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Sound insulation measurement of fire stop mortar FPS

(5 appendices)

This report is a translated version of the Swedish equivalent dated 2022-10-06 with reference O100282-1129190.

Client

SMP Putsprodukter AB

Test object

Fire stop mortar "FPS Brandskyddsmassa", sack no. 42502, prepared according to 4 parts powder and 1 part water, single- and double-sided application in a 15 mm wide slit around a quadratic single wall construction having side 1180 mm and thickness 120 mm. The depth of one of the joints was 30 mm (constructed with the aid of a backing insulation rod) while the depth of the joint on the opposite side was estimated to 43 mm with standard deviation 12 mm using 32 samples. Ready-made mixture used for the two afore-mentioned joints were approximately 2.6 kg and 3.5 kg, respectively.

Date of test object arrival

The sack had been open since Spring 2022 when initial adhesive tests were made, after which the remaining content has been exposed to indoor air. No problems were encountered during mixing or application of the mortar.

Date of test

Measurements with the fire stop mortar were made 2022-09-23 and 2022-09-26. Preparatory reference measurements without fire stop mortar were made 2022-09-20 and 2022-09-21.

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Results

An overview of the weighted sound reduction index $R_{s,w}$ relative to the area $\ell S_n/\ell_n = 4,80 \text{ m}^2$, where $\ell = 4,80 \text{ m}$ is the joint length and $S_n/\ell_n = 1 \text{ m}$, of joints as defined in section J.1 of SS-EN ISO 10140-1:2021, is found in Table 1 for the three measurements done with the fire stop mortar.

For comparison, results from two reference measurements are presented as well. The case "Mineral wool in slit and double-sided clay caulking" has been used to adjust the three fire stop mortar measurements with $R_{s,max}$ according to equation J.2 in SS-EN ISO 10140-1:2021.

Table 1: Overview of the results from the measurements. The values in the table refer to joint length $\ell = 4,80 \text{ m}$ and the frequency range included by the third-octave bands having centre frequencies 100 – 3150 Hz.

Test object (total single-sided joint-/slit-length $\ell = 4,80 \text{ m}$)	$R_{s,w}$ re 4,80 m ²	Appendix
FPS Brandskyddsmassa: Single-sided application with backing insulation rod	≥ 56 dB	1
FPS Brandskyddsmassa: Single-sided application without backing insulation rod	≥ 57 dB	2
FPS Brandskyddsmassa: Double-sided application without backing insulation rod	≥ 58 dB	3
Reference: Open slit	15 dB	4
Reference: Mineral wool in slit and double-sided clay caulking	57 dB	5

Measurement method

The measurements have been carried out according to Swedish standard SS-EN ISO 10140-1:2021, Annex J, and SS-EN ISO 10140-2:2021. Evaluation of results has been made according to SS-EN ISO 717-1:2020. RISE is accredited for these three standards.

The sound reduction index R_s of joints has been determined from the relation

$$R_s = L_1 - L_2 + 10 \lg \left(\frac{\ell S_n / \ell_n}{A} \right)$$

where

L_1 is the average sound pressure level in the source room [dB]

L_2 is the average sound pressure level in the receiving room [dB]

ℓ is the joint length [m]

$S_n = 1 \text{ m}^2$ is the reference area

$\ell_n = 1 \text{ m}$ is the reference length

A is the equivalent absorption area of the receiving room [m²S]

The average sound pressure levels have been determined using a rotating microphone boom of radius > 1.1 m and a digital frequency analyser. Broadband noise in the frequency range included by the third-octave bands having centre frequencies 50 – 5000 Hz has been used as source signal. A loudspeaker moving continuously along a straight tilted beam has been used in the source room. During the measurement time of 64 seconds, the loudspeaker has moved along the beam once through the room. The procedure is repeated once, resulting in a total measurement time of 128 seconds for both L_1 and L_2 .

The sound pressure levels are adjusted with respect to background noise using two separate 30 seconds long sample measurements of the background noise.

The equivalent absorption area A of the receiving room has, in accordance with SS-EN ISO 10140-4:2021, been calculated from Sabine's formula as

$$A = 0,16 \frac{V}{T}$$

where V is the volume of the receiving room [m^3] and T the reverberation time [s], calculated as an ensemble average of 24 decays for a loudspeaker placed in a corner and a microphone on a rotating boom.

Measurement rooms

Measurements were conducted in the upper air-borne sound insulation laboratory for doors and windows at RISE Borås. The volumes of the source and receiver rooms are $H \times W \times D = 3.43 \times 4.77 \times 6.15 = 101 \text{ m}^3$ and $h \times w \times d = 4.25 \times 4.91 \times 6.15 = 128 \text{ m}^3$, respectively. The distance from the test object to floor and closest wall was 0.9 m and 2.3, respectively.

Mounting

The mortar was applied partly inside a slit that was created between the sending and receiving room. The slit was 15 mm wide and located around a quadratic wooden frame that was clad with a steel plate on each side. The side of the square was 1180 mm and its thickness was 120 mm. The total length of the slit, calculated 10 mm from the quadratic wooden frame, was thus 4.80 m. In Figure 1 a picture of this and the rest of the partition wall, as seen from the sending room during mounting, can be seen.

Prior to measurement on single-sided application, the mortar was hardened one day (24 hours).

Prior to measurement on double-sided application, the mortar on the two sides was hardened three and four days, respectively.

In section Test object more details on mortar application depth can be found.

Sound transmission through constructions other than the mortar itself is compensated for by measurement on a reference case where the slit was insulated by mineral wool and caulked on both sides by clay, in accordance with correction for $R_{s,\text{max}}$ as described in Annex J of SS-EN ISO 10140-1:2021.

Evaluation

The results have been evaluated with respect to the weighted laboratory sound reduction index of joints $R_{s,w}$ according to SS-EN ISO 717-1:2020. The reference curve used for determining $R_{s,w}$ is defined for the third-octave bands having centre frequencies 100 – 3150 Hz.

In the appendices spectrum adaptation terms for various noise spectrum forms are provided: C corresponds to adaptation to typical indoor noise or high velocity traffic noise (so-called pink noise, i.e. larger high-frequency content compared to urban traffic noise) while C_{tr} applies to the spectrum of typical urban traffic noise.

Corresponding adaptation terms are also defined for the extended third-octave frequency band ranges 50 – 3150 Hz and 50 – 5000 Hz, and are then designated $C_{50-3150}$ and $C_{tr,50-3150}$, and $C_{50-5000}$ and $C_{tr,50-5000}$, respectively. These are provided "as-is" for general information although the general requirements in Annex A of SS-EN ISO 10140-4:2021 regarding room dimensions are not fulfilled for frequencies below 100 Hz.

Measurement uncertainty

The expanded uncertainties U , according to ISO 12999-1:2020, regarding *reproducibility* of airborne sound insulation are given Table 2. It is assumed that U for the weighted sound reduction index R_w is also representative of $R_{s,w}$, the weighted sound reduction index for joints.

The reproducibility uncertainty corresponds to the spread in measurement data in comparison tests between different laboratories with different test rooms, equipment, personnel, etc. The repeatability of measurements in the same laboratory is normally considerably better.

The values $U = k\sigma_R$ in the table, where σ_R is the reproducibility standard deviation, are given with the confidence level $k = 1.96$ (95 % confidence level)

Table 2: Expanded measurement uncertainties for reproducibility of sound reduction index in third-octave bands. The table also includes the corresponding uncertainty for weighted sound reduction index R_w .

<i>Third-octave band centre frequency [Hz]</i>	<i>Expanded measurement uncertainty U [dB]</i>
50	13.6
63	9.2
80	7.6
100	6.0
125	5.4
160	4.8
200	4.2
250	3.6
315	3.6
400	3.6
500	3.6
630	3.6
800	3.6
1000	3.6
1250	3.6
1600	3.6
2000	3.6
2500	3.8
3150	4.0
4000	4.8
5000	5.6
R_w	2.4

Pictures



Figure 1: The quadratic steel-plate clad wooden frame in the variable test opening, as seen from the sending room at the time of mounting.



Figure 2: The fire stop mortar (white) from receiving room



Figure 3: The fire stop mortar (white) at double-sided application from sending room



Figure 4: Picture of a part of the backing insulating rod (grey) used for controlling mortar depth on the receiving side (see Appendix 1). The slit is 15 mm wide.



Figure 5: Prior to test measurement on the reference case “Mineral wool in slit and double-sided clay caulking” (see Appendix 5).

Instrumentation

<i>Instrument</i>	<i>Manufacturer</i>	<i>Type</i>	<i>Serial no. / label</i>
Microphone (sending room)	Brüel & Kjaer	4166	1011605
Microphone (receiving room)	Brüel & Kjaer	4166	1072010
Microphone preamplifier (sending room)	Brüel & Kjaer	2619	970951
Microphone preamplifier (receiving room)	Brüel & Kjaer	2619	726782
Microphone power supply (sending room)	Brüel & Kjaer	2804	1054213
Microphone power supply (receiving room)	Brüel & Kjaer	2804	455245
Rotating microphone stand (sending room)	Brüel & Kjaer	3923	761963
Rotating microphone stand (receiving room)	Brüel & Kjaer	3923	681300
Loudspeaker (sending room)	SP		Högtalare 4
Loudspeaker (receiving room)	SP		Hörnhögtalare No. 3
Loudspeaker amplifier	Crest Audio	CPX-900	-
Noise reduction system (loudspeaker receiving room)	Behringer	Denoiser SNR 1000	51125616
Equaliser (loudspeaker sending room)	Apex	PE 232MKII Paragraphic equaliser	139401272
Sound analyser	Norsonic	850	8501116
Barometer / Hygrometer / Thermometer	Vaisala	PTU303	S0930516
Calibrator	Brüel & Kjaer	4230	1411048
Weighing scale	Stathmos	490.19SB	1377

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Appendices

Appendix 1: FPS Brandskyddsmassa: Single-sided application with backing insulation rod

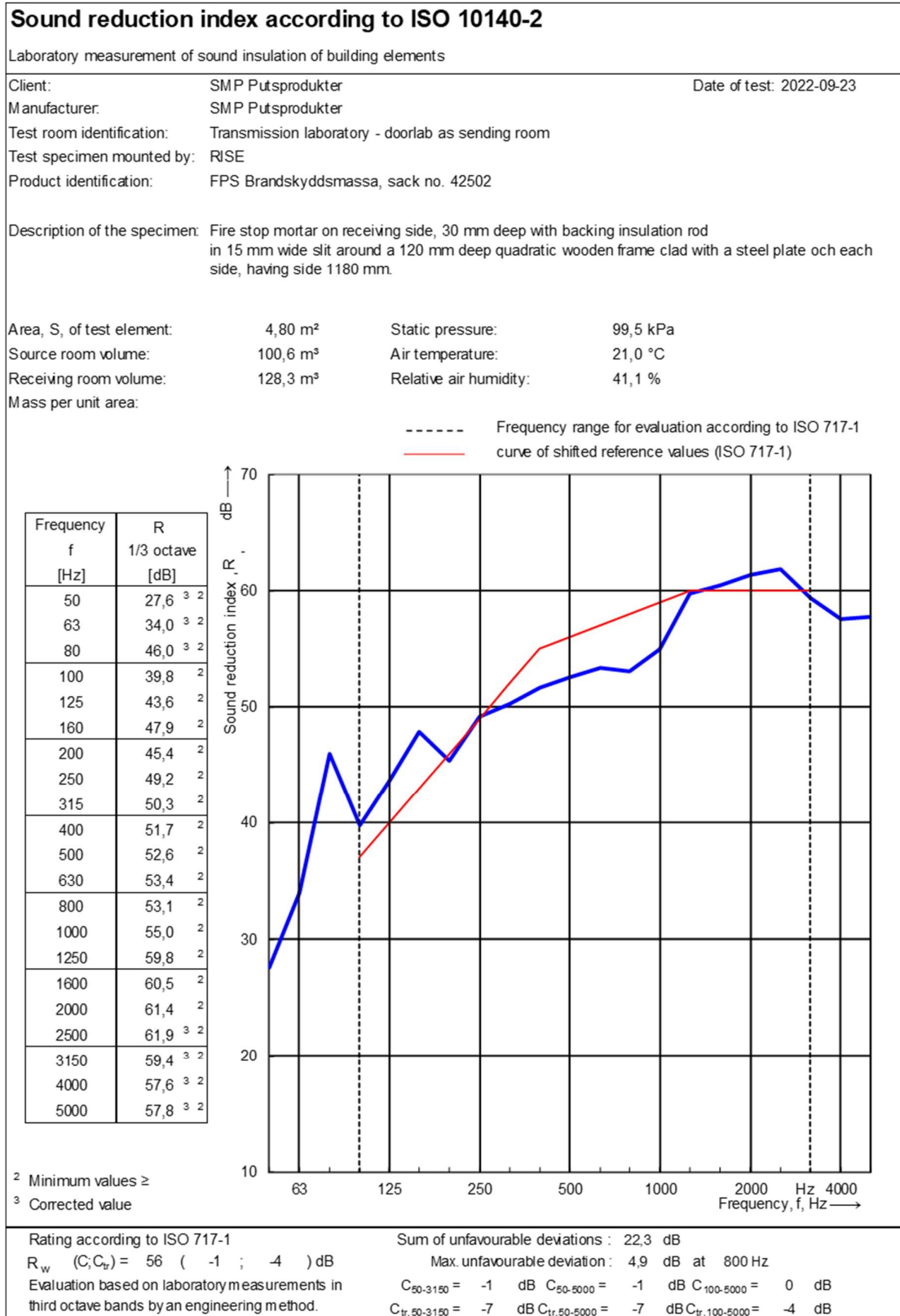
Appendix 2: FPS Brandskyddsmassa: Single-sided application without backing insulation rod

Appendix 3: FPS Brandskyddsmassa: Double-sided application without backing insulation rod

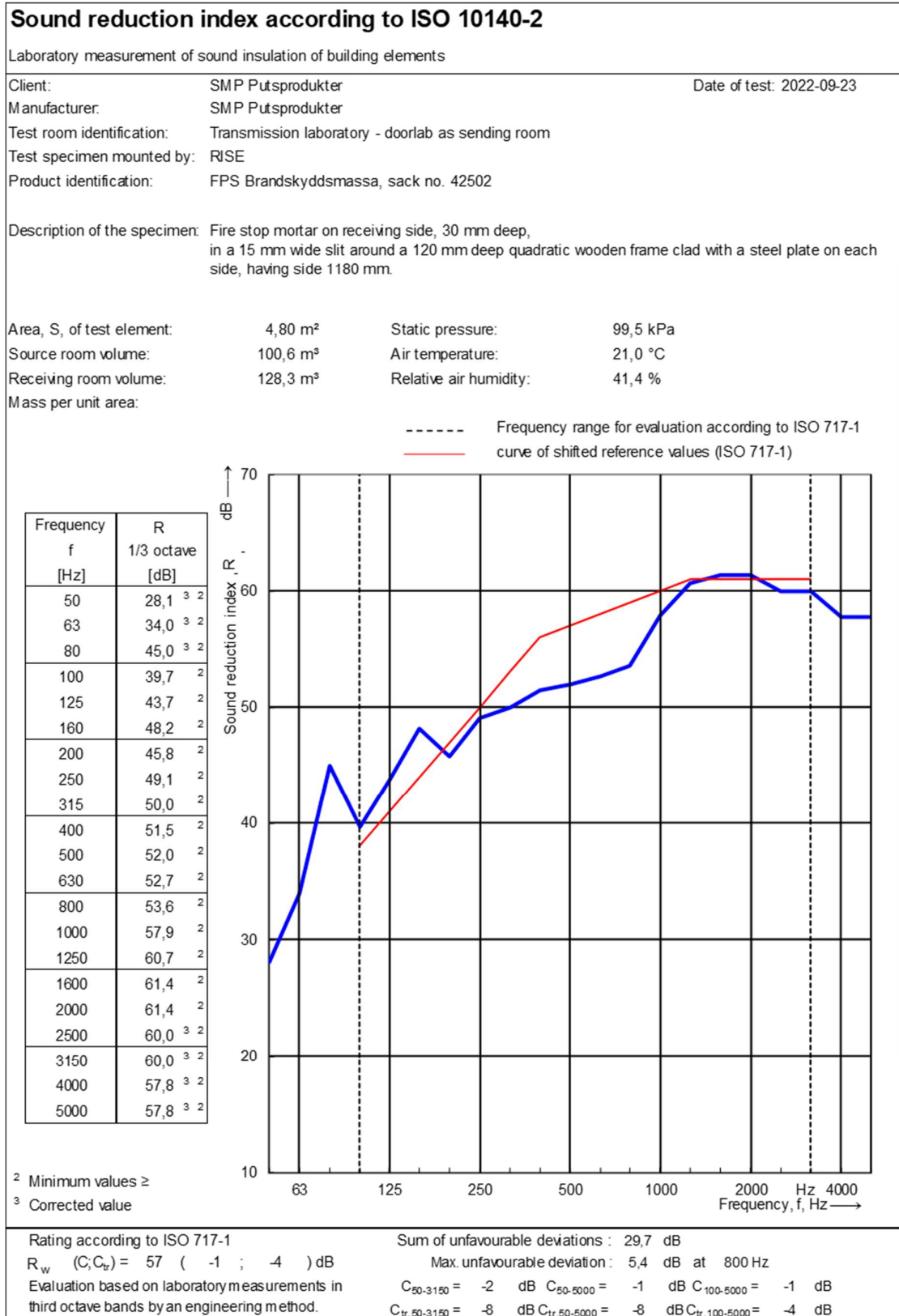
Appendix 4: Reference: Open slit

Appendix 5: Reference: Mineral wool in slit and double-sided clay caulking

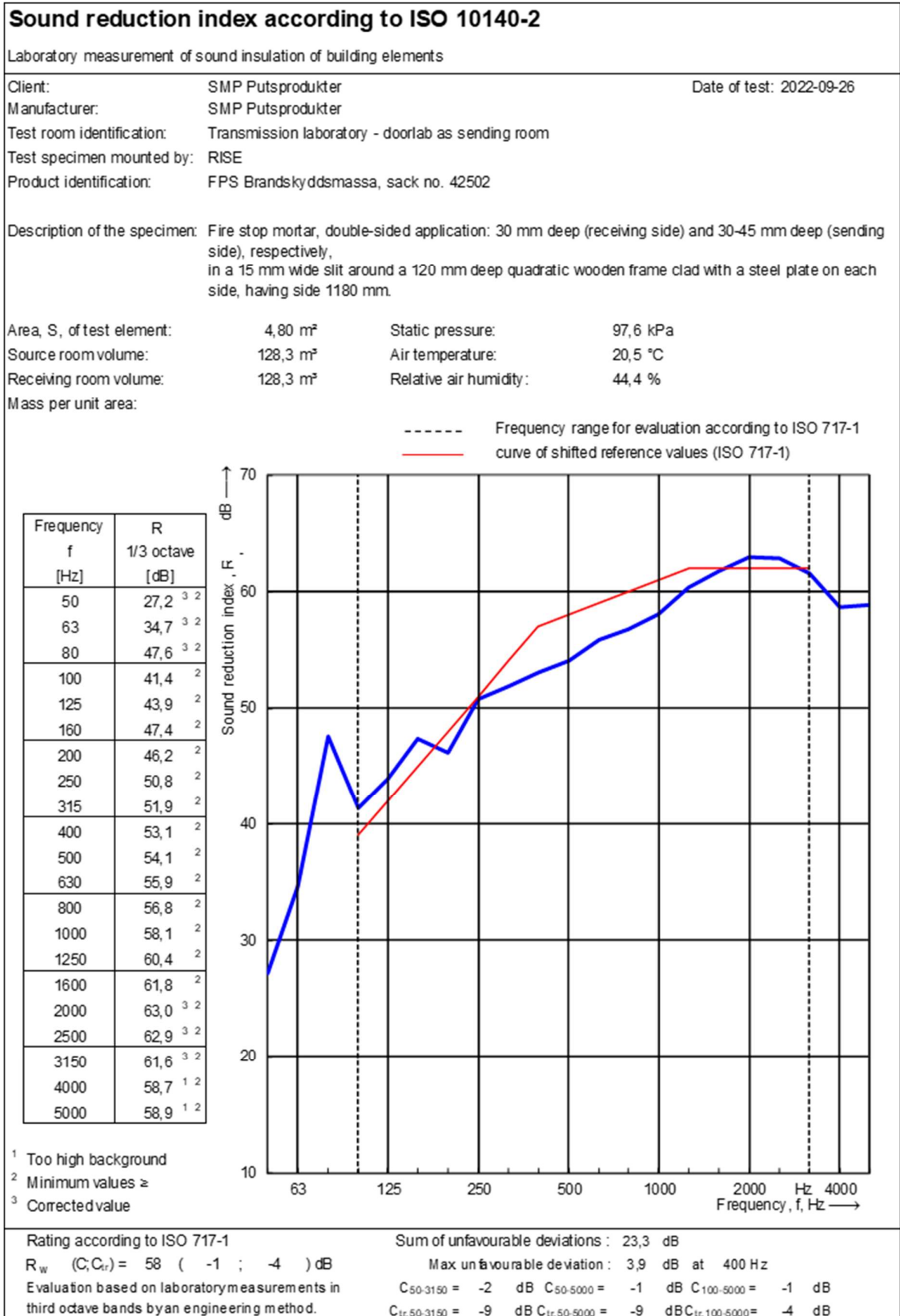
Appendix 1



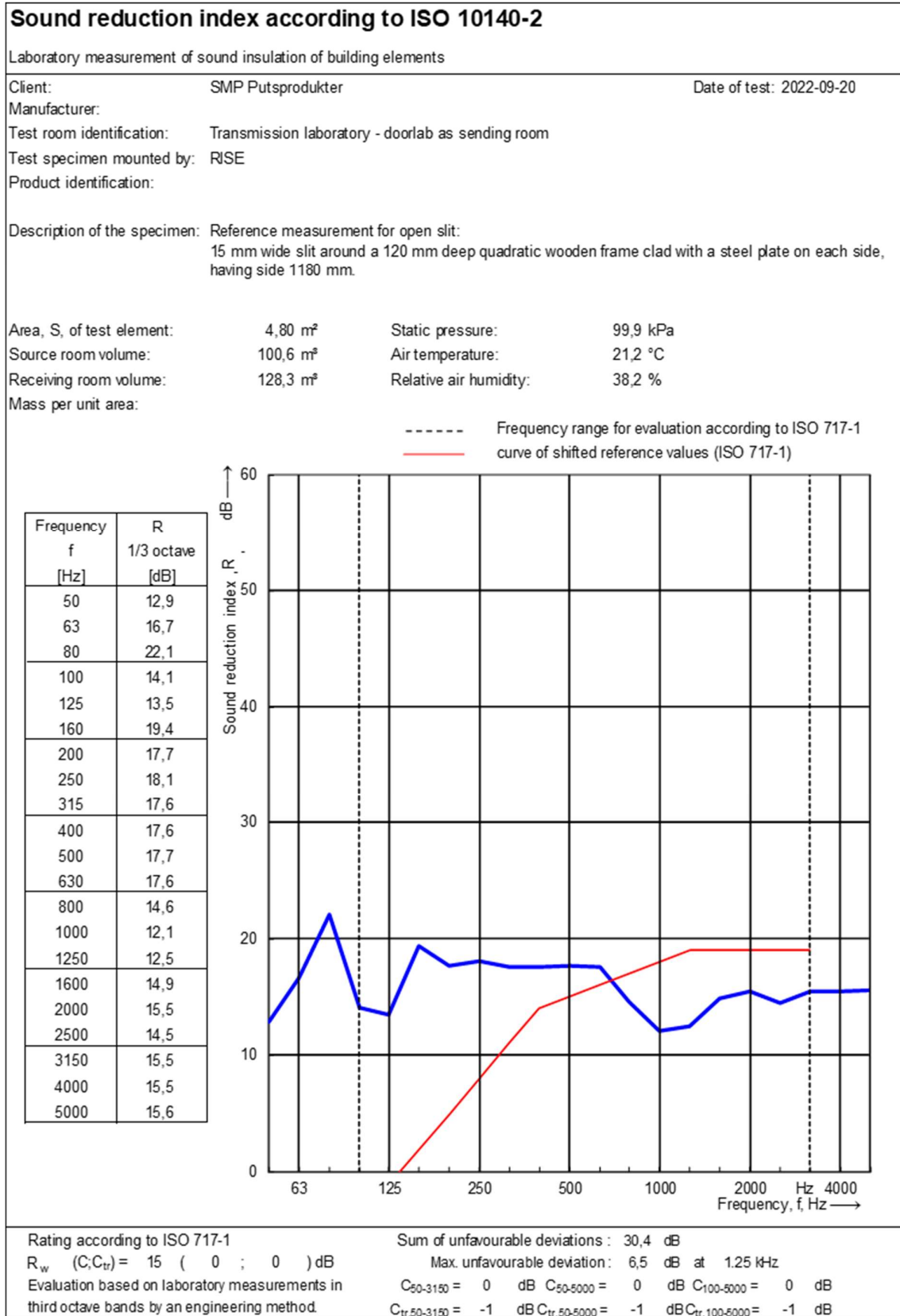
Appendix 2



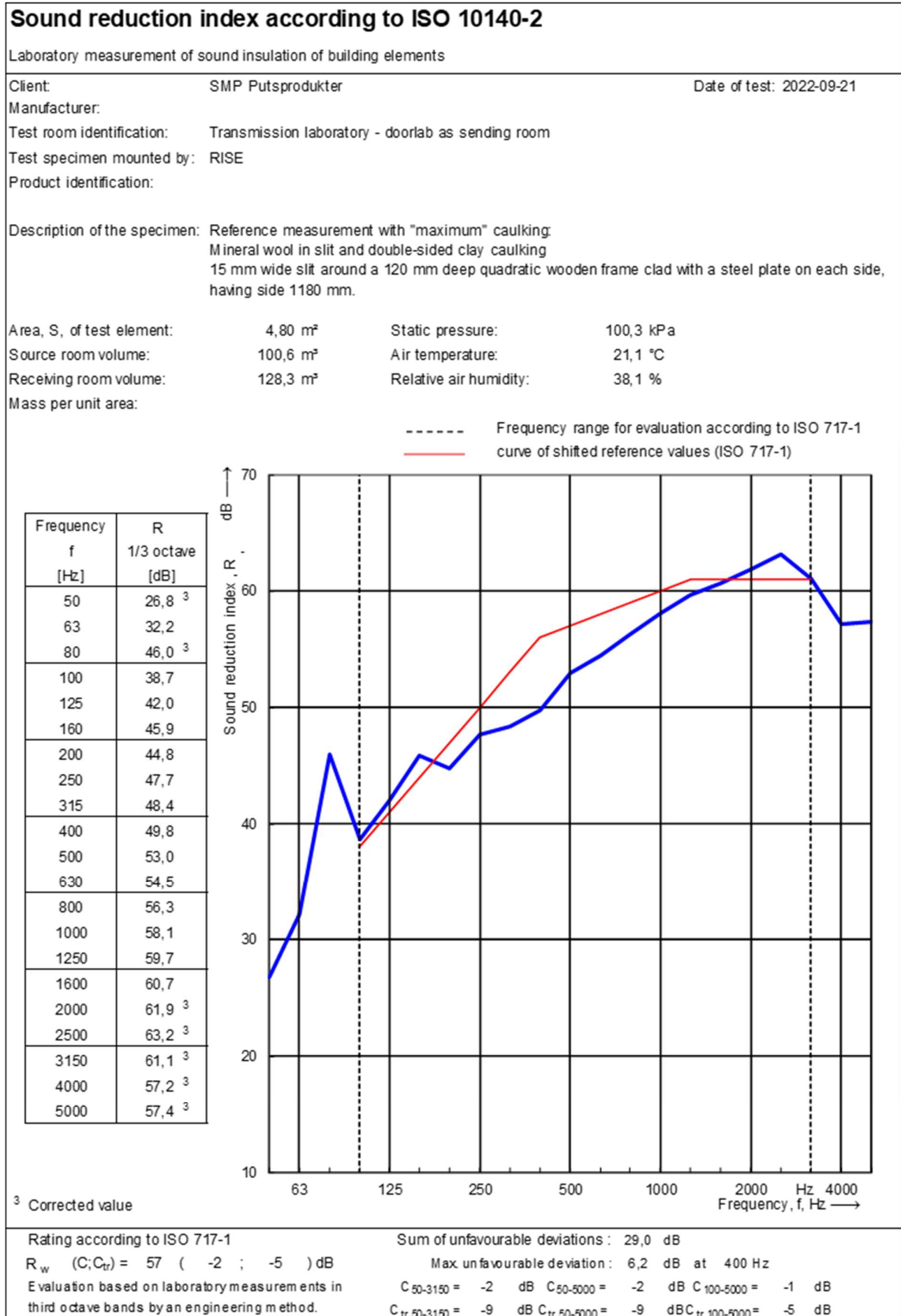
Appendix 3



Appendix 4



Appendix 5



Verification

Transaction 09222115557482710516

Document

O100282-1129190-eng Report

Main document

16 pages

Initiated on 2022-12-02 16:06:03 CET (+0100) by Georgios Natsiopoulos (GN)

Finalised on 2022-12-02 16:06:49 CET (+0100)

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