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Zulassung neuer Baustoffe, Bauteile
und Bauarten
Forschung, Entwicklung,
Demonstration und Beratung auf
den Gebieten der Bauphysik

Institutsleitung
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Test report P-BA 74-3/2010e

Determination of the Acoustic Performance of a Wastewater Installation System in the Laboratory

Client: Poliplast Sp. z o.o.
ul. Energetyczna 6
PL 56-400 OLESNICA
POLAND

Test specimen: Wastewater installation system consisting of "dBlue" plastic pipes (manufacturer: Poliplast) mounted with pipe clamps "POLIclamp".

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.

Object under test and measurement results are identical to those in test report P-BA 74/2010e

Stuttgart, May 27, 2011

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

Head of Laboratory: rer. nat. L. Weber

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Informe de la prueba P-BA 74/2010e

DETERMINACIÓN DEL COMPORTAMIENTO ACÚSTICO DE UN SISTEMA DE INSTALACIÓN DE EVACUACIÓN EN LABORATORIO

Cliente: Poliplast Sp. z o.o.

ul. Energetyczna 6

PL 56-400 OLESNICA

POLAND

Muestra: Sistema de instalación de evacuación consistente en tuberías de plástico "POLIphon" (fabricante POLIPLAST) montadas con abrazaderas de tubería "POLIclamp".

Contenido:

Las pruebas se realizaron en un laboratorio acreditado por el German Acreditation System for Testing (DAP, archivo nº PL-3743.26) según la norma EN ISO/IEC 17025.

Stuttgart, 22 Abril, 2010

Determination of the installation sound level L_{In} in the laboratory

P-BA 74-3/2010e

Table 1

Client: Poliplast Sp. z o.o., ul. Energetyczna 6, PL 56-400 OLESNICA, POLAND

Test specimen: Wastewater installation system (test specimen S 10255-01) consisting of "dBlue" plastic pipes (manufacturer: Poliplast) mounted with pipe clamps "POLIclamp" (manufacturer: Poliplast)

Test set-up:
- The pipe system was mounted according to figure 4 (see also Annex A).
- The system consisted of wastewater pipes (nominal size OD 110), three inlet tees (90°), two 45°-basement bends with intermediate calming section (250 mm) and a horizontal drain section. The inlet tees in the basement and in the ground floor were closed by lids supplied by the manufacturer. The pipe system was mounted by the client.
- Pipe system "dBlue": size OD 110, three-layer pipe with attached sleeve. Internal layer: PP copo; medial layer: PP MD, external layer: pp copo. Wall thickness 3.4 mm, weight 1.4 kg/m, density 1.15 g/cm³. One-layer fittings: pp MD, wall thickness 3.4 mm, density 1.12 – 1.3 g/cm³. Connection of the pipes by plug-on socket connection.
- Pipe clamps "POLIclamp" (figure 5): Plastic clamps with three elastomer inlays. The clamps were completely closed and they were fixed to the installation wall with dowels and thread rods.

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 following German standard DIN 52 219: 1993-07 and EN 14366; noise excitation by stationary water flow with 0.5 l/s, 1.0 l/s, 2.0 l/s and 4.0 l/s (details in Annexes A and F).

Results:

Waste water system "dBlue" with pipe clamps "POLIclamp"				
Flow rate [l/s]	0,5	1,0	2,0	4,0
Installation sound level L_{In} [dB(A)] measured in the basement test-room UG front	49	49	52	56
Installation sound level L_{In} [dB(A)] measured in the basement test-room UG rear	15	14	17	21
Airborne sound pressure level $L_{a,A}$ [dB(A)] [1)]	49	49	52	56
Structure-borne sound characteristic level $L_{sc,A}$ [dB(A)] [1)]	13	11	15	19

[1)] Evaluation according to DIN EN 14366.

Date of tests: March 9, 2010

Comments:
- The requirements of DIN 4109 only apply for the test room UG rear.

Fraunhofer IBP

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, May 27, 2011

Head of Laboratory:

DETERMINACIÓN DEL COMPORTAMIENTO ACÚSTICO DE UN SISTEMA DE INSTALACIÓN DE EVACUACIÓN EN LABORATORIO **Tabla 1**

Cliente: Poliplast Sp. z o.o., ul. Energetyczna 6, PL 56-400 OLESNICA, POLAND

Muestra: Sistema de instalación de evacuación consistente en tuberías de plástico "POLIPHON" (fabricante POLIPLAST) montados con abrazaderas de tubería POLICLAMP (fabricante POLIPLAST).

Realización de la prueba: La tubería fue montada de acuerdo con la figura 4 (ver también Anexo A).

El sistema consiste en tuberías de evacuación (diámetro nominal 110), tres tes (90º), dos codos de 45º y una sección horizontal. Las tres tes en la planta baja y sótano fueron sujetos con abrazaderas suministradas por el fabricante. El sistema fue montado por el cliente.

Sistema de tuberías "POLIphon": diámetro 110 compuesto de tres capas con la siguiente descripción , capa interna PP copolímero, capa intermedia PP-HD, capa externa PP copolímero. Espesor de pared 3.4 mm, peso 1.4 kg/m, densidad 1.15 g/cm^3. Accesorios monocapa: pp MD, espesor de pared 3.4 mm, densidad 1.12 - 1.3 g/cm^3. Conexión de tuberías y accesorios mediante conector de inserción con junta elástica.

Abrazaderas de fijación "POLIclamp" (figura 5): Abrazaderas de plástico con tres perfiles elastómeros. Las abrazaderas estaban completamente cerradas y fueron fijadas al muro mediante tacos de plástico y tornillos.

Lugar de realización del ensayo: Instalación para la realización del test P12, masa por unidad de área en el muro: 220 kg/m^2, habitaciones de instalación: subsótano (KG), sótano (UG), suelo (EG), piso superior (DG), habitaciones de medición: UG frente, UG parte trasera (detalles en Anexo P y EN 14366: 2005-02)

Método del ensayo: Las mediciones fueron realizadas siguiendo la norma DIN 52 219: 1993-07 y la norma DIN EN 14366; determinación del comportamiento acústico con descargas de agua a 0.5 l/s, 1.0 l/s, 2.0 l/s y 4.0 l/s (detalles en Anexos A y F).

Resultados:

Sistema de evacuación "POLIphon" con abrazaderas "POLIclamp"				
Flujo de agua [l/s]	0,5	1,0	2,0	4,0
Nivel sonido de la instalación [dB (A)] medido en la habitación de medición del sótano habitación UG frente	49	49	52	56
Nivel sonido de la instalación [dB (A)] medido en la habitación de medición del sótano habitación UG parte trasera	15	14	17	21
Nivel de presión del sonido aéreo $L_{a,A}$ [dB (A)] [1])	49	49	52	56
Nivel características de sonido procedente de la estructura $L_{sc,A}$ [dB (A)] [1])	13	11	15	19

[1]) Evaluación de acuerdo con la norma DIN EN 14366.

Fecha: 9 Marzo 2010

Comentarios: Los requisitos de la norma DIN 4109 sólo aplican a la habitación del ensayo UG trasera.

Las pruebas se realizaron en un laboratorio acreditado por el German Acreditation System for Testing (DAP, archivo nº PL-3743.26) según la norma EN ISO/IEC 17025.

Stuttgart, 22 Abril 2010

Jefe del Laboratorio:

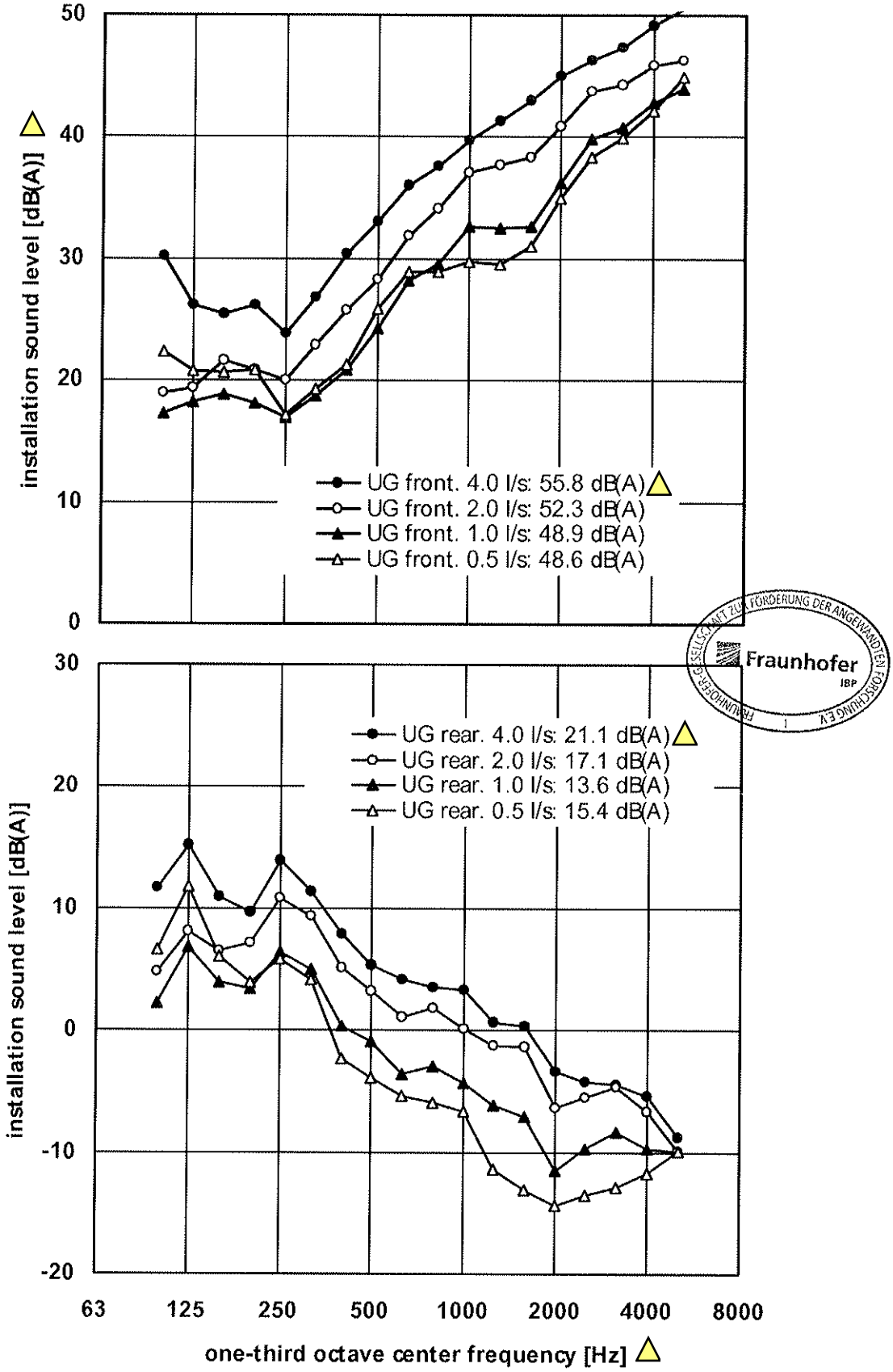


Figure 1 Wastewater pipe system "dBlue" mounted in sub-basement (KG), basement (UG front), ground floor (EG front) and top floor (DG) using pipe clamps "POLIclamp". The installation sound level L_{In} was measured at various flow rates in the test rooms UG front (above) and UG rear (below).

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.

Figura 1 Sistema de tuberías de evacuación “POLIphon” montado en el subsótano (KG), sótano (UG frontal), planta baja (EG frontal) y último piso (DG) con abrazaderas de tubería “POLIclamp”. El nivel de sonido de la instalación L_{in} se midió con diferentes tasas de caudal en las habitaciones frontales (arriba) y traseras (abajo).

Las pruebas se realizaron en un laboratorio acreditado por el German Acreditation System for Testing (DAP, archivo nº PL-3743.26) según la norma EN ISO/IEC 17025.

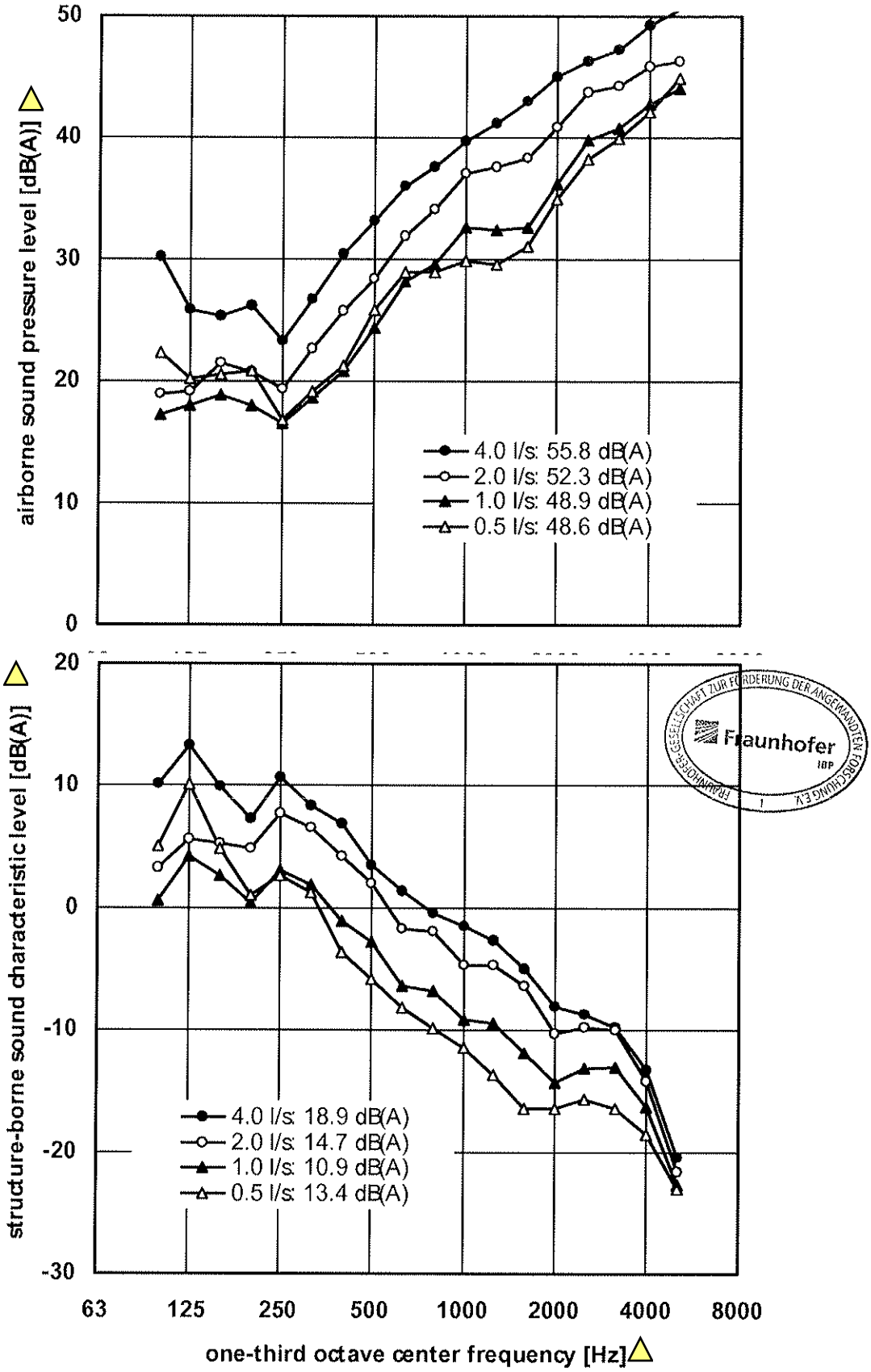


Figure 2 Wastewater pipe system "dBlue" mounted in sub-basement (KG), basement (UG front), ground floor (EG front) and top floor (DG) using pipe clamps "POLIclamp". Airborne sound pressure level (above) and structure-borne sound characteristic level (below) measured at various flow rates according to DIN 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.

Figura 2 Sistema de tuberías de evacuación “POLIphon” montado en el subsótano (KG), sótano (UG frontal), planta baja (EG frontal) y último piso (DG) con abrazaderas de tubería “POLIclamp”. Nivel de presión del sonido transportado por el aire (arriba) y nivel característico de sonido transmitido por la estructura (abajo) medidos con diferentes tasas de fluido según DIN EN 14366.

Las pruebas se realizaron en un laboratorio acreditado por el German Acreditation System for Testing (DAP, archivo nº PL-3743.26) según la norma EN ISO/IEC 17025.

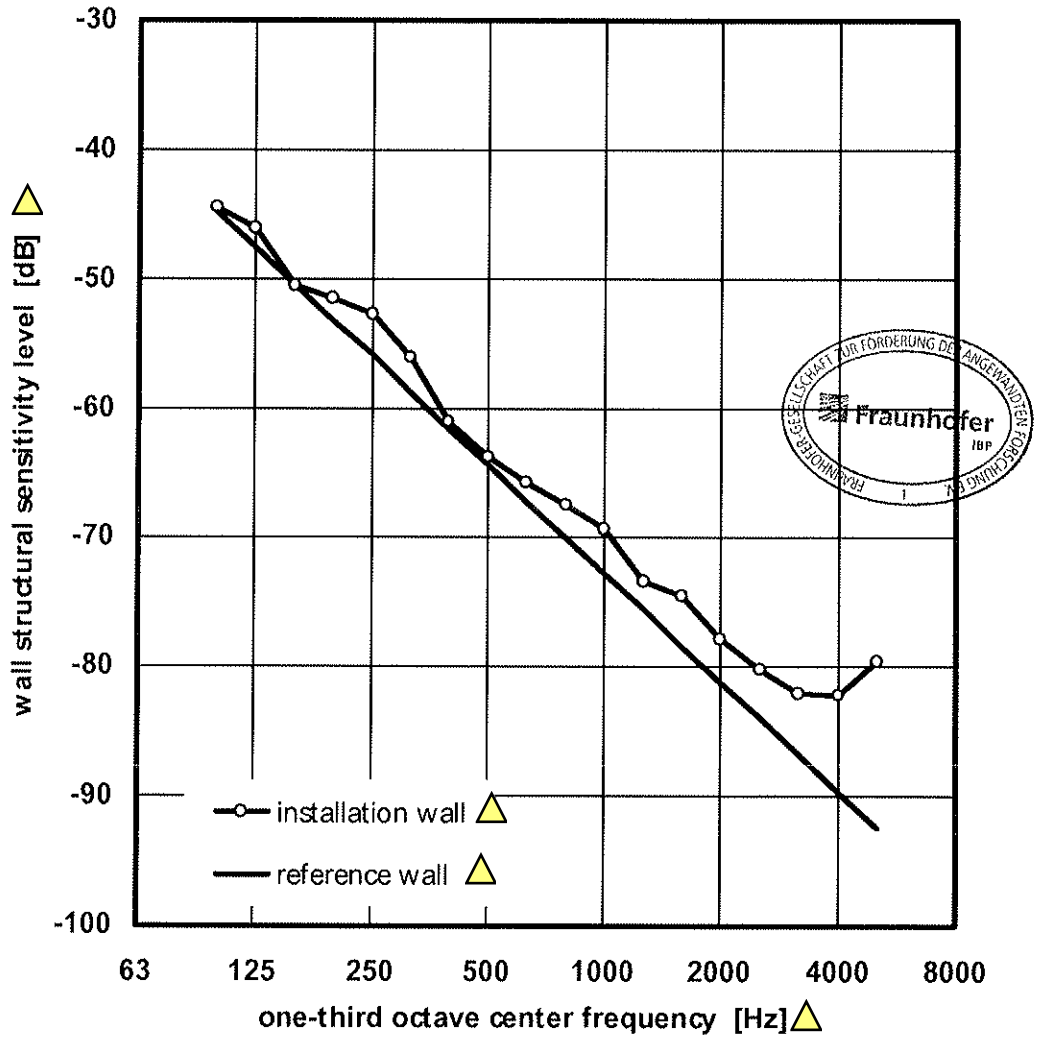


Figure 3 Wall structural sensitivity level L_{ss} of the installation wall between the test rooms UG front and UG rear in the installation test facility in the Fraunhofer-Institute of Building Physics. The installation wall consists of lime stones (thickness 115 mm, ceiled on both sides) with a mass 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 4. For comparison the wall structural sensitivity level L_{ssR} of the reference wall is also indicated (evaluation according to DIN 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.

Figura 3 Nivel de sensibilidad estructural de la pared L_{SS}, de la pared de la instalación entre la habitación frontal UG y la trasera UG en las instalaciones del Fraunhofer-Institute of Building Physics. La pared de la instalación es de piedra caliza (espesor 115 mm, techada en ambos extremos con una masa por unidad de superficie de 220 kg/m^2. Dicho nivel de sensibilidad estructural L_{SS} se refiere a la posición de montaje del sistema de tuberías de evacuación según la figura 4. Por comparación también se indica el nivel de sensibilidad estructural de pared L_{SSR} de la pared de referencia (evaluación según DIN EN 14366).

Las pruebas se realizaron en un laboratorio acreditado por el German Acreditation System for Testing (DAP, archivo nº PL-3743.26) según la norma EN ISO/IEC 17025.

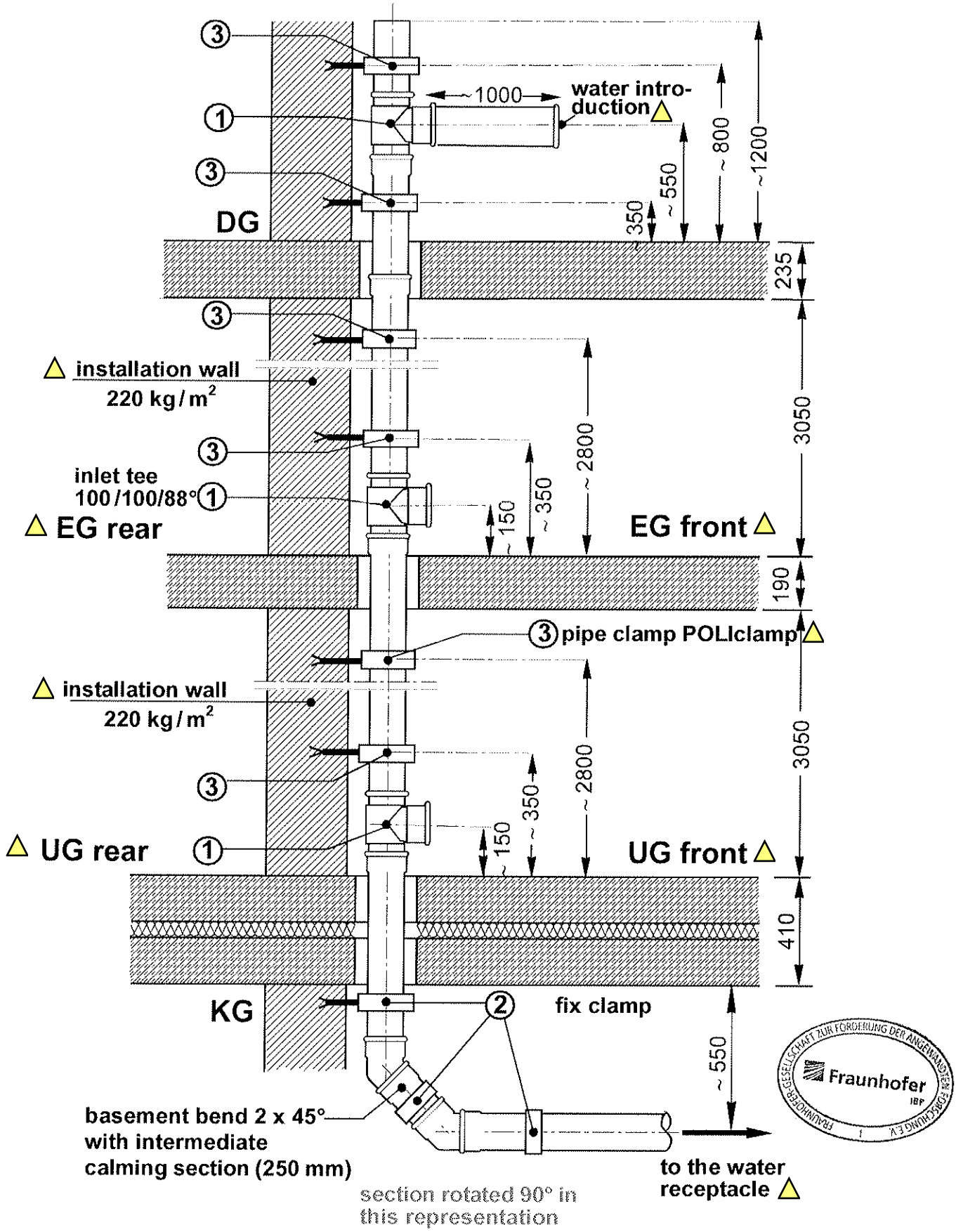


Figure 4 Installation plan of the pipe system "dBlue" (manufacturer: Poliplast), mounted with clamps "POLIclamp" (drawing not to scale, dimensions in mm).

Figura 4 Proyecto de instalación del sistema de tuberías “POLIphon” (fabricante: Poliplast), montado con abrazaderas “POLIclamp” (el dibujo no está a escala, las dimensiones son en mm).

Figure 5 Pipe clamp "POLIclamp" manufactured by Poliplast.

Figura 5 Abrazaderas “POLIclamp” elaboradas por Poliplast

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/m²) 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} (or $L_{AFmax,n}$) according to DIN 52219, DIN EN ISO 10052, DIN 4109-11 and DIN 4109.

Evaluation of Measurements

Stationary noise

The measured sound pressure level is given as time and space averaged one-third octave spectrum in the frequency range between 100 Hz and 5 kHz. First, the measured value is corrected for background noise. Subsequently, it is normalized to an equivalent sound absorption area of A_0 = 10 m² and A-weighted:

$$(1) \qquad L_{n,AF,10} = 10 \cdot \lg\left(10^{\frac{L_{n,F}}{10}} - 10^{\frac{L_{n,S}}{10}}\right) + 10 \cdot \lg\frac{A_n}{A_0} + k(A)_n \qquad [\text{dB(A)}]$$

$L_{n,F}$	space and time averaged sound pressure level in one-third octave band n (time constant: fast)	[dB]
$L_{n,S}$	background noise level in one-third octave band n	[dB]
$A_n = \frac{0.16 \cdot V}{T_n}$	sound absorption area of test room for one-third octave band n	[m²]
V	volume of test room	[m³]
T_n	reverberation time of test room in one-third octave band n	[s]
$k(A)_n$	A-weighting for one-third octave band n	[dB]

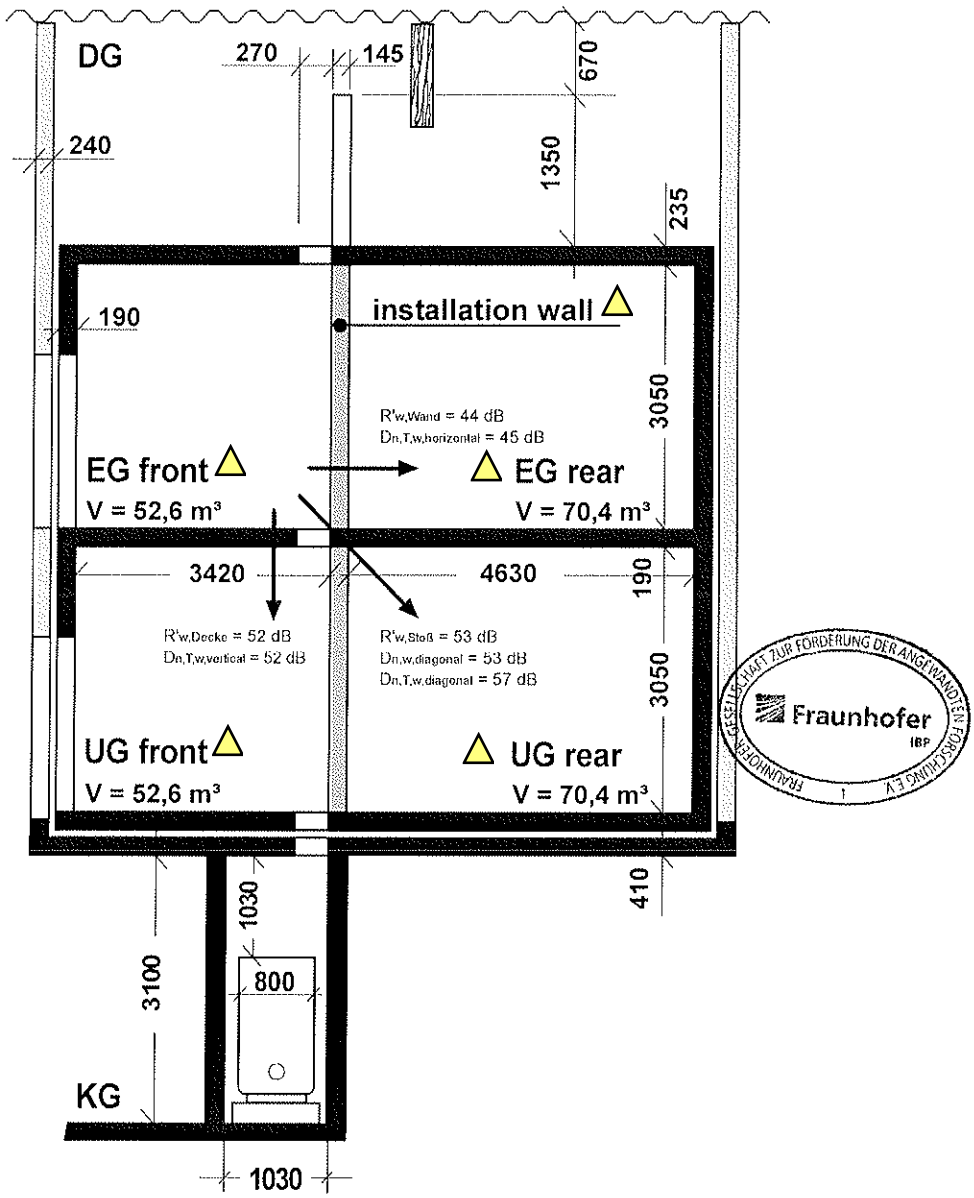
If the difference between the measured one-third octave level and the background noise level is less than 3 dB, the correction for background noise will not be performed. Instead, the measured background noise level will be used as test result (as largest possible value). The total sound pressure level is obtained by energetically adding the one-third octave values.

$$(2) \qquad L_{AF,10} = 10 \cdot \lg\left(\sum_{n=1}^{18} 10^{\frac{L_{n,AF,10}}{10}}\right), \qquad [\text{dB(A)}]$$

where n indicates the number of one-third octave bands from 100 Hz to 5 kHz. The calculated level $L_{AF,10}$ corresponds to the sound pressure level that would arise in a sparsely furnished reception room under otherwise equal conditions. The value ($L_{AF,10}$) represents the installation sound level L_{In} (or $L_{AFmax,n}$) in the test facility.

Time-dependent noise

In this case, the measurement signal consists of a series of one-third octave spectra (frequency range from 100 Hz through 5 kHz) which are consecutively measured at the same place with a time interval of 0.128 s. The evaluation is performed in the same way as in the case of stationary noise, with the exception that background noise correction is not performed. After evaluation the maximum value ($L_{AF,10,max}$) is determined from the measured time response.



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/m² (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/m², are made of concrete.

Anexo P

Sección de las dependencias de la instalación del Fraunhofer-Institute ofBuilding Physics (dimensiones en mm). Las dependencias de la instalación que se someten a prueba consisten en dos espacios, cada uno de ellos en la planta baja (EG) y en el sótano (UG), que se sitúan uno encima del otro. Esta construcción, que incluye el último piso (DG) y el subsótano (KG), permite realizar las pruebas sobre el sistema instalado en varios pisos, e.g. instalación de sistemas de evacuación. Ambas paredes de instalación se pueden sustituir según requerimientos concretos. En el caso estándar se utilizan paredes sólidas, sencillas de una hoja con una masa por unidad de área de 220 kg/m^2 (según la norma alemana DIN 4109). Como las propiedades aislantes de sonido de estas paredes no cumplen los requisitos de una pared separadora de distintas dependencias dentro del mismo edificio ($R'_w \geq 53$ dB), los espacios próximos adyacentes que deben protegerse del ruido se encuentran emplazados diagonalmente encima o debajo del espacio de la instalación (en el caso de un proyecto estándar corriente). Debido a su construcción de doble hoja con una estructura adicional de aislamiento del sonido transmitido por el aire, la prueba de las dependencias de la instalación es especialmente adecuada para medir niveles de presión de sonido bajo. Las habitaciones de medición se han diseñado de manera que los tiempos de reverberación estén entre 1 s y 2 s dentro del rango de frecuencia examinado. Los flancos, de una masa promedio de aproximadamente 440 kg/m^2 por unidad de área, son de cemento.