Fraunhofer Institut Bauphysik

Amtlich anerkannte Prüfstelle für die Zulassung neuer Baustoffe, Bauteile und Bauarten · Forschung, Entwicklung, Prüfung, Demonstration und Beratung auf den Gebieten der Bauphysik

Institutsleitung
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P-BA 115/1999e

Airborne sound insulation of a noise barriers in accordance with German technical provision ZTV-Lsw 88 and according to DIN EN 1793-2: 1997

Client: Röhm GmbH Chemische Fabrik
Kirschenallee
D-64293 Darmstadt

1. Place and date of the measurements

The measurements were performed between November 19 th, 1998 and November 25 th, 1998 in the test facilities of the Fraunhofer-Institut für Bauphysik in Stuttgart.

2. Test specimens

Noise barrier consisting of PMMA panels, manufacturer's designation: PLEXIGLAS® and PLEXIGLAS SOUNDSTOP® (test objects S 8732-1, S 8731-2, S 8731-3, S 8731-4, S 8731-5, S 8731-6 and S 8731-7), see Fig. 1 and
Fig. 2.
Plates of different thicknesses were inserted into a supporting frame constructed from carrying channels and H-sections, plate edges were sealed with perimeter gaskets. The frame construction was adapted to the various plate depths by way of displaceable contact angles. The following panel thicknesses were tested:

Test specimen	Plate thickness [mm]	Designation	mass per unit area [kg/m²]
8731-5	12	PLEXIGLAS®	14.1
8731-3	15	PLEXIGLAS SOUNDSTOP®	17.6
8731-2	16	PLEXIGLAS SOUNDSTOP®	18,7
8731-1	18	PLEXIGLAS SOUNDSTOP®	21.9
8731-4	20	PLEXIGLAS SOUNDSTOP®	23.5
8731-6	22	PLEXIGLAS SOUNDSTOP®	26.6
8731-7	25	PLEXIGLAS SOUNDSTOP®	29.9

Dimensions of test specimens were 3.71 m (W) x 2.95 m (H),
visible panel surfaces were 1.91 m (W) x 2.85 m (H) and
1.495 m (W) x 2.85 m (H).

At the top and at the bottom, the gaskets were sealed with a permanent sealant; to the left and to the right side, U-sections were backed with mineral fibres, with a permanent seal towards the test facility.

3. Sampling procedure

The test material was delivered by the client in June 1998. The panels were mounted in November 1998.

4. Test procedure

The test specimens were mounted on the test facility following the instructions specified in ZTV-Lsw 88. Due to the wall construction, the wall's overlapping by the centre post was approx. 45 mm instead of 20 mm. This is however in accordance with the mounting conditions as specified in the standard DIN EN 1793-2: 1997.

According to the "Additional technical rules and directions for the construction of noise barriers along roads" (ZTV-Lsw 88) the test procedure laid down in German standard DIN 52 210 has to be applied. The tests were performed in a test facility with suppressed flanking transmission acc. to German standard DIN 52 210-2:1984; measurements were performed according to German standards DIN 52 210-1: 1984 and DIN 52 210-3: 1987. The test sound was pink noise, which was filtered by one-third octave band filters in an analyser. The sound reduction index was determined according to the following relation

$$R = L_1 - L_2 + 10 \lg (S/A) \text{ dB}.$$

where:

- R sound reduction index
- L_1 average sound pressure level in the source room
- L_2 average sound pressure level in the receiving room
- S area of test specimen
- A equivalent absorption area in the receiving room evaluated by measurements of the reverberation time

The sound reduction index relevant for noise barriers along roads $\Delta L_{A,R,Str}$ was computed acc. to the instructions specified in ZTV-Lsw 88. The single number rating for the airborne sound insulation was determined acc. to the standard DIN EN 1793-2: 1997.

5. Test equipment and test conditions

Dimensions of test rooms:	
Source room (L x W x H):	4.79 m x 3.56 m x 3.02 m; V = 51.5 m³
Receiving room (L x W x H):	5.90 m x 3.56 m x 3.01 m; V = 63.2 m³
Test opening (W x H):	3.71 m x 2.95 m; S = 10.9 m²
Air temperature:	19 °C to 22 °C
Relative air humidity:	36 % to 45%

Measuring equipment:	
Microphones:	B&K 4165
Preamplifier:	B&K 2639
Analyser:	Norsonic 840-2
Amplifier:	Klein & Hummel AK 120
Loudspeaker:	MLS Lanny 03/93

6. Measurement results

The measured sound reduction indices are indicated in Tables 1 to 7 and plotted versus frequency in Figs. 3 to 9. The relevant values for sound insulation acc. to ZTV-Lsw 88 and the single number ratings for the airborne sound reduction acc. to DIN EN 1793-2: 1997 are

Panel thickness [mm]	$\Delta L_{A,R,Str}$ [dB]	DL_R [dB]
12	29	29
15	30	30
16	30	31
18	31	31
20	32	32
22	32	32
25	33	33

All systems under test meet the requirements specified in clause 7.2.1 of ZTV-Lsw 88. The airborne sound insulation properties of the systems under test are to be classified in group B3 according to the standard DIN EN 1793-2. The adaptation of the noise barrier units to the test facility did not cause any degradation of the measured results.

The present test report comprises 5 pages, 7 tables and 8 figures. The measured results contained therein are only valid for the specimens under test. The publication of excerpts of this test report is subject to written authorisation by the Fraunhofer Institut für Bauphysik.

Stuttgart, December 17 th, 1999
Nic/Hy/Ec

Test engineer:

Dipl.-Ing. M. Nicolai

On behalf of the
head of the laboratory

Dipl.-Ing. S. Koch

Table 2 Noise barrier with 15 mm thick panel

Single values for sound pressure levels L_1 in the source room and L_2 in receiving room, reverberation times T in the receiving room, sound insulation R_i and total sound reduction index $\Delta L_{A,R,Str}$

acc. to ZTV-Lsw 88, Table 7 and single figure rating for the airborne sound insulation acc. to the standard DIN EN 1793-2

f [Hz]	L_1 [dB]	L_2 [dB]	T [s]	R_i [dB]
100	83,7	62,1	1,0	21,9
125	87,0	67,3	1,2	20,9
160	96,7	75,9	1,2	22,0
200	104,2	80,5	1,4	25,5
250	105,4	82,7	1,3	24,3
315	101,2	77,8	1,6	25,8
400	98,6	72,8	1,6	28,1
500	96,4	69,2	1,5	29,4
630	95,8	66,4	1,6	31,7
800	95,2	63,4	1,5	34,0
1000	94,6	61,6	1,4	34,9
1250	92,2	58,1	1,4	36,0
1600	92,1	59,0	1,3	34,9
2000	91,5	64,1	1,3	29,0
2500	88,0	59,2	1,2	30,1
3150	88,9	54,3	1,1	35,4
4000	87,0	49,1	1,1	38,5
5000	75,9	35,1	1,0	41,1

$\Delta L_{A,R,Str} = 30$ dB

$DL_R = 30$ dB

Table 5 Noise barrier with 20 mm thick panel
Single values for sound pressure levels L_1 in the source room and L_2 in the receiving room, reverberation times T in the receiving room, sound insulation R_i and total sound reduction index $\Delta L_{A,R,Str}$
acc. to ZTV-Lsw 88, Table 7 and single figure rating for the air-borne sound insulation acc. to the standard DIN EN 1793-2

f [Hz]	L_1 [dB]	L_2 [dB]	T [s]	R_i [dB]
100	83,5	59,9	0,9	23,5
125	87,0	66,4	1,0	21,0
160	97,0	74,6	1,2	23,6
200	103,8	78,8	1,5	27,0
250	105,0	80,0	1,4	26,8
315	100,9	75,1	1,6	28,1
400	98,4	70,5	1,4	29,8
500	96,4	66,4	1,5	32,0
630	95,8	64,0	1,4	33,7
800	95,1	61,4	1,5	35,7
1000	94,6	59,9	1,4	36,5
1250	92,1	59,1	1,3	34,8
1600	92,0	63,7	1,3	30,0
2000	91,6	60,0	1,2	33,0
2500	88,2	52,6	1,2	36,7
3150	88,8	48,0	1,1	41,4
4000	87,0	43,2	1,0	44,1
5000	76,0	29,6	0,9	46,3

$\Delta L_{A,R,Str} = 32$ dB

$DL_R = 32$ dB

Table 7 Noise barrier with 25 mm thick panel
Single values for sound pressure levels L_1 in the source room and L_2 in the receiving room, reverberation times T in the receiving room, sound insulation R_i and total sound reduction index $\Delta L_{A,R,Str}$
acc. to ZTV-Lsw 88, Table 7 and single figure rating for the airborne sound insulation acc. to the standard DIN EN 1793-2

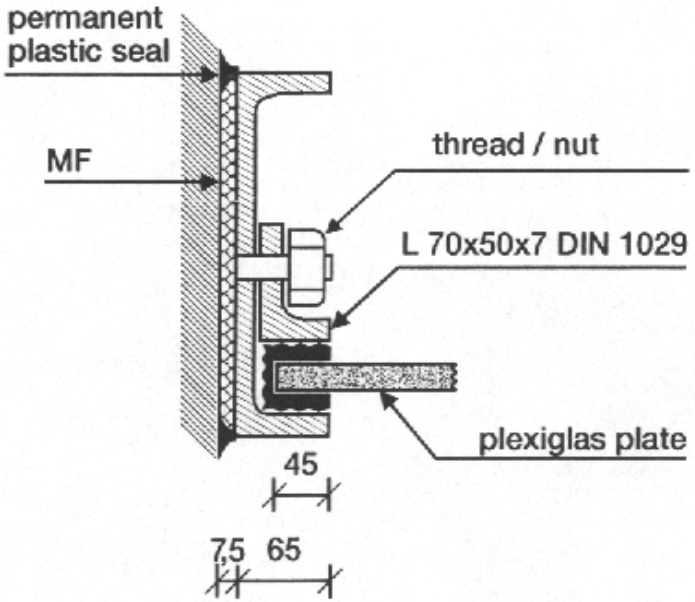
f [Hz]	L_1 [dB]	L_2 [dB]	T [s]	R_i [dB]
100	83,5	58,5	1,2	26,1
125	86,4	63,7	1,4	24,5
160	97,0	71,8	1,4	27,0
200	104,3	77,2	1,6	29,3
250	105,3	78,8	1,5	28,6
315	101,4	73,2	1,6	30,5
400	98,8	68,8	1,6	32,4
500	96,7	65,1	1,6	33,9
630	96,2	62,7	1,5	35,5
800	95,3	60,8	1,5	36,5
1000	94,9	61,6	1,4	35,2
1250	92,3	63,2	1,4	31,1
1600	92,2	60,7	1,4	33,4
2000	91,9	56,3	1,3	37,3
2500	88,5	50,0	1,2	39,9
3150	89,0	46,0	1,1	43,8
4000	87,3	41,4	1,0	46,3
5000	76,3	27,9	1,0	48,4

$\Delta L_{A,R,Str} = 33$ dB

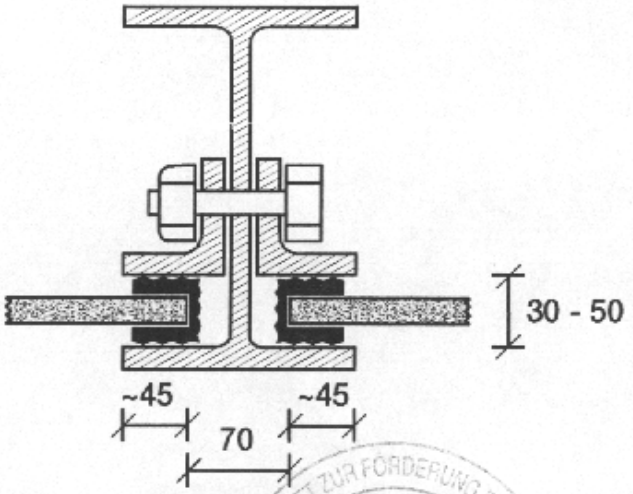
$DL_R = 33$ dB

Scale 1: 20

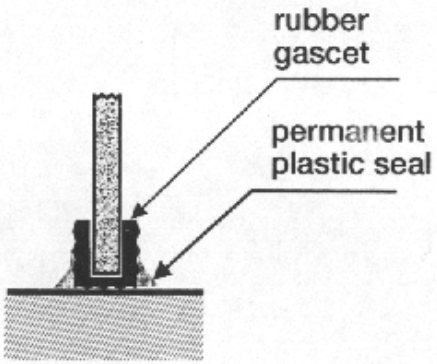
Detail: wall junction



Detail: support

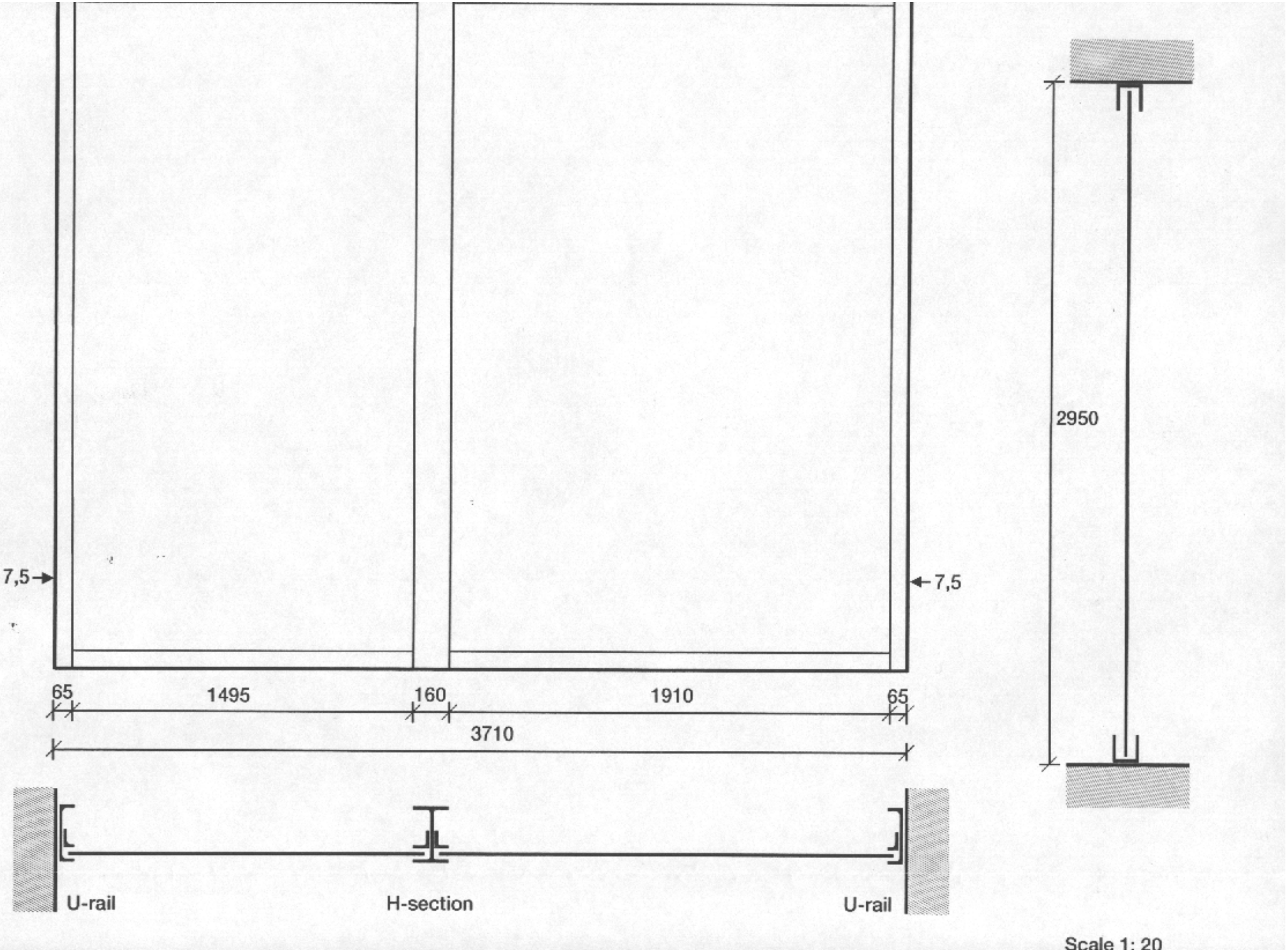


Detail: floor and ceiling



Scale 1: 5

Fig. 1: View and sections of the tested noise barriers.


7,5
7,5
65
1495
160
1910
65
3710
U-rail
H-section
U-rail
2950
Scale 1: 20

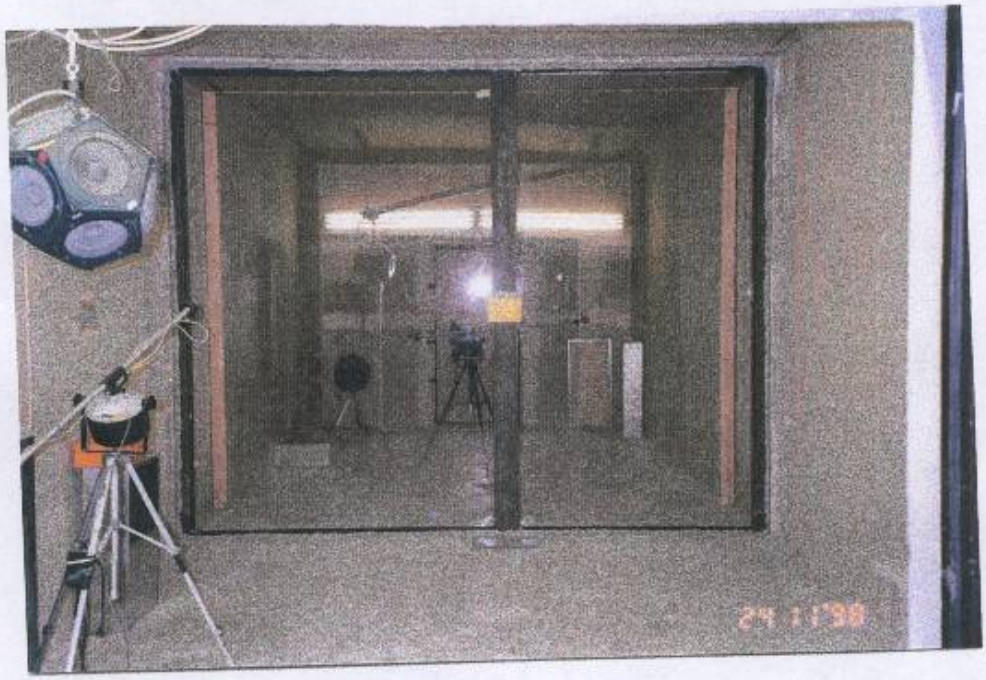


Fig. 2: Photo of the test specimen
above: total view.
below: detail of the sealing.

Sound reduction in accordance with ZTV-Lsw 88 and acc. to DIN EN 1793-2

Client: Röhm GmbH Chemische Fabrik
D - 64293 Darmstadt

P-BA 115/1999e
Fig. 4

Test specimen:
Noise barrier consisting of PMMA panels, manufacturers designation: PLEXIGLAS SOUNDSTOP® (test object S 8731-3). Thickness of panels 15 mm, mass per unit area: 17,6 kg/m². Construction see Fig. 1 and Fig. 2.

Test area: 10,9 m²

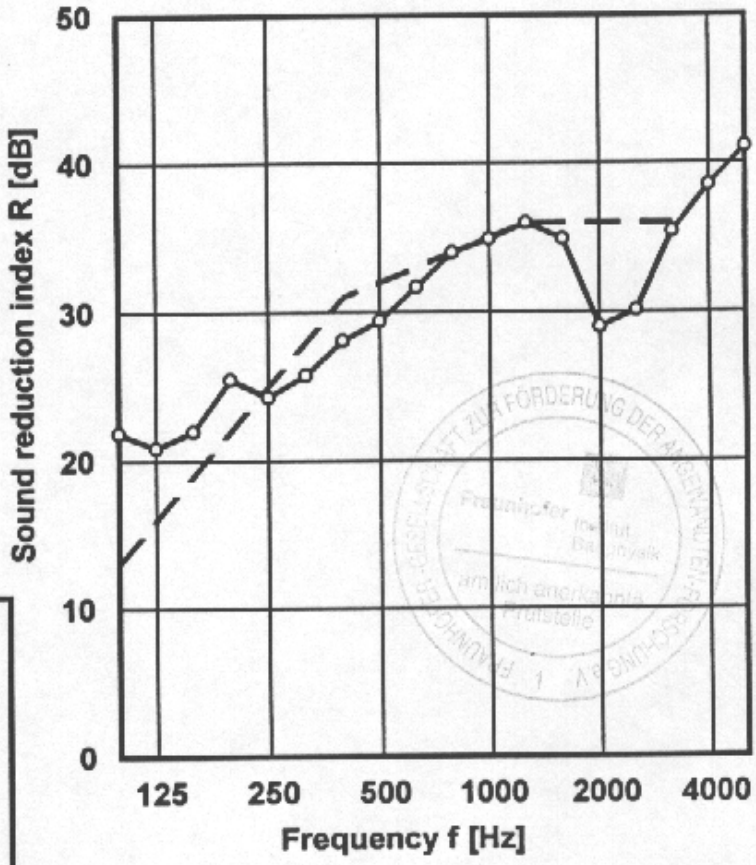
Test rooms:
Volumes: V_S = 52 m³
V_E = 63 m³
Type: laboratory
Condition: empty
Upper limit:
$R'_{max,w}$ = 75 dB.

Test sound: pink noise

Test method:
DIN 52 210-03-M-L-P-W

Date of measurement:
November 20 th, 1998

Test conditions:
Test temperature: 20 °C



Rating acc. to ZTV-Lsw 88
$\Delta L_{A,R,Str}$ = 30 dB.
The system under test meets the requirements specified in clause 7.2.1 of ZTV-Lsw 88.

Rating acc. to DIN EN 1793-2:1997
DL_R = 30 dB.
The airborne sound insulation properties of the system under test are to be classified in group B3.

Fraunhofer Institut Bauphysik

Stuttgart, December 17 th, 1999
On behalf of the head of the laboratory:

Sound reduction following ZTV-Lsw 88 and acc. to DIN EN 1793-2

Client: Röhm GmbH Chemische Fabrik
D - 64293 Darmstadt

P-BA 115/1999e
Fig. 7

Test specimen:
Noise barrier consisting of PMMA panels, manufacturers designation: PLEXIGLAS SOUNDSTOP® (test object S 8731-4). Thickness of panels 20 mm, mass per unit area: 23,5 kg/m². Construction see Fig. 1 and Fig. 2.

Test area: 10,9 m²

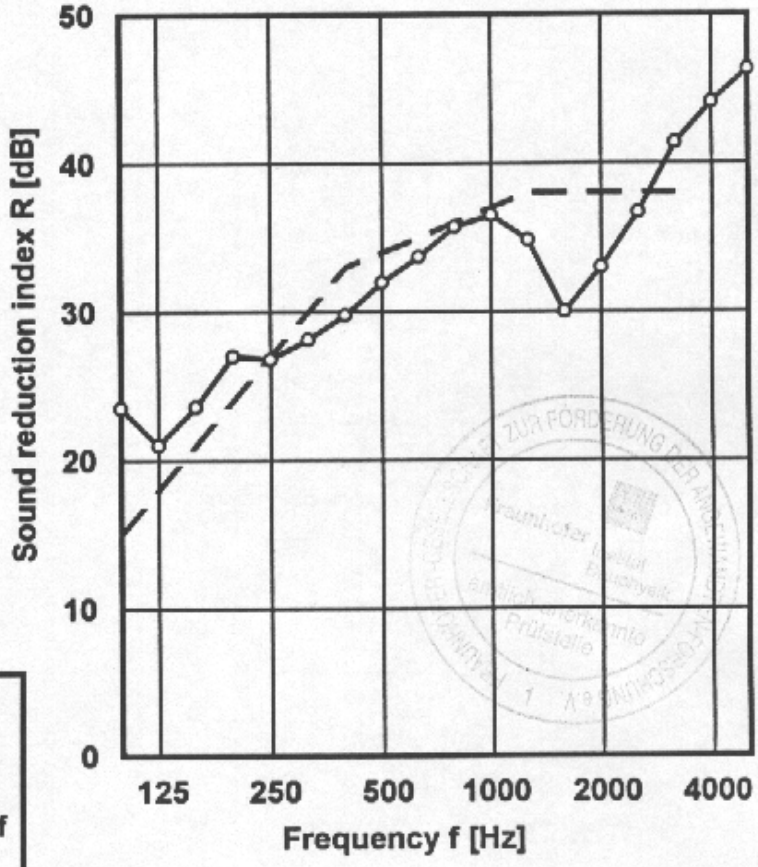
Test rooms:
Volumes: V_S = 52 m³
V_E = 63 m³
Type: laboratory
Condition: empty
Upper limit:
$R'_{max,w}$ = 75 dB.

Test sound: pink noise

Test method:
DIN 52 210-03-M-L-P-W

Date of measurement:
November 23 th, 1998

Test conditions:
Test temperature: 21 °C



Rating acc. to ZTV-Lsw 88
$\Delta L_{A,R,Str}$ = 32 dB.
The system under test meets the requirements specified in clause 7.2.1 of ZTV-Lsw 88.

Rating acc. to DIN EN 1793-2:1997
DL_R = 32 dB.
The airborne sound insulation properties of the system under test are to be classified in group B3.

IBP
Fraunhofer Institut Bauphysik

Stuttgart, December 17 th, 1999
On behalf of the head of the laboratory:

Sound in accordance with ZTV-Lsw 88 and acc. to DIN EN 1793-2

Client: Röhm GmbH Chemische Fabrik
D - 64293 Darmstadt

P-BA 115/1999e
Fig. 9

Test specimen:
Noise barrier consisting of PMMA panels, manufacturers designation: PLEXIGLAS SOUNDSTOP® (test object S 8731-7). Thickness of panels 25 mm, mass per unit area: 29,9 kg/m². Construction see Fig. 1 and Fig. 2.

Test area: 10,9 m²

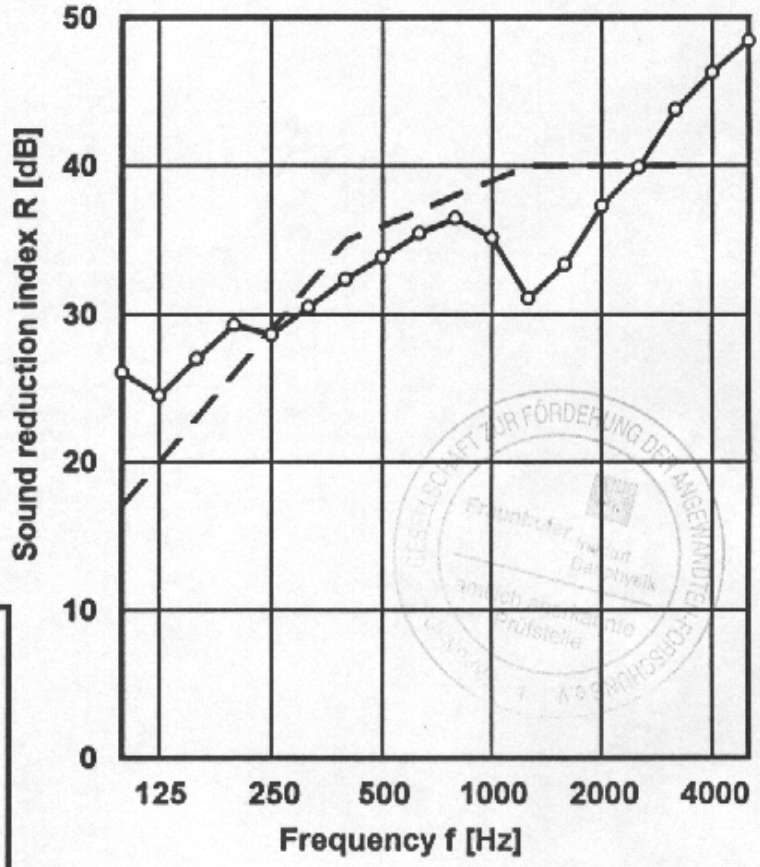
Test rooms:
Volumes: V_S = 52 m³
V_E = 63 m³
Type: laboratory
Condition: empty
Upper limit:
$R'_{max,w}$ = 75 dB.

Test sound: pink noise

Test method:
DIN 52 210-03-M-L-P-W

Date of measurement:
November 25 th, 1998

Test conditions:
Test temperature: 21 °C



Rating acc. to ZTV-Lsw 88
$\Delta L_{A,R,Str}$ = 33 dB.
The system under test meets the requirements specified in clause 7.2.1 of ZTV-Lsw 88.

Rating acc. to DIN EN 1793-2:1997
DL_R = 33 dB.
The airborne sound insulation properties of the system under test are to be classified in group B3.

Fraunhofer Institut Bauphysik

Stuttgart, December 17 th, 1999
On behalf of the head of the laboratory: