Report Nr. FEB/FS-75/13 – 3e

Measurement of the insertion loss of the pipe clamp FRSPlus for 4“ sewer pipes

Client:

fischerwerke GmbH & Co. KG

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TABLE OF CONTENTS

1. Scope of work

The company fischerwerke GmbH & Co. KG produces pipe clamps to connect sewer pipes to walls and floors in buildings. 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 from the sewer pipes, the insides of the pipe clamps made of steel are covered with rubber profiles. The acoustical performance of the pipe clamps should be quantified by experimental determination of the insertion loss. For this an experimental set-up with a 4‘‘ cast iron pipe connected to the reception plate test rig at the HFT Stuttgart was realised.

2. Date and location

Measurements were performed at 14th December 2014 at the reception plate test rig in the Zentrum für Bauphysik der Hochschule für Technik Stuttgart, Pfaffenwaldring 10, 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 M10 threaded rod. The trade names of the clamps given by the manufacturer are FRSN (without rubber profiles) and FRSPlus (with rubber profiles). The tests were performed in combination with a 4‘‘ cast iron pipe that was connected to the reception plate test rig (Figure 1).

4. Test procedure

A standard test procedure for determination of the acoustical performance of pipe clamps is not available. The reception plate method according to EN 15657-1[1] that was used here was developed for the characterisation of structure-borne sound sources and connecting elements. The editors of this report contributed to the development of the method in national and international standardisation committees. For the measurements that are described below, the sewer pipe excited with a miniature tapping machine that provides a broadband excitation, is the structure-borne sound

[1] DIN EN 15657-1:2009-10: Acoustic properties of building elements and of buildings – Laboratory measurement of airborne and structure-borne sound from building equipment - Part 1: Simplified cases where the equipment mobilities are much higher than the receiver mobilities, taking whirlpool baths as example; German version EN 15657-1:2009.

source. The insertion loss (section 4.3) is the characteristic quantity that is measured in order to rate and compare the acoustical performance of the rubber profiles.

Remark:
The applied test procedure was newly developed with the aim to get reproducible and meaningful results of the insertion loss for the frequency range that is relevant in building acoustics. The results for the insertion loss of the pipe clamps are not directly comparable with the insertion loss that was determined by other test procedures.

4.1 Reception plate test rig

The reception plate test rig at the Hochschule für Technik according to EN 15657-1 (Figure 2) consists of three homogeneous reception plates that are isolated from each other. The plates have a thickness of 10 cm and are isolated from the environment (floor, wall of the adjacent test stand). The dimensions of the vertical reception plate that was used for the investigations are 3,1 m x 2,2 m (width x height).

4.2 Test set-up

The realized test set-up consists of a cast iron pipe which is connected to the big vertical reception plate with fischer pipe clamps (Figure 1). For the mounting of the pipe clamps threaded bolts were concreted in the reception plate at two positions with 150 cm distance in between. The distance pipe-wall is 4 cm. 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 by default tightened with a torque of 2 Nm in order to provide a defined compression of the rubber profiles.

4.3 Insertion loss

The insertion loss equals the difference of the velocity levels on the reception plate without and with rubber profiles inside the pipe clamps when the pipe is excited by the miniature tapping machine.

$$D_v = \overline{L}_{v,FRSN} - \overline{L}_{v,FRSX} \tag{1}$$

D_v : Insertion loss [dB]

$\overline{L}_{v,FRSN}$: average velocity level without rubber profile [dB]

$\overline{L}_{v,FRSX}$: average velocity level with rubber profile X [dB]

The average velocity levels were sampled for 12 measurement positions on the reception plate.

$$\overline{L}_v = \frac{1}{12} \cdot 10 \lg \left(\sum_{i=1}^{12} 10^{\frac{L_{v,i}}{10}} \right) \tag{2}$$

$\overline{L}_v$: average velocity level [dB]

$L_{v,i}$: Velocity level at position i [dB]

All tests comprised the frequency range from 50 – 5000 Hz with a 3rd octave band frequency resolution. The single-rated value of the insertion loss was determined from the difference of the linear sum levels.

4.4 Measurement equipment

The measurements were performed with the system PULSE by Brüel & Kjaer. For the excitation of the pipes a miniature tapping machine type Missel was used. The measurement equipment is listed in Table 1.

5. Measurement results

The frequency dependant insertion loss of the pipe clamp FRSPlus 4‘‘ is shown in Figure 3. A relevant insulation effect by the rubber profiles is given in the frequency range above 200 Hz. The maximum of the insertion loss is 20.8 dB at 2500 Hz. The single-rated value of the insertion loss for the frequency range from 50 – 5000 Hz is 8,2 dB.

Figure 1: Experimental set-up for determination of the insertion loss: 4“ cast iron pipe connected to the reception plate test rig with fischer pipe clamps; excitation of the pipe with a miniature tapping machine

Figure 2: Reception plate test rig at the Hochschule für Technik Stuttgart

Description	Manufacturer	Type	Serial Nr.
16 Channel Pulse-Analyser	Brüel & Kjaer		
Calibration Exciter	Brüel & Kjaer	4294	2863238
DeltaTron® Accelerometer	Brüel & Kjaer	4533 B 001	30314
DeltaTron® Accelerometer		4533 B 001	30315
DeltaTron® Accelerometer		4533 B 001	30316
DeltaTron® Accelerometer		4533 B 001	30317
DeltaTron® Accelerometer		4533 B 001	30172
DeltaTron® Accelerometer		4533 B 001	30173
DeltaTron® Accelerometer		4533 B 001	30174
DeltaTron® Accelerometer		4533 B 001	30175
DeltaTron® Accelerometer		4533 B 001	30176
DeltaTron® Accelerometer		4533 B 001	30177
DeltaTron® Accelerometer		4533 B 001	30178
DeltaTron® Accelerometer		4533 B 001	30179
DeltaTron® Accelerometer		4533 B 001	30180
DeltaTron® Accelerometer		4533 B 001	30181
DeltaTron® Accelerometer		4533 B 001	30182
DeltaTron® Accelerometer		4533 B 001	30183
Impact Hammer	Brüel & Kjaer	8206-003	56403
Miniature tapping machine	Stratenschulte Messtechnik	System Gösele	06100134

Table 1: Measurement equipment

Insertion loss

Client: fischerw erke GmbH & Co. KG

Test date 14.12.2013

Test procedure: Measurement of the average velocity levels on the reception plate for excitation of a 4" cast iron pipe w ith the miniature tapping machine. The structure-borne sound transmission pipe - reception plate is through fischer pipe clamps and threaded rods that are concreted in the reception plate.

Test facility: vertikal reception plate of a test rig after DIN EN 15657-1

Test object 1: FRSN 4"

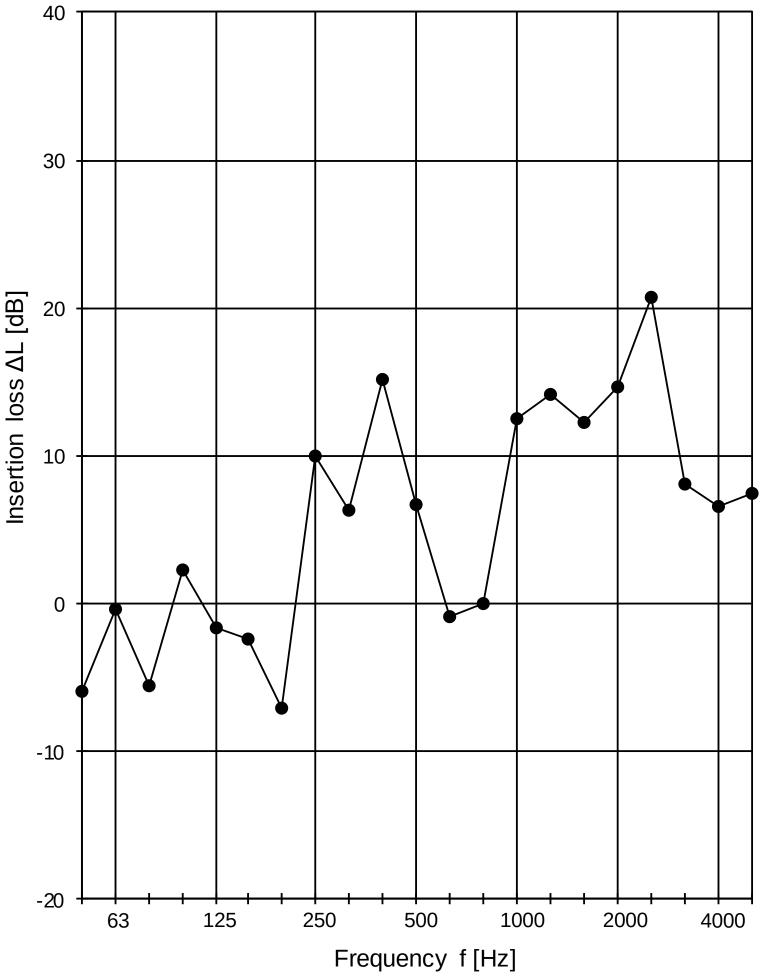
Description: pipe clamp made of steel

Test object 2: FRSPlus 4"

Description: pipe clamp made of steel w ith rubber profile

grey:
Distance to noise floor
not sufficient

Frequency [Hz]	L_1 [dB]	L_2 [dB]	ΔL [dB]
50	30.8	36.7	-6.0
63	33.0	33.3	-0.4
80	34.0	39.7	-5.6
100	42.9	40.7	2.2
125	41.5	43.1	-1.6
160	50.1	52.4	-2.4
200	40.4	47.5	-7.1
250	56.7	46.7	10.0
315	54.7	48.5	6.3
400	62.6	47.4	15.2
500	44.4	37.7	6.7
630	48.5	49.3	-0.9
800	59.3	59.3	0.1
1000	65.2	52.7	12.6
1250	62.4	48.2	14.1
1600	57.8	45.5	12.3
2000	60.8	46.1	14.7
2500	59.5	38.7	20.8
3150	42.9	34.8	8.1
4000	51.2	44.7	6.5
5000	45.4	38.0	7.5
Lin	70.7	62.5	8.2



Receive filter: 3rd octave band filter

Difference of the unw eighted sum levels in the frequency range 50 - 5000 Hz

ΔL_{Lin} = 8.2 dB

Project-Nr.: FEB/FS-75/13

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Figure 3: Insertion loss of the pipe clamp FRSPlus 4“