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Fraunhofer Institut Bauphysik

Bauaufsichtlich anerkannte Stelle
für Prüfung, Überwachung und Zertifizierung
Zulassung neuer Baustoffe, Bauteile und Bauarten
Forschung, Entwicklung, Demonstration und Beratung auf den Gebieten der Bauphysik

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Test report P-BA 262/2008e

Determination of the Acoustic Performance of Wastewater Installation Systems in the Laboratory

Client: SAINT-GOBAIN PAM
91, AVENUE DE LA LIBERATION
54076 NANCY CEDEX
FRANCE

Test specimen: Wastewater installation system consisting of cast iron pipes and fittings "SMU® (DN 100)", manufacturer: SAINT-GOBAIN PAM in various test set-ups

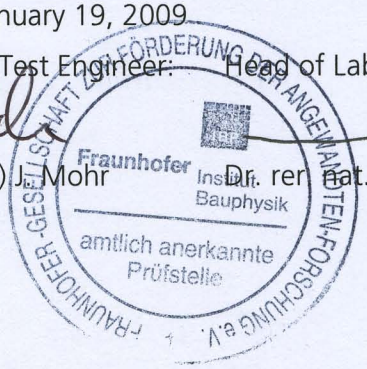
Contents:

The tests were performed in a laboratory accredited by the German Accreditation System for Testing (DAP, file no. PL-3743.26) according to standard EN ISO/IEC 17025.

Stuttgart, January 19, 2009

Responsible Test Engineer: Dipl.-Ing.(FH) J. Mohr

Head of Laboratory: Dr. rer. nat. L. Weber



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Determination of the sound level according to EN 14366 in the laboratory

P-BA 262/2008e

Table 1

Client: SAINT-GOBAIN PAM - 91, AVENUE DE LA LIBERATION, 54076 NANCY CEDEX, FRANCE

Test specimen: Wastewater system, consisting of "SMU®" pipes and fittings (nominal size DN 100) with "SMU Rapid 2® couplings, product code (pc) 157641" and with a "Stack support pipe with bracket, pc 156657" in the basement (KG) at the wall. The wastewater system (System I) was mounted with "Steel brackets, without acoustic insulation, pc 156649" with "Separates, pc 205113" (test specimen S 10083-03), respectively (System II) mounted with "Steel brackets, without acoustic insulation, pc 156649" (test specimen S 10083-04), respectively (System III) mounted with "Steel brackets, with acoustic insulation, pc 173630" (test specimen S 10083-05).
All parts are manufactured by SAINT-GOBAIN PAM.

Test set-up: The pipe systems were mounted according to Figure 5 (see also Annex A).
- The systems consisted of cast iron wastewater pipes (nominal size DN 100), three 88° single branches, a 88° large radius basement bend (R = 230 mm) and a horizontal drain section. The 88° single branches in the basement and in the ground floor were closed off by blank ends (flat ends facing the branch). The pipes were connected with "SMU Rapid 2® couplings".
- The following brackets were used in different test set-ups: "Steel brackets, without acoustic insulation" and with "Separates", "Steel brackets, without acoustic insulation" and "Steel brackets, with acoustic insulation". In each storey two brackets were installed (Figure 5). All brackets were completely closed and they were fixed to the installation wall with dowels and thread rods.

The wastewater systems were mounted by the client.

Test facility: Installation test facility P12, mass per unit area of the installation wall: 220 kg/m², installation rooms: sub-basement (KG), basement (UG front), ground floor (EG front) and top floor (DG), measuring rooms: UG front, UG rear (details in Annex P and EN 14366: 2005-02)

Test method: The measurements were performed in accordance with EN 14366; noise excitation by stationary water flow with 0.5 l/s, 1.0 l/s, 2.0 l/s, 4.0 l/s and 8.0 l/s (details in Annex A).

Results:

Waste water system "SMU® (DN 100)" mounted with different brackets, manufacturer SAINT-GOBAIN PAM

	Airborne sound pressure level $L_{a,A}$ [dB(A)]					Structure-borne sound characteristic level $L_{sc,A}$ [dB(A)]				
Flow rate [l/s]:	0.5	1.0	2.0	4.0	8.0	0.5	1.0	2.0	4.0	8.0
I: "Steel brackets, without acoustic insulation" with "Separates"	-	-	-	-	54	-	-	-	-	19
II: "Steel brackets, without acoustic insulation"	-	-	-	-	54	-	-	-	-	34
III: "Steel brackets, with acoustic insulation"	-	-	-	-	53	-	-	-	-	32

Date of tests: October 7, 2008

Comments: The stated results are calculated values according to EN 14366. They can only be compared with results according to this standard.

Fraunhofer Institut Bauphysik

The tests were performed in a laboratory accredited by the German Accreditation System for Testing (DAP, file no. PL-3743.26) according to standard EN ISO/IEC 17025.

Stuttgart, January 19, 2009

Head of Laboratory:

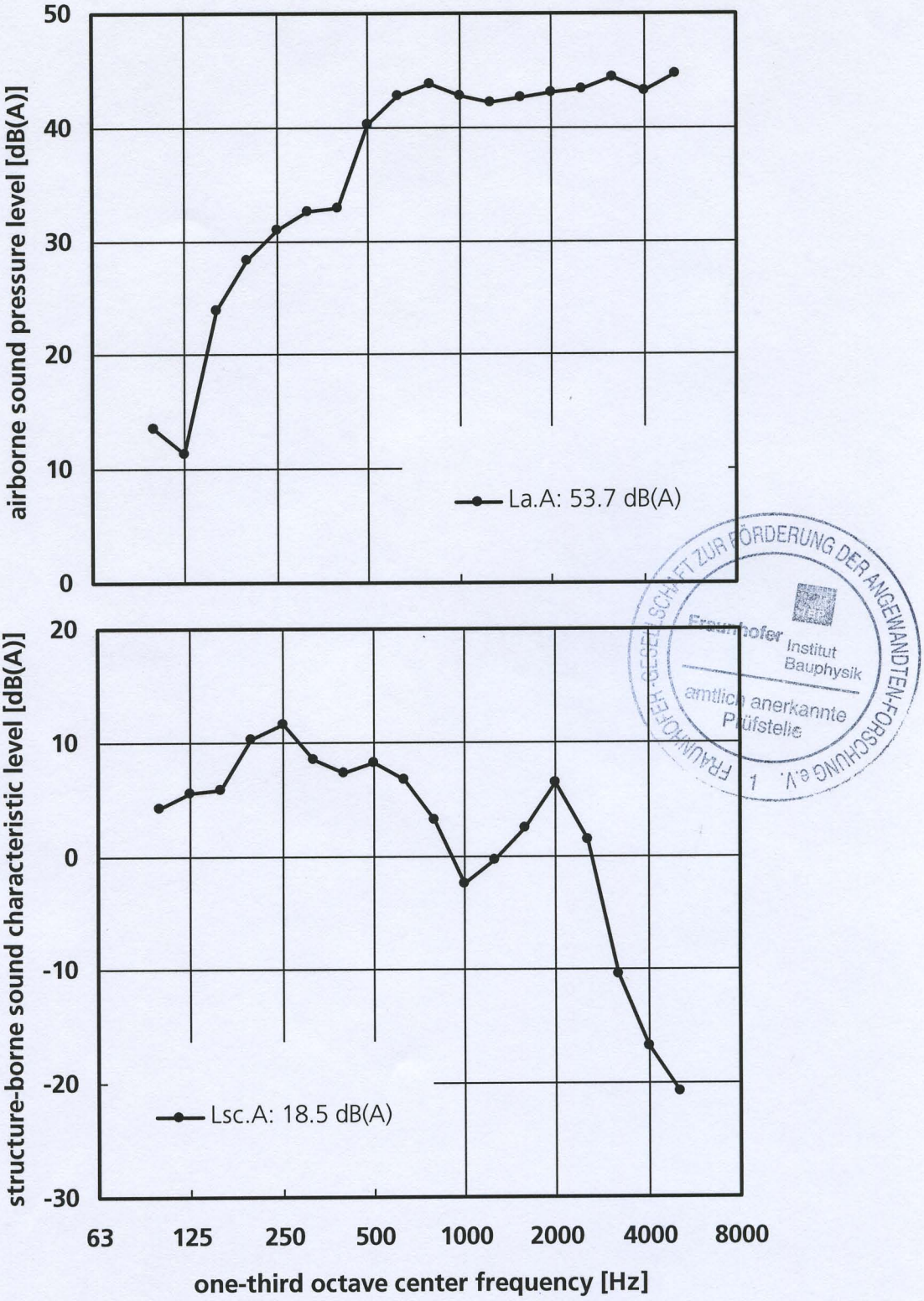


Figure 1 Airborne sound pressure level (above) and structure-borne sound characteristic level (below) measured at the flow rate 8 l/s in accordance with EN 14366 for the Wastewater system I: "SMU® (DN 100)" with "Steel brackets, without acoustic insulation, pc 156649" with "Separates, pc 205113" (test specimen S 10083-03), manufacturer SAINT-GOBAIN PAM.

The tests were performed in a laboratory accredited by the German Accreditation System for Testing (DAP, file no. PL-3743.26) according to standard EN ISO/IEC 17025.

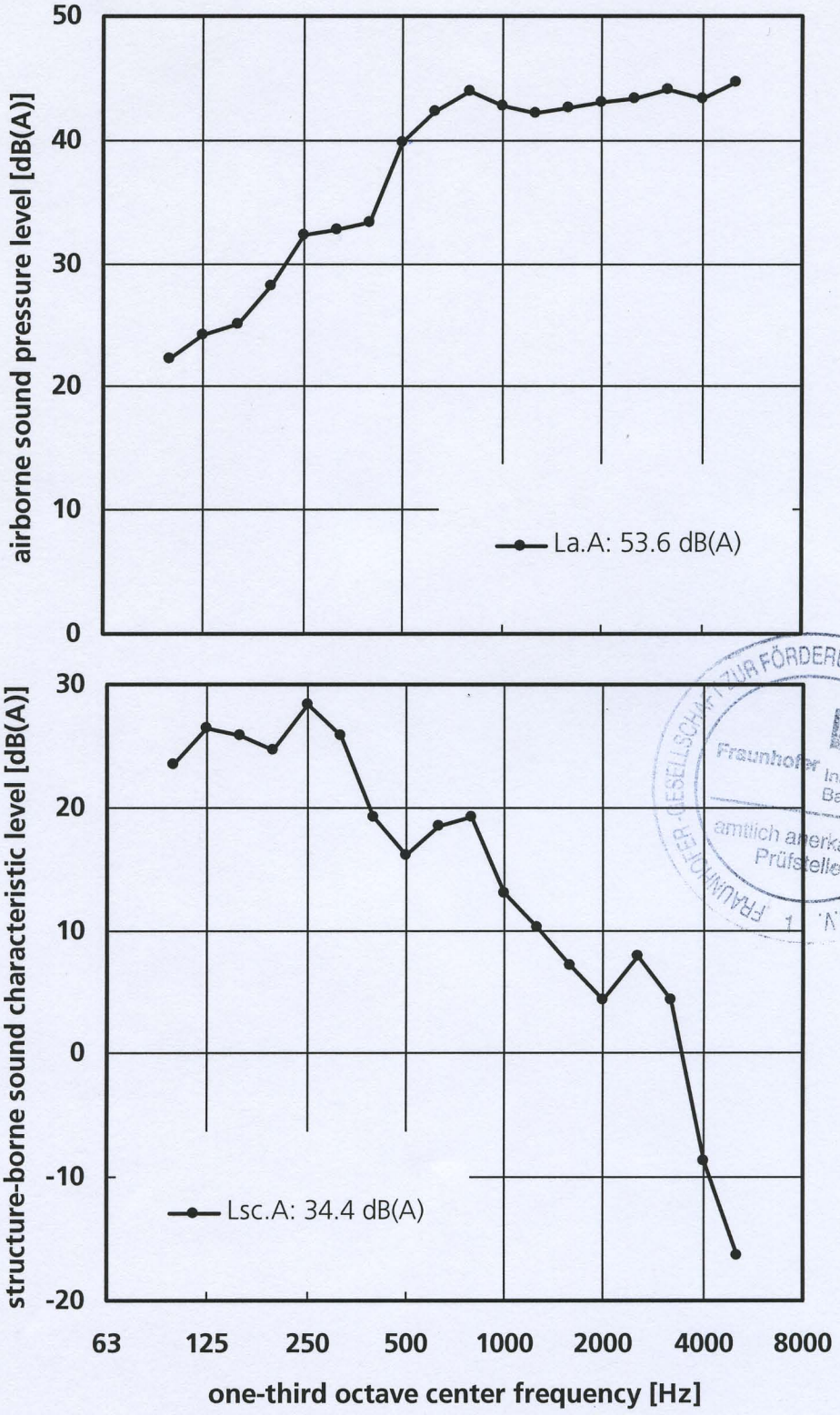


Figure 2 Airborne sound pressure level (above) and structure-borne sound characteristic level (below) measured at the flow rate 8 l/s in accordance with EN 14366 for the Wastewater system II: "SMU® (DN 100)" with "Steel brackets, without acoustic insulation, pc 156649" (test specimen S 10083-04), manufacturer SAINT-GOBAIN PAM.

The tests were performed in a laboratory accredited by the German Accreditation System for Testing (DAP, file no. PL-3743.26) according to standard EN ISO/IEC 17025.

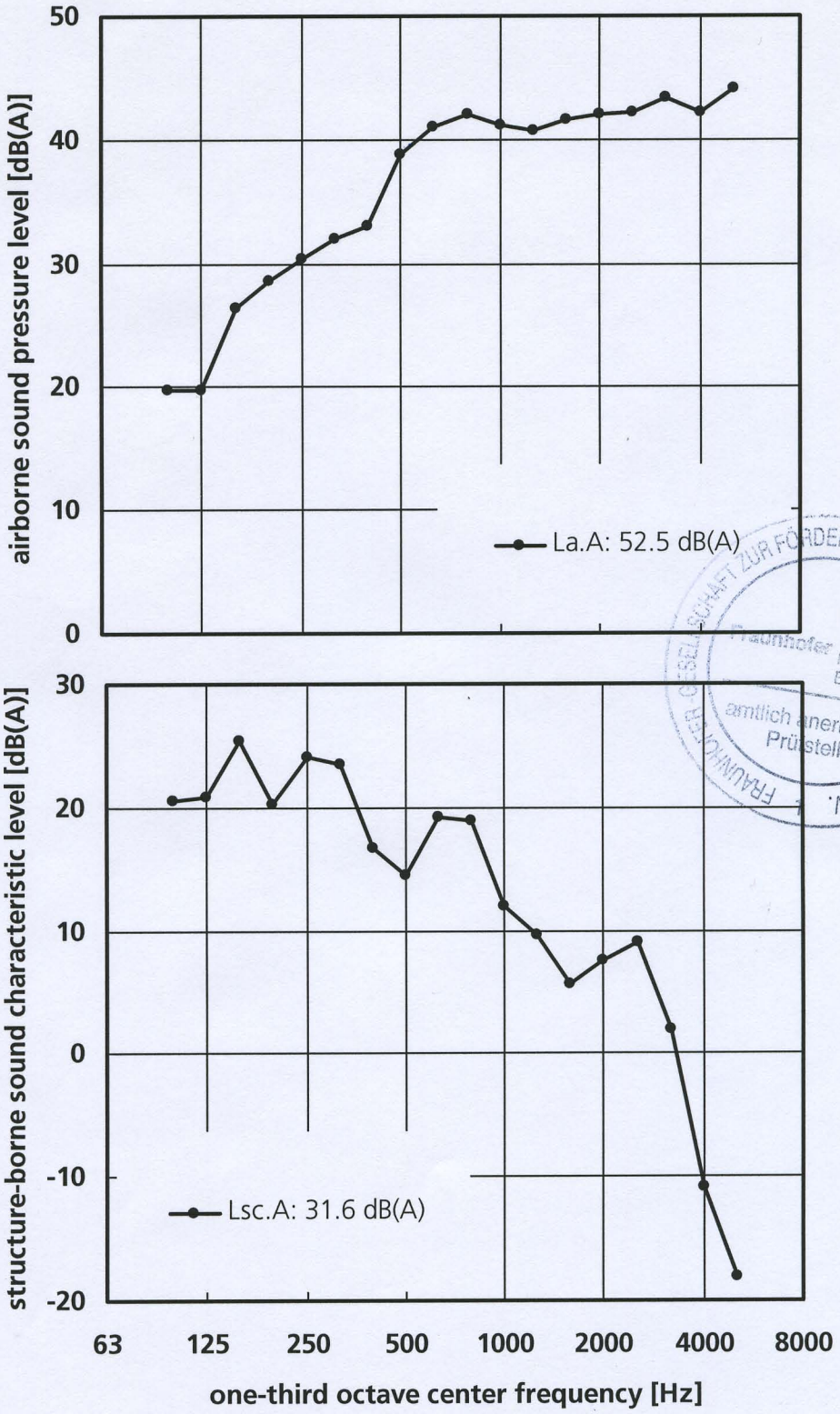


Figure 3 Airborne sound pressure level (above) and structure-borne sound characteristic level (below) measured at the flow rate 8 l/s in accordance with EN 14366 for the Wastewater system III: "SMU (DN 100)®", manufacturer SAINT-GOBAIN PAM, with "Steel brackets, with acoustic insulation, pc 173630" (test specimen S 10083-05).

The tests were performed in a laboratory accredited by the German Accreditation System for Testing (DAP, file no. PL-3743.26) according to standard EN ISO/IEC 17025.

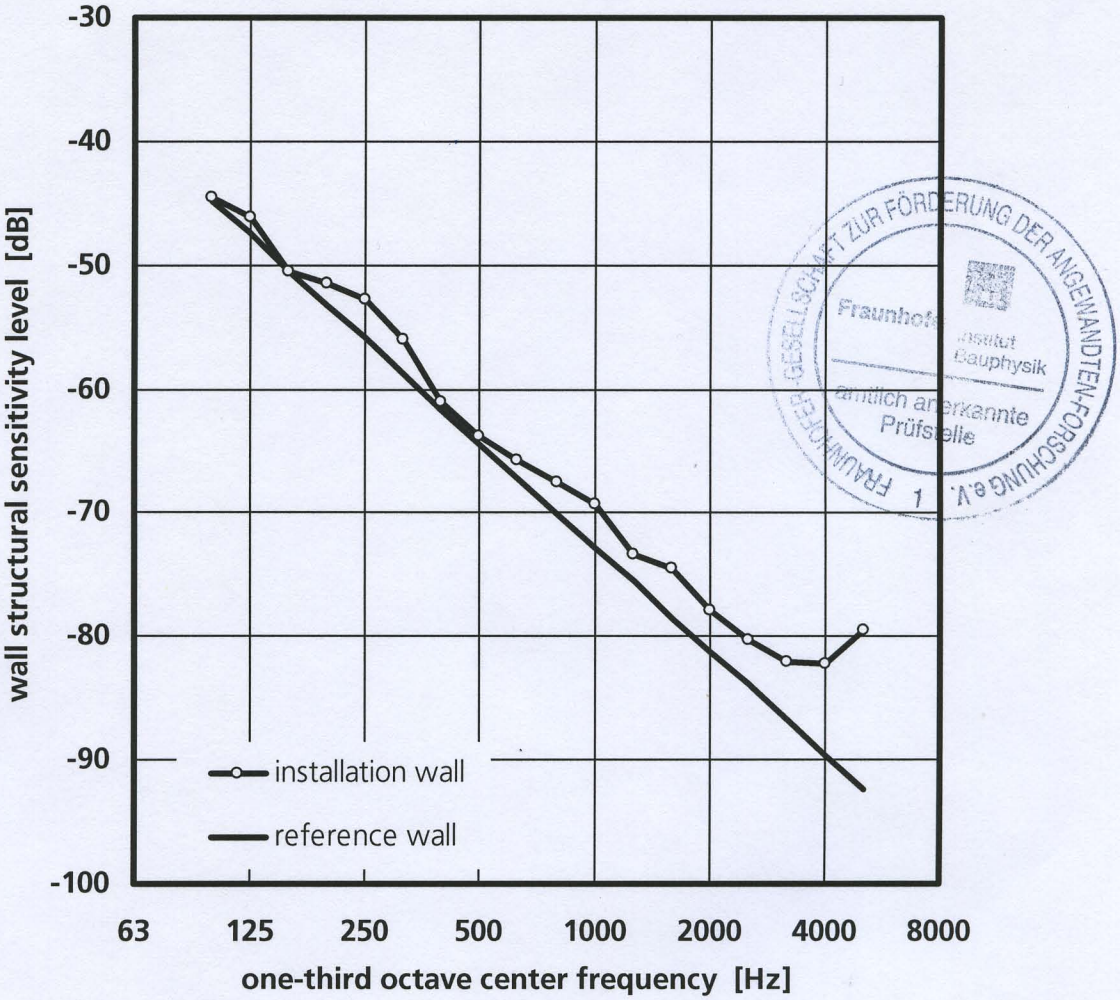


Figure 4 Wall structural sensitivity level L_{SS} of the installation wall between the test rooms UG front and UG rear in the installation test facility in the Fraunhofer-Institute of Building Physics. The installation wall consists of lime stones (thickness 115 mm, ceiled on both sides) with a mass per unit area of 220 kg/m². The indicated structural sensitivity level L_{SS} refers to the mounting position of the waste water system according to figure 5. For comparison the wall structural sensitivity level L_{SSR} of the reference wall is also indicated (evaluation according to EN 14366).

The tests were performed in a laboratory accredited by the German Accreditation System for Testing (DAP, file no. PL-3743.26) according to standard EN ISO/IEC 17025.

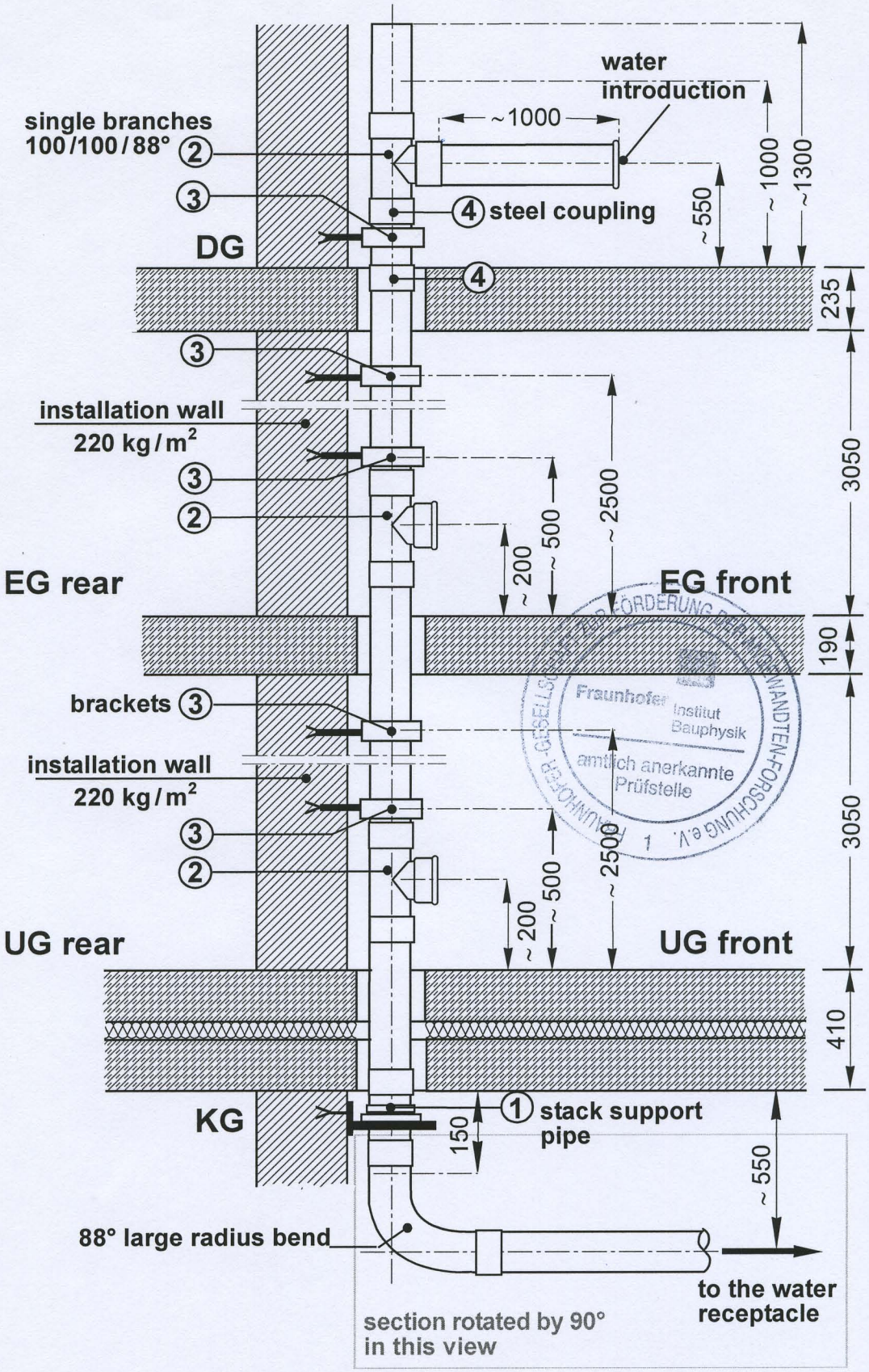


Figure 5 Installation plan of the Wastewater systems I, II and III: "SMU®", manufacturer SAINT-GOBAIN PAM, with different brackets (drawing not to scale, dimensions in mm).

Measurement set-up, noise excitation and evaluation parameters

Measurement set-up

In the water-installation test-facility run by the Fraunhofer Institute of Building Physics, a down pipe is installed leading from the top floor (DG) down to the sub-basement (KG) (for further details, please see Annex P). This down pipe is connected to a (OD 110) water inlet pipe on the top-floor level. The water is introduced through an S-shaped bend according to the standard EN 14366. In the sub-basement, the down pipe is connected to a bend (2 x 45 degree, usually) and merges into a horizontal discharge section, which in turn is joined to a water receptacle. The waste-water pipe on the ground floor (EG) and in the basement (UG) is fitted with conventional branches from main lines (usually, OD 110). Pipes and fittings are mounted according to the instructions given by the manufacturer. The air gaps between the tube and floor in the entrance and exit openings are stuffed with porous absorber in order to prevent any structure-borne sound bridges influencing the building. The waste-water piping is fastened to the installation wall (mass per unit surface $m'' = 220\ kg/m^2$) by means of pipe clamps supplied by the Client, which are adapted to the external diameter of the pipes. The locations of the fixation points and further dimensions are specified in the installation plan that is included in the test report.

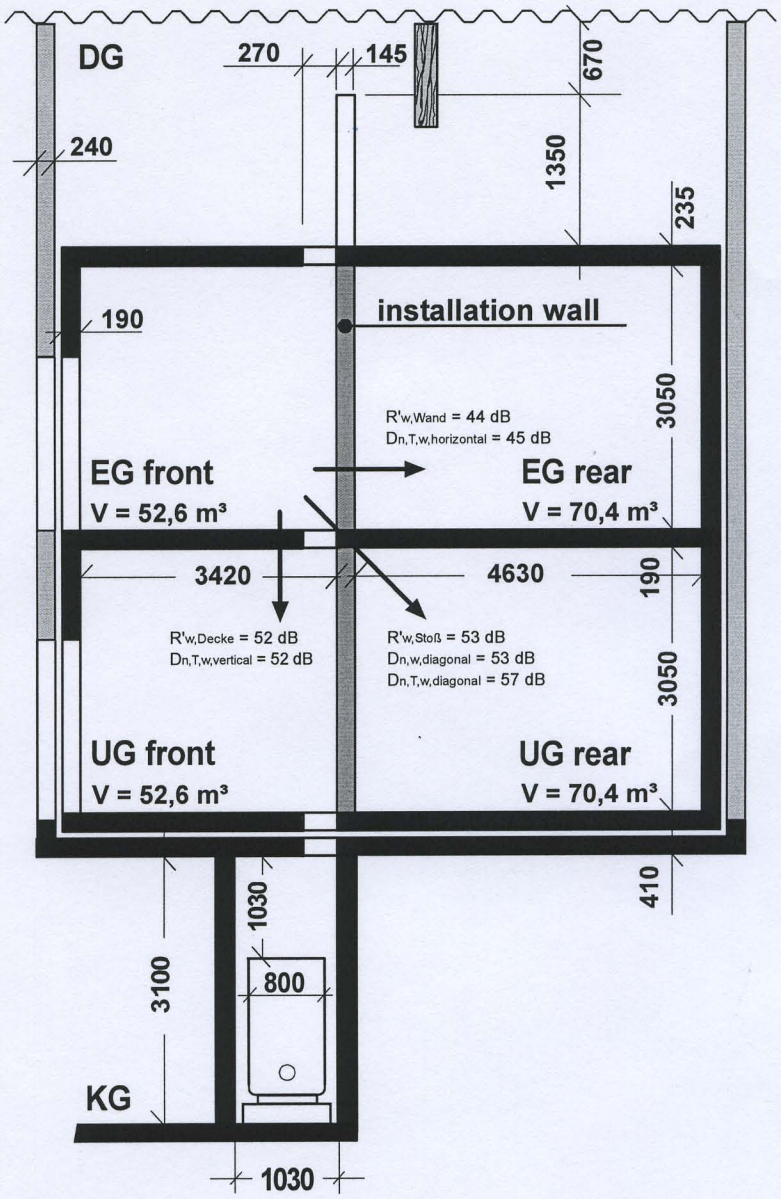
Noise excitation and evaluation parameters

Any defined and metrological reproducible noise excitation requires steady state flow conditions inside the waste-water pipes. As the noise generation in waste water systems depends on the flow rate, noise measurements are performed at several flow rates Q which are typically encountered in practice:

(1) Q = 0.5 l/s, corresponding to Q = 30 l/min,
(2) Q = 1.0 l/s, corresponding to Q = 60 l/min,
(3) Q = 2.0 l/s, corresponding to Q = 120 l/min,
(4) Q = 4.0 l/s, corresponding to Q = 240 l/min.

Here, a flow rate of Q = 2.0 l/s roughly corresponds to the average flow rate required for flushing a toilet. According to Prandtl-Colebrook, the highest flow rate used results from the admissible hydraulic charge of the horizontal pipe sections, which is Q_{max} = 4 l/s for OD 110 pipes.

The measurements take place in the installation room (UG front) and in the room behind the installation wall (UG rear). The water flow generates vibrations of the wastewater pipe. These vibrations are transmitted to the installation wall through pipe clamps and/or other structure-borne sound bridges (e.g. fire protection sleeves), and then radiated by the wall (and to a lesser extent, also by the adjoining building parts) as airborne sound into the test room behind the installation wall. In the test room UG front additionally the airborne sound which is radiated from the waste water system is measured. According to EN ISO 140-3 the sound pressure level is picked up at six points in the room, to be space and time-averaged and corrected for the background noise. With this value the airborne sound pressure level $L_{a,A}$ and the structure-borne sound characteristic level $L_{sc,A}$ is calculated according to EN 14366. The installation sound level is determined following Annex F. Thereby the rounded $L_{AF,10}$ is equivalent to the installation sound level L_{In} according to DIN 52219 and DIN 4109.



Sectional drawing of the installation test facility in the Fraunhofer-Institute of Building Physics (dimensions given in mm). The test facility comprises two couples of rooms in the ground floor (EG) and in the basement (UG) that are located above each other. Due to this construction, including the top floor (DG) and the sub-basement (KG), it is possible to perform tests on installation systems which extend across several floors, e.g. waste-water installation systems. The installation walls in the ground floor and in the basement can be substituted according to actual requirements. In the standard case, single-leaf solid walls with a mass per unit area of 220 kg/m^2 (according to German standard DIN 4109) are used. Since the sound insulation of these walls do not meet the requirements to be fulfilled by a wall separating different occupancies within the same building ($R'_w \geq 53$ dB), the next adjacent rooms to be protected from noise are located diagonally above or below the installation room (in case of a usual design of the ground plan). Due to its double-leaf construction with an additional structure-borne sound insulation, the installation test facility is particularly suited for measuring low sound pressure levels. The measuring rooms are designed in such a way that the reverberation times are between 1 s and 2 s within the examined frequency range. The flanking walls, with an average mass per unit area of approximately 440 kg/m^2, are made of concrete.