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TEST REPORT PB 1725

Client/Manufacturer:	HART Keramik AG Mittelteicher Str. 6 95652 Waldsassen
Commissioned:	Determination of the sound reduction index according to DIN EN ISO 10140-2 [12-2010] on a test
Standard / Approval:	specimen DIN EN ISO 10140-2 [12-2010]
Sample identification:	Lemix 2.0, panel size 62.5 cm x 125.0 cm x 2.0 cm (IAB sample no. 17101)
Source of sample:	HART Keramik AG
Sample production date:	factory
Sample collection person:	HART Keramik AG employees in the
Sample collection date:	factory
Processor/examiner: Test	Dipl.-Ing. Alrik Badstübner
facility device:	Sound test rig according to DIN EN ISO 140-1 [03-2005]

This test report consists of 8 pages including cover sheet and appendix.

Institut für Angewandte Bauforschung Weimar gemeinnützige GmbH IAB

Weirńar, 20.04.2017

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Head of Test

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1 Task

According to the order, the sound reduction index R of a wall consisting of a stud frame with clay building boards on both sides was determined in the wall test rig according to DIN EN ISO 10140-2.

2 Description of the test object

Type of test object:	Clay slab
Manufacturer:	HART Keramik AG Mittelteich Str. 6 95652 Waldsassen
Type designation:	Lemix 2.0
Description:	Wooden post and beam construction (60 mm x 80 mm) with cavity board insulation Thermo Jute 100 (80 mm thick) and single-layer clay board Lemix 2.0 (62.5 cm x 125 cm x 2 cm) on both sides with approx. 2 mm Agaton clay finishing plaster.
Fastening conditions: Bulk density:	Permanently installed in the test frame Plastered on both sides
Dimensions: Wall thickness:	approx. 80 kg/m2 W x H = 4.99 m x 2.50 m = size of test opening
Curing time:	approx. 12.4 cm
Installation by:	34 days Client
ÜOtOS :	

3 Metrological test

3.1 General information

The test took place on 28 March 2017 in the wall test stand at the IAB - Institut für Angewandte Bau- forschung Weimar gemeinnützige GmbH, Über der Nonnenwiese 1 in 99428 Weimar. It was carried out by Dipl.-Ing. Alrik Badstübner.
The environmental conditions are specified on the test certificate in Appendix 1.

3.2 Testing equipment

The following test equipment was used.

- Two-channel real-time frequency analyser SINUS Soundbook, serial number 07046
- Microphones type MK 255 Microtech Gefell, serial numbers 11175 (channel 1) and 11190 (channel 2) with microphone amplifiers type MV 210, serial numbers 2981 (channel 1) and 2982 (Channel 2)
- Dodecahedron Brüel & Kjaer Omnipower Type 4292, serial number 029009
- Measuring amplifier Brüel & Kjaer Type 2716, serial number 00142591 V35/09
- Acoustic calibrator Larson & Davis type CAL200, serial number 8683

The calibration for the acoustic calibrator Larson & Davis type CAL200 is valid until March 2018. The calibration was carried out by SPEKTRA Schwingungstechnik und Akustik GmbH Dresden.

3.3 Standards applied

The following standards were applied for the testing and evaluation of the measurement results.

[1] DIN EN ISO 10140-1, edition 09/2014, "Acoustics - Measurement of sound insulation of building components on a test bench - Part 1: Application rules for specific products

(2] DIN EN ISO 10140-2, edition 12/2010, "Acoustics - Measurement of sound insulation of building components on a test bench - Part 2: Measurement of airborne sound insulation".

[3] DIN EN ISO 10140-4, edition 12/2010, "Acoustics - Measurement of sound insulation of building components on a test bench - Part 4: Measurement methods and requirements".

[4] DIN EN ISO 10140-5, edition 09/2014, "Acoustics - Measurement of sound insulation of components on a test bench - Part 5: Requirements for test benches and test equipment".

[5] DIN EN ISO 10848-1, edition 08/2006, "Acoustics - Measurement of airborne and impact sound transmission between adjacent rooms in test stands - Part 1: Framework document".

[6] DIN EN ISO 12999-1, edition 09/2014, "Acoustics - Determination and application of measurement uncertainties in architectural acoustics - Part 1: Sound insulation".

4 Test result

With the help of the building acoustics quality test, the assessed sound insulation Mä/ Rw shown in the following table was recorded for the investigated component.

Attachment	Component	Rated sound reduction index Rp in d B
1	Wall in stud construction with internal insulation made of Thermo Jute 100 (80 mm thick) as well as both- Lemix 2.0 clay building board (62.5 cm x 125 cm x 2 cm) attached on both sides with approx. 2 mm Agaton clay finishing plaster on both sides	52

The frequency curve of the sound reduction index R is shown in the test certificate in Appendix 1.

The test result is inklusi\le of the expanded uncertainty U = 1.2 dB according to DIN EN ISO 12999-1:

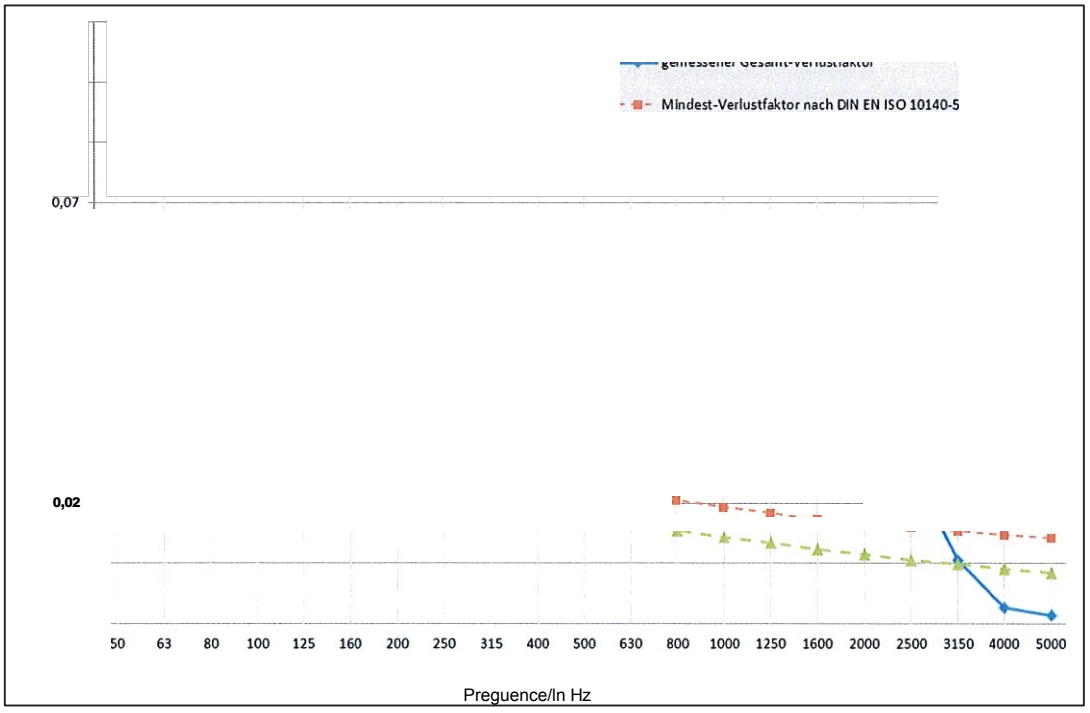
R = (52.1 4 1.2) dB (k = 1, two-sided)

Erläuterung: Die erweiterte Unsicherheit U = 1,2 dB = k * u wurde mit der aus Tab. 3 der DIN EN ISO 12999-1 entnommenen Standardunsicherheit u = σ_R = 1,2 dB und dem Erweiterungsfaktor k = 1 berechnet. σ_R stellt eine Vergleichsstandardabweichung dar, die aus Ringversuchen gewonnen wurde. k = 1 gilt bei zweiseitiger Prüfung für ein Vertrauensniveau von 68 %.

5 Appendix A Total loss factor and converted sound reduction indexes

f [Hz]	η_{mess} []	η_{min} []	$R_{\eta_{mess}}$ [dB]	η_{Bau} []	$R_{\eta_{Bau}}$ [dB]
50	0,055	0,052	12,0	0,039	10,7
63	0,064	0,048	11,4	0,036	10,2
80	0,065	0,044	18,5	0,033	17,3
100	0,064	0,040	37,8	0,031	36,6
125	0,063	0,037	30,0	0,029	28,9
160	0,053	0,034	30,8	0,026	29,8
200	0,056	0,031	32,4	0,024	31,3
250	0,049	0,029	34,9	0,023	33,8
315	0,045	0,027	41,2	0,021	40,2
400	0,044	0,025	47,0	0,019	45,9
500	0,041	0,023	51,8	0,018	50,7
630	0,038	0,022	53,0	0,017	51,8
800	0,034	0,021	56,4	0,015	55,1
1000	0,031	0,019	60,4	0,014	59,1
1250	0,035	0,018	61,4	0,013	60,0
1600	0,028	0,018	63,7	0,012	62,2
2000	0,031	0,017	62,7	0,011	61,0
2500	0,026	0,016	58,9	0,011	57,1

T"",s Measured total loss factor
//";; Minimum loss factor according to DIN EN ISO 10140-5
fii „s Sound reduction index standardised to g ;,
B" Typical average construction loss factor according to Resolution Book No. 19 of the Working Group on Sound Testing Bodies
R ", Sound reduction index standardised to *rB'*



Appendix B Test methods

The sound attenuation test was carried out according to DIN EN ISO 10140-2 with a dodecahedron as spherical sound source, which was set up at 11 fixed positions in the transmission room. The selection of suitable loudspeaker positions was made according to Annex D of DIN EN ISO 10140-5, whereby the measurement itself was carried out in the extended frequency range from 50 Hz to 5,000 Hz.

The spatial averaging of the sound pressure levels was carried out with continuously moving microfoils along a circular arc of 360 with a path circulation time of 30 s, whereby the path radius was at least 1.00 m, the path plane was inclined by at least 10° with respect to the space-limiting surfaces and the averaging time was 30 s.

The value of the sound reduction index is determined by calculating the difference between the average sound pressure level in the receiving ten andtransmitting room ,taking into account the e q u i v a l e n t sound absorption area in the receiving room and the area of the separating component' @è°. @è° is determined as follows

$$fi = Li \quad Lz + 101d\frac{S}{A}\ [dB]$$

MİN:

L1' mean sound pressure level in the emitting room [dB]
L : mean sound pressure level in the receiving room [dB]
s: Area of the separating component [m'J
A: Equi√alente sound absorption area in the receiving room [m*j ... î.–

The single-number value for the weighted sound reduction index Mă/ Rw is determined according to DIN EN ISO 717-1 from the measured third-octave band values by comparison with the reference curve for airborne sound third-octave bands. For this determination of the weighted sound reduction index, the frequency range 100 Hz - 3,150 Hz is taken into account.

The spectrum adjustment values C and Ct are used to evaluate the sound insulation in relation to typical sound level spectra of different noise sources in addition to the single number value R. The respective spectrum adjustment value must be added to the evaluated sound reduction index R. For this purpose, the respective spectrum adjustment value must be added to the weighted sound reduction index R. According to Table A.1 of DIN EN ISO 717-1, the spectrum adaptation value C (spectrum 1) can be used for predominantly medium- and high-frequency noise sources, such as residential activities, children's games, motorway traffic > 80 km/h, rail traffic at medium and high speeds, jet aircraft at short distances and businesses that predominantly emit medium- and high-frequency noise.

Spectrum adjustment value C (spectrum 2) may be used for e.g. urban road traffic, low-speed rail traffic, propeller aircraft, long-range jet aircraft, disco music and businesses that emit predominantly low and mid-frequency noise. The spectrum adjustment values may further be related to one or more extended frequency ranges: e.g. 50 - 3,150 Hz, 100 - 5,000 Hz, 50 - 5,000 Hz. In this case, the matched frequency range is given as an index.

The reverberation time T in the receiving room, which is necessary to determine the equivalent absorption area A, was determined according to equation (5) of DIN EN ISO 10140-4 with A = 0.16 V/T and the method of integrated impulse response for 5 different combinations of loudspeakers and microphone positions according to DIN EN ISO 3382-2. Thereby, the reverberation time in the measuring rooms according to DIN EN ISO 10140-5 is between 1 s and 2 s.

The extraneous noise correction was carried out according to the regulations of DIN EN ISO 10140-4, section 4.3, if required by the level differences in the third octave bands. The extraneous noise level should be at least 6 dB (preferably more than 15 dB) below the sound level to be measured including extraneous noise level. If the difference is greater than 6 dB but less than 15 dB, the corrected sound level in the receiving room is as follows:

$L = 10 \lg 10^{0,1 L_h} - 10^{0,1 L_r}$ [dB]

with:

L_h: Corrected sound level of the measured signal [dB] Sound pressure level of the measured signal incl. extraneous noise level [dB].

L_r: Extraneous noise level [dB]

The loss factor was determined according to DIN EN ISO 10140-4 by measuring the structure-borne sound reverberation time according to DIN EN ISO 10848-1. The method with hammer excitation was used, whereby ten transducer positions with three excitation points each and three excitations each were used. The analysis of the impulse responses was carried out according to the time reversal method.

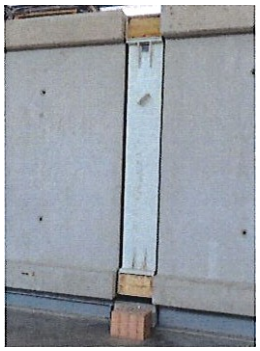
7 Appendix C Description of the test bench

The measurements were carried out in the wall test stand at the IAB - Institut für Angewandte Bauforschung Weimar gemeinnützige GmbH, Über der Nonnenwiese 1 in 99428 Weimar. The wall test stand is a movable construction with an exchangeable metal mounting frame. It is located in a test hall with a solid concrete floor. The test hall itself stands on solid ground.

The test stand is a prefabricated solid construction made of reinforced concrete elements with a thickness of d = 30 cm. This results in an area-related mass \/on m = 690 kg/m^2 . The two test rooms (transmitting and receiving room) are mounted on rails which are elastically decoupled from the floor of the test hall. The receiving room can be moved by means of a hydraulic system and thus enables the installation and removal of the installation frame.

The installation frame has a width of 40 cm. It is inserted into the space between the two test rooms and clamped tightly by moving the receiving room between the rooms. It remains elastically decoupled from the two test rooms and from the floor support. The test object is usually installed in the centre of the frame. Additional covers are used for sealing. For wall thicknesses < 40 cm, these are installed on both the transmitting and receiving sides. If the wall thickness is 40 cm and thus completely covers the metal frame, a cover is only required on the receiving side.

The following illustrations show an example of the installed test frame from the outside (left) and the cover on the receiving side in the overall view (centre) and in detail (right).



The volumes of the two test rooms up to the level of the test frame are 55 m^3 in the transmitter room and 50 m^3 in the receiver room. The actual volumes in the test situation depend on the wall thickness of the test specimen. The test opening has clear dimensions of W x H = 5.0 m x 2.5 m.

Sound absorber modules are installed in both test rooms to regulate the reverberation time.

The wall test stand was tested by the Physikalisch-Technische-Bundesanstalt (PTB) with the following result:

"The sound insulation of a solid wall measured in the IAB wall test stand agrees with the available interlaboratory test results. There are no objections to the use of the test stand...
Determination of the sound-insulating properties of wall constructions there are k Objections." (PTB report no. PTB-1. 72-4065350 of 01.06.2014, 5. 7, para. 9).

"

The results refer exclusively to the sample material/the test set s

End of the test report

Sound level difference according to DIN EN ISO 10140-1

Annex 1/1

Manufacturer:	**HART Keramik AG**	**Product Name:**	**Clay building board Lemix**
Client:	**HART Keramik AG**	**2.0 (Order number:**	**GIB-BS 125/16**
	Mittelteich Str. 6		
	95652 Waldsassen		

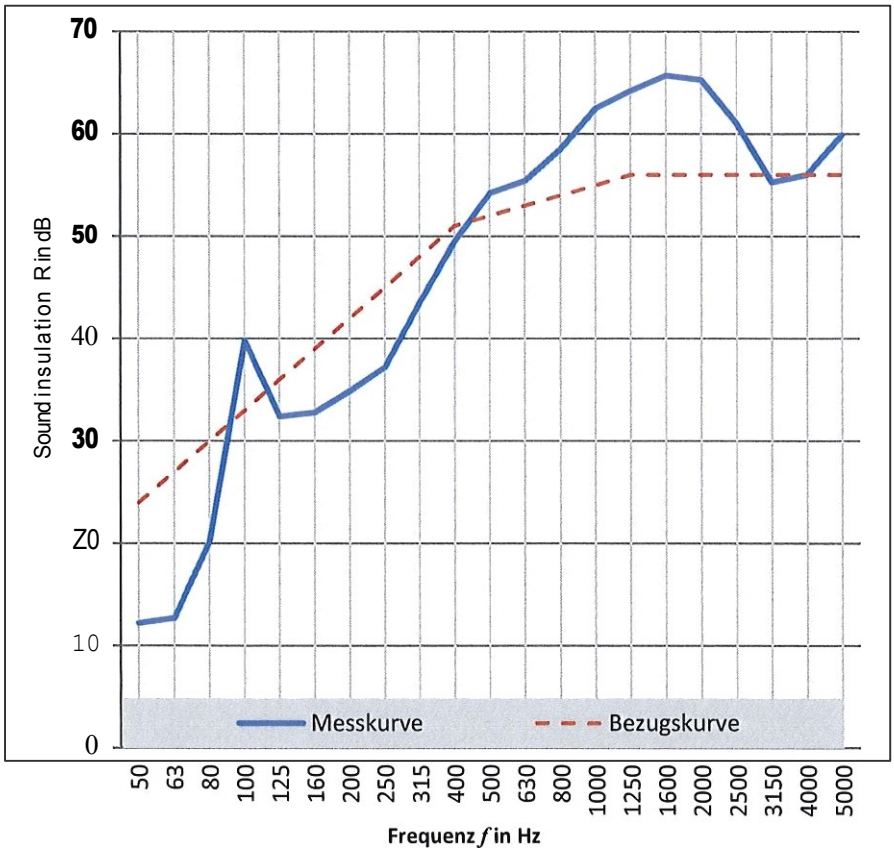
Test component installed by: Client Date of installation: 21.02. - 22.02.2017

Plastering date: 22.02.2017
Test date: 28.03.2017

Description: **Clay building board Lemix 2.0 (62.5 x 125 x 2 cm˚) on both sides on wooden stud frame (60 x 80 ^{mm2}) with internal insulation Thermo Jute 100 (80 mm).**
Plastered on both sides with approx. 2 mm Agaton loam finishing plaster, single layer
11 loudspeaker positions and one microphone position each moving in a circular path

Test area	**11,7 m***	**Air temperature in the test**	**21 °C**
room:			**36 %**
Bulk density:	**approx. 80 $^{kg/m2}$**	**Humidity in the test**	**990 hPa**
room: Volume of the transmitter room:		**55,00 m'** **Static**	**white noise**
pressure: volume of the receiving room:		**51,66 m"** **Test**	
sound:			

Frequency f [Hz]	Level diff. R [dB]
50	12,2
63	12,7
80	20,2
100	39,8
125	32,4
160	32,8
200	34,9
250	37,2
315	43,5
400	49,5
500	54,2
630	55,4
800	58,5
1000	62,5
1250	64,2
1600	65,7
2000	65,3
2500	61,0
3150	55,3
4000	56,0
5000	59,9



Rating according to ISO 717-1 Rp(C ; Ch.f= 52 (-8; -7) dB *so szso' -3 dB Cso-soo-o7' dB Cj0Q-als'o -8 dB

Ct! s -iso' -20 dB Ct so-soo' -20 dB Ct! oo-s s - -7 dB

IAB - Institute for Applied Building Research gGmbH Weimar gemeinnützige GmbH

Research Test Report: PB 17/25 Weimar, 20.04.2017

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