500 / 1200x2500

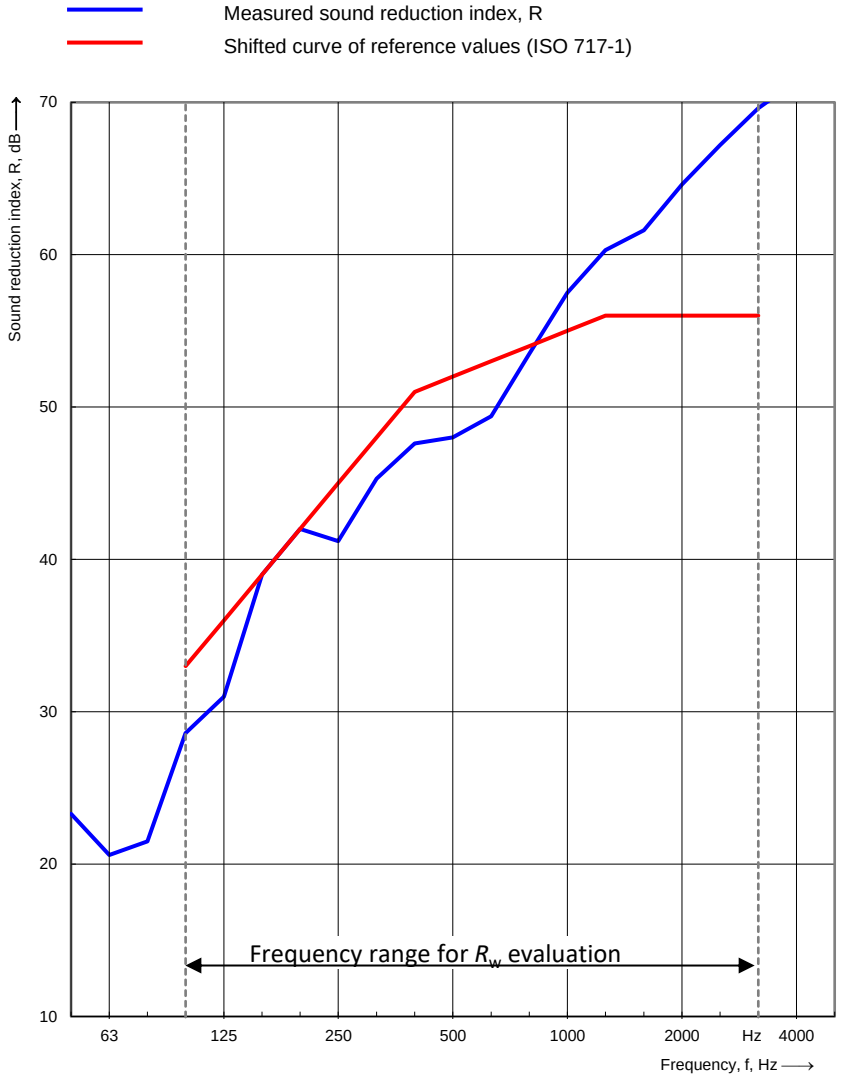
Description of the specimen:

Paper studs 70x45 mm CTC 450 mm. Filled with 70 mm Hemp fiber insulation. 2 layer of 12,5 mm Recoma packwall board on each side.



Barometric pressure:	100.1	kPa
Size of test opening:	10.00	m^2
Mass per unit area:	-	kg/m^2
Temperature:	17.0	°C
Air humidity:	40	%
Source room volume:	123	m^3
Receiving room volume:	200.0	m^3

Frequency f [Hz]	R 1/3 octave [dB]
50	≥ 23.3
63	20.6
80	21.5
100	28.6
125	31.0
160	≥ 39.0
200	42.0
250	41.2
315	45.3
400	47.6
500	48.0
630	49.4
800	53.5
1000	57.5
1250	60.3
1600	61.6
2000	64.6
2500	67.2
3150	69.6
4000	71.4
5000	73.1



≥ indicates R-value within 15 dB from R'max

Rating according to ISO 717-1

$R_w(C;C_{tr})$ = 52 (-2 ; -7) dB

$C_{50\text{-}3150}$ =	-4	dB	$C_{50\text{-}5000}$ =	-3	dB	$C_{100\text{-}5000}$ =	-1	dB
$C_{tr,50\text{-}3150}$ =	-14	dB	$C_{tr,50\text{-}5000}$ =	-14	dB	$C_{tr,100\text{-}5000}$ =	-7	dB

Sum of unfavourable deviations: 27.4 dB

Evaluation based on laboratory measurement results obtained in one-third-octave bands by an engineering method.

AKUSTIKVERKSTAN

Sound reduction index according to ISO 10140-2

Laboratory measurements of airborne sound insulation of building elements

No.of test report: 2696-R2-M3
Date of report: 2023-04-18
Date of test: 2023-04-04
Name: Staffan Andersson

Client: Ekolution
Manufacturer: Ekolution, Wood Tube, Recoma
Test specimen mounted by: Akustikverkstan

Test room identification:

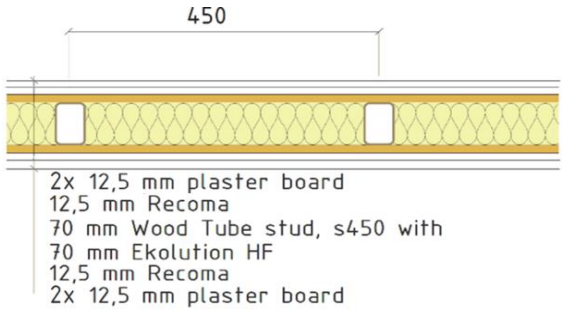
Testroom 2 to Testroom 1

Product identification:

2x 12,5 mm plaster board, 12,5 mm Recoma 900x2500, 70 WT studs s450 / 70 HF, 12,5 mm Recoma 900x2500, 2x 12,5 mm plaster board

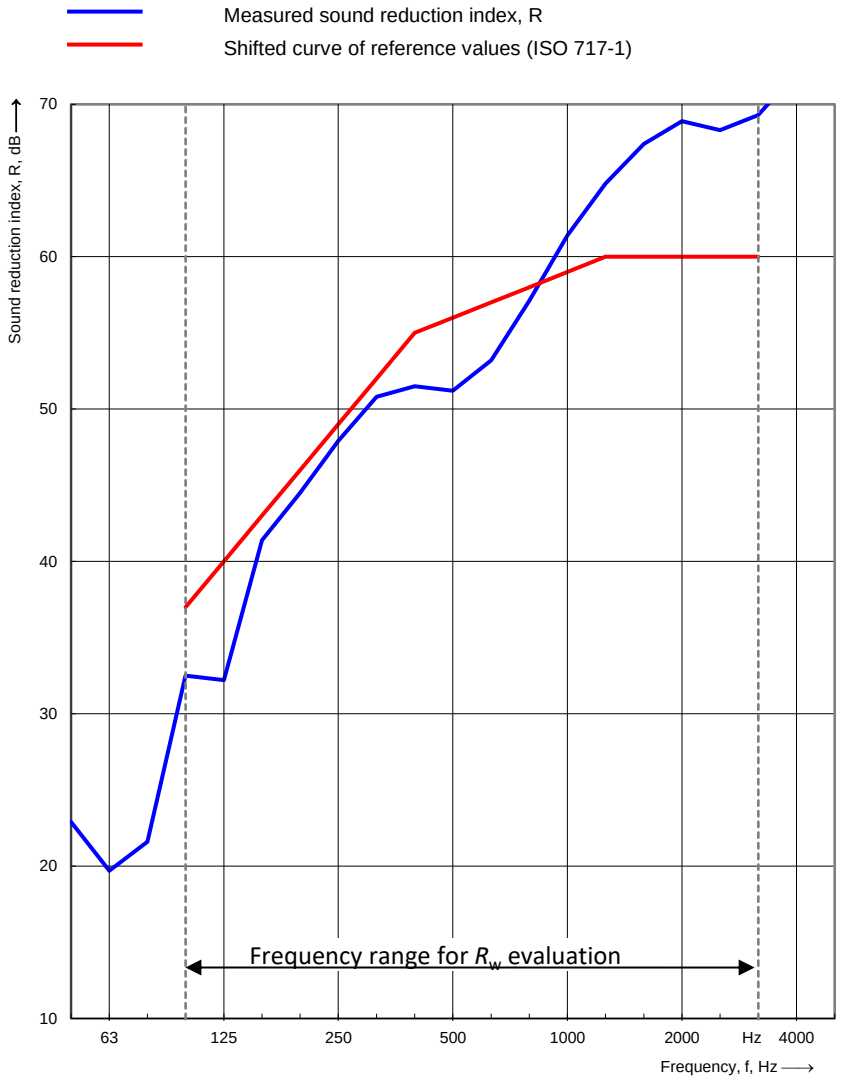
Description of the specimen:

Paper studs 70x45 mm CTC 450 mm. Filled with 70 mm thick hemp fiber insulation. 12,5 mm Recoma pack wall and 2 layer of 12,5 mm plaster board on each side.



Barometric pressure: 99.8 kPa
Size of test opening: 10.00 m^2
Mass per unit area: - kg/m^2
Temperature: 10.0 °C
Air humidity: 50 %
Source room volume: 123 m^3
Receiving room volume: 200.0 m^3

Frequency f [Hz]	R 1/3 octave [dB]
50	≥ 22.9
63	19.7
80	21.6
100	≥ 32.5
125	32.2
160	≥ 41.4
200	≥ 44.5
250	≥ 47.9
315	≥ 50.8
400	51.5
500	51.2
630	53.2
800	57.1
1000	61.4
1250	64.8
1600	67.4
2000	68.9
2500	68.3
3150	69.3
4000	72.1
5000	74.1



≥ indicates R-value within 15 dB from R'max

Rating according to ISO 717-1

$R_w(C;C_{tr})$ = 56 (-3 ; -8) dB

$C_{50\text{-}3150}$ = -6 dB $C_{50\text{-}5000}$ = -5 dB $C_{100\text{-}5000}$ = -2 dB
$C_{tr,50\text{-}3150}$ = -17 dB $C_{tr,50\text{-}5000}$ = -17 dB $C_{tr,100\text{-}5000}$ = -8 dB
Sum of unfavourable deviations: 30.7 dB

Evaluation based on laboratory measurement results obtained in one-third-octave bands by an engineering method.

Sound reduction index according to ISO 10140-2

Laboratory measurements of airborne sound insulation of building elements

No.of test report: 2696-R2-M4
Date of report: 2023-04-18
Date of test: 2023-04-04
Name: Staffan Andersson

Client: Ekolution
Manufacturer: Ekolution, Wood Tube, Recoma
Test specimen mounted by: Akustikverkstan

Test room identification:

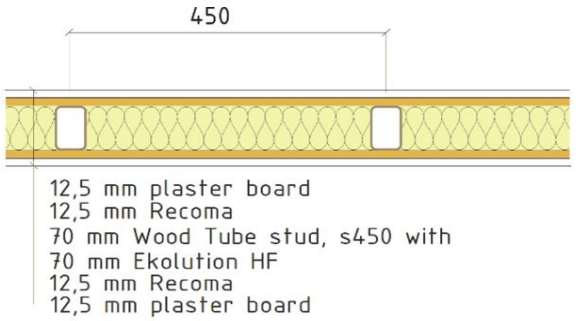
Testroom 2 to Testroom 1

Product identification:

12,5 mm plaster board, 12,5 mm Recoma 900x2500, 70 WT studs s450 / 70 HF, 12,5 mm Recoma 900x2500, 12,5 mm plaster board

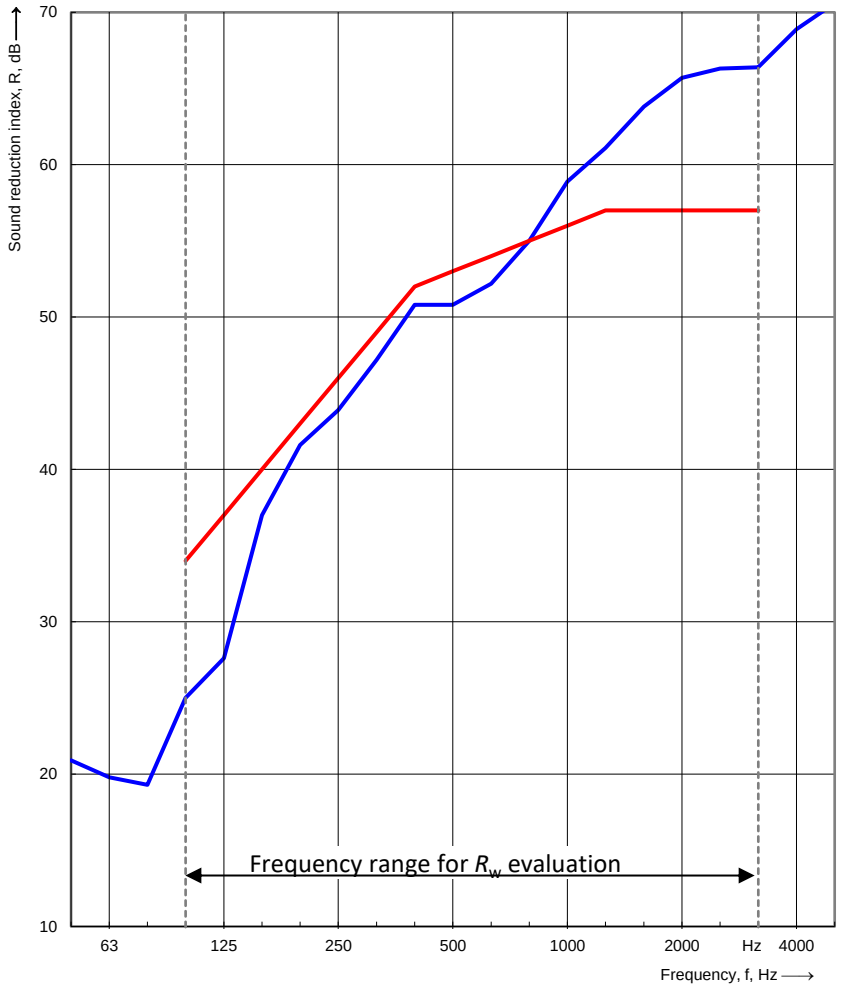
Description of the specimen:

Paper studs 70x45 mm CTC 450 mm. Filled with 70 mm thick hemp fiber insulation. 12,5 mm Recoma pack wall and 12,5 mm plaster board on each side.



Barometric pressure: 99.8 kPa
Size of test opening: 10.00 m^2
Mass per unit area: - kg/m^2
Temperature: 10.0 °C
Air humidity: 50 %
Source room volume: 123 m^3
Receiving room volume: 200.0 m^3

Frequency f [Hz]	R 1/3 octave [dB]
50	≥ 20.9
63	19.8
80	19.3
100	25.0
125	27.6
160	≥ 37.0
200	41.6
250	43.9
315	47.2
400	50.8
500	50.8
630	52.2
800	55.0
1000	58.9
1250	61.1
1600	63.8
2000	65.7
2500	66.3
3150	66.4
4000	68.9
5000	70.6



≥ indicates R-value within 15 dB from R'max

Rating according to ISO 717-1

$R_w(C;C_{tr})$ = 53 (-4 ; -11) dB

$C_{50\text{-}3150}$ = -6 dB $C_{50\text{-}5000}$ = -5 dB $C_{100\text{-}5000}$ = -3 dB
$C_{tr,50\text{-}3150}$ = -17 dB $C_{tr,50\text{-}5000}$ = -17 dB $C_{tr,100\text{-}5000}$ = -11 dB
Sum of unfavourable deviations: 31.9 dB

Evaluation based on laboratory measurement results obtained in one-third-octave bands by an engineering method.