**Forschungs - und Entwicklungsgemeinschaft
für Bauphysik e. V.
an der Fachhochschule Stuttgart,
Hochschule für Technik**

Prof. Dr.-Ing. H.-M. Fischer

Report Nr. FEB/FS-80/17 – 1e

Measurement of the insertion loss of the pipe clamp FRS-L for fresh water pipes

Client:

fischerwerke GmbH & Co. KG

Weinhalde 14 – 18

72178 Waldachtal

Project Nr.: FEB/FS-80/17

This report contains 9 pages

Stuttgart, 31th March 2017

Editors:

Dr. Jochen Scheck

Dipl.-Ing. (FH) Andreas Ruff

Project leader:

Prof. Dr.-Ing. H.-M. Fischer

Forschungs- und Entwicklungsgemeinschaft für Bauphysik e.V.
an der Hochschule für Technik Stuttgart
FEB, Postfach 10 14 52, 70013 Stuttgart

TABLE OF CONTENTS

1. Scope of work

The company fischerwerke GmbH & Co. KG produces pipe clamps to connect pipes to walls and floors. Through the contact points structure-borne sound is transmitted into the building that results in an unwanted sound radiation into living rooms. In order to reduce the sound transmission, the insides of the pipe clamps made of steel are covered with rubber profiles. The acoustical performance of the rubber profiles should be quantified by an experimental determination of the insertion loss. For this an experimental set-up with a 1“ - steel pipe was realised in the installation test stand of the HFT Stuttgart. The structure-borne sound transmission resulted from vibrations of the steel pipe due to water flow.

2. Date and location

Measurements were performed at 17th March 2017 in the installation test stand located in the Zentrum für Bauphysik der Hochschule für Technik Stuttgart, Pfaffenwaldring 10a, Stuttgart-Vaihingen.

3. Test object

The pipe clamps consist of two steel elements and a screw nut welded on one of the elements for connection to the wall with a M8- or M10 threaded rod. The trade names of the clamps given by the manufacturer are FRSN-L (without rubber profiles, clamping range 31-37 mm) and FRS-L (with rubber profiles, clamping range 25-30 mm). The tests were performed in combination with a 1“ - steel pipe that was connected to an installation wall in the installation test stand (Figure 1, Figure 2). The clamping range of the pipe clamps was adjusted to the outside-diameter of the pipe.

4. Test procedure

As measure for the insulating effect of the rubber profiles the frequency dependent insertion loss and as single number value the frequency independent A-weighted sound level reduction were determined. Therefore the sound transmission of pipe clamps with and without rubber profiles was measured.

4.1 Installation test stand

The installation test stand at the Hochschule für Technik Stuttgart is shown in Figure 3. The test configuration was realized in the ground level. As installation wall between the sending room (2a left) and the receiving room (2a right) a 11,5 cm thick Calcium-Silicate wall with density class 2.0, plastered on both sides, was installed. From the walls' properties the calculated mass per unit area is m' ≈ 220 kg/m², which corresponds to the lightest single-leaf wall, that water installations can be attached to without an acoustical suitability test. Also in DIN 4109-36: 2016 the reference wall regarding the fulfillment of requirements has a mass per unit area of m' ≈ 220 kg/m². The installation wall was rigidly connected to the test stand.

4.2 Test set-up

The test set-up that was realized in the ground level of the installation test stand consists of a 2,5 m long 1'' - steel pipe (wall thickness 3 mm), that was attached to the installation wall in vertical direction with fischer pipe clamps (Figure 2). The pipe was angled such that the vertical part of the pipe had a length of 2 meters. For the attachment of the pipe clamps metal expansion anchors (fischer Hammerset anchor EA II M 10 x 40) were inserted in the wall at 2 positions with a distance of 100 cm in between. The pipe clamps were screwed into the anchors using M10-threaded rods, the distance between pipe clamp and wall was 40 mm. When the pipe clamps were exchanged the pipe clamps were first mounted at the reception plate and then the pipes were inserted. The pipe clamps were tightened with a torque of 2 Nm in order to provide a defined compression of the rubber profiles. The water inlet was attached to the lower end of the pipe. At the top end an Installation Noise Standard (IGN) according to DIN EN ISO 3822-1: 1999 was inserted. The water flowing off was silently drained in a waste water pipe DN100. The tests were performed with a flow pressure of 0,3 MPa, the flow rate was 16,4 l/min.

4.3 Insertion loss

The insertion loss is the frequency dependent difference of the A-weighted normalized sound pressure level in the receiving room without and with rubber profiles in the pipe clamps when the pipe is excited by a constant water flow:

$$\mathrm{D_e} = \mathrm{L_{AF,n,0}} - \mathrm{L_{AF,n,1}} \quad (1)$$

$\mathrm{D_e}$: Insertion loss [dB]

$\mathrm{L_{AF,n,0}}$: A-weighted normalized sound pressure level without rubber profile, in dB

$\mathrm{L_{AF,n,1}}$: A-weighted normalized sound pressure level with rubber profile, in dB

The A-weighed normalized sound pressure level is obtained by normalization to the reference absorption area:

$$\mathrm{L_{AF,n}} = \mathrm{L_{AF}} + 10\lg\frac{A}{A_0} \quad (2)$$

$\mathrm{L_{AF,n}}$: A-weighted normalized sound pressure level, in dB

$\mathrm{L_{AF}}$: A-weighted sound pressure level, in dB

A: the measured equivalent absorption area of the receiving room [m^2]

$\mathrm{A_0}$: the reference absorption area with $\mathrm{A_0} = 10\mathrm{m}^2$

The sound pressure levels in the receiving room were determined at 6 positions with respect to the correction of background noise and the correction of airborne sound transmission and averaged energetically. All measurements were taken in the frequency range 50 – 5000 Hz using 3rd octave band filters.

4.4 A-weighted sound level reduction

In addition the A-weighted sound level reduction D_A was determined from the difference of the A-weighted sum levels without and with rubber profile in the frequency range 50 – 5000 Hz.

$$\mathrm{D_A} = \mathrm{L_{AF,n,0,gesamt}} - \mathrm{L_{AF,n,1,gesamt}} \quad (3)$$

$\mathrm{L_{AF,n,0,gesamt}}$: A-weighted sum level without rubber profile, in dB

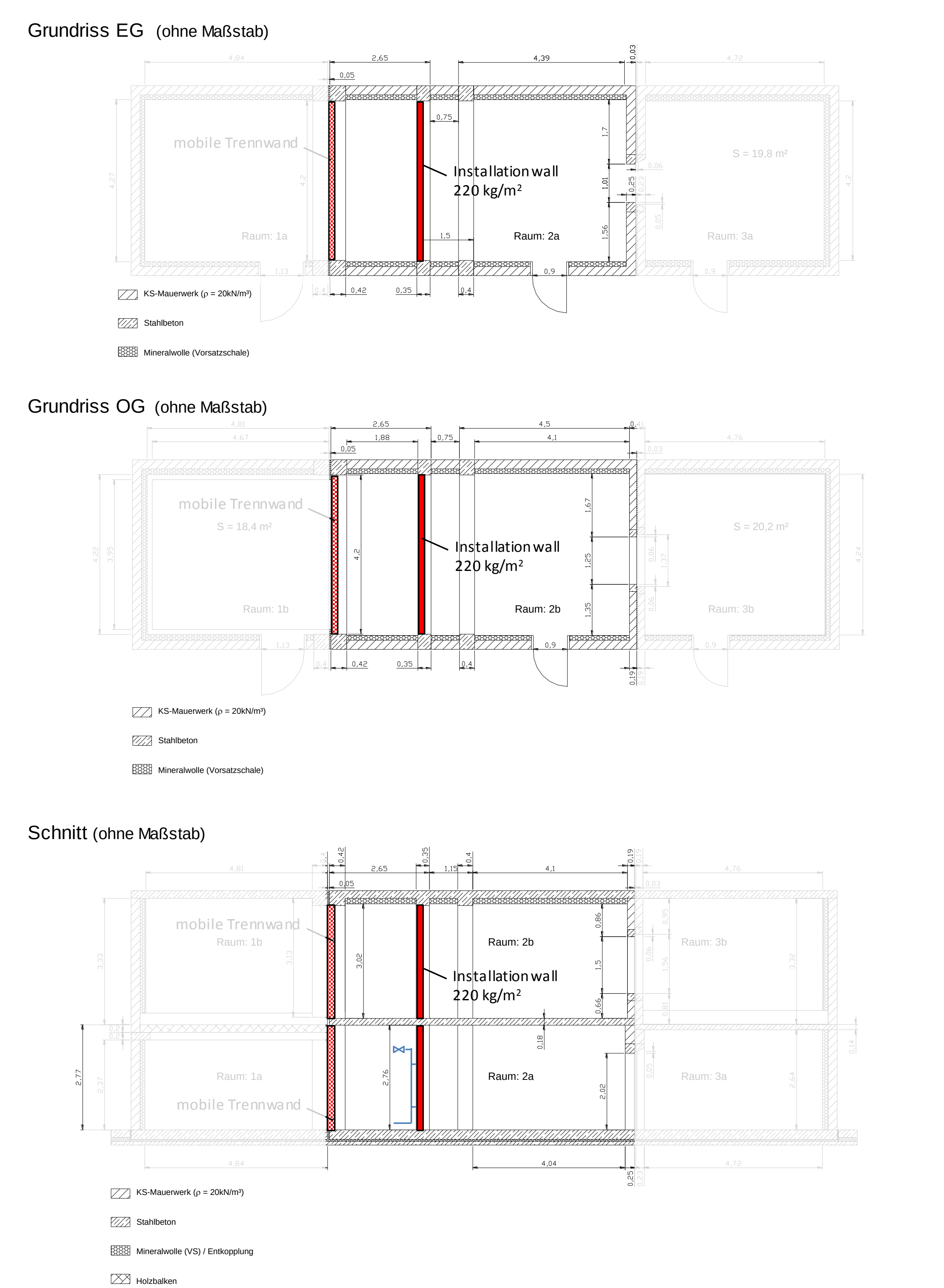
$\mathrm{L_{AF,n,1,gesamt}}$: A-weighted sum level with rubber profile, in dB

The A-weighted sound level reduction is a measure of the perceived noise reduction by humans due to the use of rubber profiles in relation to the rigid pipe clamps for the chosen test set-up. It is explicitly related to the sound spectrum generated by the IGN in the given transmission situation and is not readily transferable to other types of excitation and transmission situations.

5. Measurement results

In Figure 3 the frequency dependent insertion loss of the pipe clamp FRS-L 1‘‘, related to the pipe clamp FRSN-L 1‘‘ is shown. The A-weighted sound level reduction is DA = 7,1 dB.

Installation test stand at HFT Stuttgart



Hochschule für Technik Stuttgart

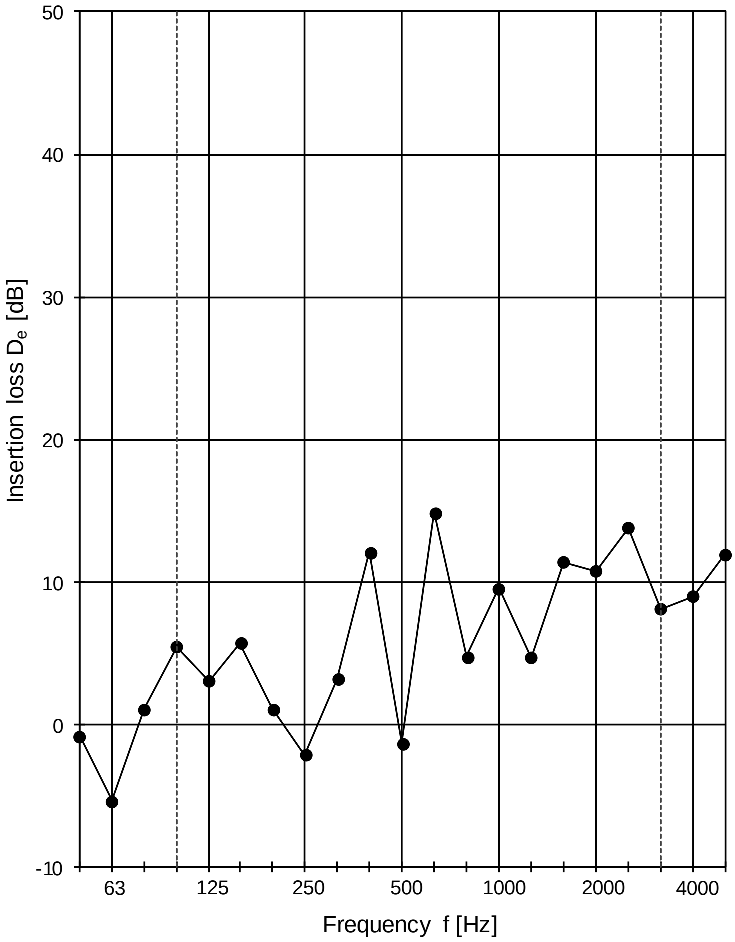
Figure 1: Test set-up in the installation test stand of the HFT Stuttgart for determination of the insertion loss of the pipe clamp FRS-L

Figure 2: fresh water pipe attached to the installation wall

Insertion loss

Client:	fischerw erke GmbH & Co. KG	Test date:	17.03.2017
Test facility:	Installation test stand at HFT Stuttgart		
Test specimen 1:	**pipe clamp FRSN-L 1''**		
Test specimen 2:	**pipe clamp FRS-L 1''**		
Description of the test set-up:	Installation w all: 11,5 cm CaSi, RDK 2,0, both sides plasterd fresh w ater pipe: 1" steel pipe w ith IGN; connection to the w all w ith pipe clamps (tightening torque 2 Nm) and metal expansion anchors w ith M 10-threaded rods		
Test procedure:	Measurement of sound pressure levels in the receiving room w ith constant w ater flow through the fresh w ater pipe w ith a flow pressure of 0,3 MPa		
Measurement direction:	horizontal		
Receiving room:	2a right V_E = 62,2 m³		

Frequency [Hz]	$L_{AF,n,0}$ [dB]	$L_{AF,n,1}$ [dB]	D_e [dB]
50	4,4	5,2	-0,8
63	3,9	9,2	-5,3
80	17,8	16,7	1,1
100	25,9	20,4	5,5
125	37,2	34,1	3,1
160	34,4	28,7	5,7
200	28,1	27,0	1,1
250	36,3	38,4	-2,1
315	46,5	43,3	3,2
400	54,8	42,7	12,1
500	49,2	50,5	-1,3
630	55,9	41,0	14,9
800	55,7	50,9	4,8
1000	52,5	42,9	9,6
1250	51,8	47,1	4,7
1600	57,3	45,9	11,4
2000	42,5	31,7	10,8
2500	43,5	29,7	13,8
3150	32,5	24,4	8,1
4000	36,0	27,0	9,0
5000	33,1	21,1	12,0
A-bew. Sum.	63,3	56,1	7,1



A-Sound level reduction from the difference of the A-w eighted sum levels in the frequency range 50 - 5000 Hz

D_A = 7,1 dB

Project number: FEB/FS-80/17 - 1	FEB Prof. Dr.-Ing. H.-M. Fischer	Date:	31.03.2017

Figure 3: insertion loss and A-weighted sound level reduction of the pipe clamp FRS-L 1“ related to the pipe clamp FRSN-L 1“