PEUTZ

Laboratory for Acoustics

TESTING
RvA L 334

Determination of the sound insulation of Bostik FP 404 Fire Retardant PU (Gun)Foam sealant made by Bostik

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Table of contents

1 Introduction

At the request of Bostik B.V. based at 's-Hertogenbosch (the Netherlands) sound insulation measurements have been carried out on:

Bostik FP 404 Fire Retardant PU (Gun)Foam
sealant
manufactured by Bostik

in the Laboratory for Acoustics of Peutz bv, at Mook, the Netherlands (see figure 1).

For these type of measurements the Laboratory for Acoustics has been accredited by the Dutch Accreditation Council (RvA).

The RvA is member of the EA MLA (**EA MLA**: **E**uropean **A**ccreditation Organisation **M**ulti**L**ateral **A**greement: http://www.european-accreditation.org).

EA: "Certificates and reports issued by bodies accredited by MLA and MRA members are considered to have the same degree of credibility, and are accepted in MLA and MRA countries."

2 Standards and guidelines

The measurements have been carried out according to the Quality Manual of the Laboratory for Acoustics as well as:

ISO 10140-2:2010   Acoustics - Laboratory measurements of sound insulation of building elements – Part 2: Measurement of airborne sound insulation

ISO 10140-1:2016   Acoustics - Laboratory measurements of sound insulation of building elements – Part 1: Application rules for specific products
Annex J Guidelines for the determination of sound reduction index of joints filled with fillers and/or seals

Various other related standards:

ISO 10140-4:2010   Acoustics - Laboratory measurements of sound insulation of building elements – Part 4: Measurement procedures and requirements

ISO 10140-5:2010-A1(2014)
Acoustics - Laboratory measurements of sound insulation of building elements – Part 5: Requirements for test facilities and equipment

ISO 140-2:1991   Acoustics - Measurement of sound insulation of building elements - Part 2: Determination, verification and application of precision data

ISO 717-1:2013   Acoustics - Rating of sound insulation in buildings and of building elements - Part 1: Airborne sound insulation

3 Tested sealants

The following data have been provided by the principal, supplemented by observations in the laboratory where applicable.

The following sealants were tested:

Bostik FP 404 Fire Retardant PU (Gun)Foam
base;   Polyurethane
mass: 15 - 20 kg/m^3

The depth of the joint for all measurements was 100 mm.
The length of the joint was 2200 mm.
The measurements have been carried out for joint widths:
10 / 20 / 30 / 40 mm.

The results as presented here relate only to the tested items and laboratory conditions as described in this report. The laboratory can make no judgement about the representativity of the tested samples. The test report ahead is valid as long as the tested constructions and/or materials are unchanged.

4 Measurements

4.1 Measurement setup

For the purpose of this measurement a twin leaf wall construction has been build into the test opening between measuring rooms (3) and (4) (see figure 1 en 2). The wall construction exists out of a wooden box construction filled with sand and covered with a mass layer on one side and a separate frame covered with two panels of 12,5 mm gypsum board on the other side. The twin leaf partition is mounted across the acoustic break of the laboratory. The wall cavity is filled with stonewool. All seams and chinks are carefully sealed.
The maximal measurable sound reduction index of joints with this set-up is given in figure 3.

4.2 Method

The tests were conducted in accordance with the provisions of the test method ISO 10140 in the Laboratory for Acoustics of Peutz bv in Mook. A detailed description of the test set up has been given in figures 1 and 2 of this report.

The construction to be tested is placed into a test opening between two measuring rooms. In one of the rooms (the so-called sending room) loudspeakers generate broadband noise.
In this sending room as well as in the adjacent room (the "receiving room") the resulting sound pressure level is measured by means of a continuous rotating boom, so the (time- and space-) averaged sound pressure level is determined.

The reverberation time of the receiving room is also measured.

The instruments and the method used meet the requirements of ISO 10140-5.

As allowed by the test method the test procedure is repeated reversing the sending and receiving rooms. The reported value of each sound insulation is the arithmetic average of the two results.

There are several quantities to express the element performance of filled joints
In this document the sound reduction index R_s per meter is chosen as the prime quantity to be estimated

In ISO 10140-1:2010 Annex J the sound reduction index of joints filled with fillers and/or seals is defined as the "sound reduction index of joints, R_s per meter" to be evaluated according to formula 1 and expressed in dB:

$$R_s = L_1 - L_2 + 10 \; lg\left(\frac{(S_n l)}{(A l_n)}\right) \tag{1}$$

in which:

L_1 = the energy average sound pressure level in the source room   [dB]
L_2 = the energy average sound pressure level in the receiving room   [dB]
l   = the length of the joint (l = 2,187 m) in the used measurement set up   [m]
l_n = reference length (l_n = 1 m)   [m]
S_n = reference area (S_n= 1 m^2)   [m^2]
A   = equivalent absorption area in the receiving room according to:

$$A = \frac{0,16\,V}{T} \qquad (2)$$

in which:
V   = volume of the receiving room   [m^3]
T   = reverberation time in the receiving room   [s]

Based on the quantity R_s the following other quantities can be deduced:
− the sound reduction R based on the area (S_S) of the separating element
− the element normalized level difference $D_{n,e}$ (used when the sound transmission is only due to a small building element)

4.3 Accuracy

The accuracy of the airborne sound insulation as calculated can be expressed in terms of repeatability (tests within one laboratory) and reproducibility (between various laboratories).

4.3.1 Repeatability r
When: - two tests are performed on identical test material - within a short period of time - by the same person or team - using the same instrumentation - under unchanged environmental conditions - the probability will be 95% that the difference between the two test results will be less than or equal to r.

In order to evaluate the repeatability r for the sound insulation measurements performed in the laboratories of Peutz bv in Mook eight series of measurements have been carried out according to ISO 140-2. From the results of those measurements the repeatability r has been calculated. It was found that for the frequency range from 100 to 250 Hz the repeatability r is 2,0 dB as a maximum. For the frequency range 315 to 3150 Hz the repeatability r is 1,3 dB as a maximum.

The repeatability r regarding the single-figure rating $R_{s,w}$ is 0,7 dB as a maximum. As ISO 717-1 prescribes rounding of the R_w-values to the nearest dB repeatability r of 1 dB is applicable for the $R_{s,w}$-value.

From these results it may be concluded that the repeatability r as found satisfies the demands of ISO 140-2.

4.3.2 Reproducibility R

When: - two tests are performed on identical test material - in different laboratories - by different person(s) - under different environmental conditions - the probability will be 95% that the difference between the two test results will be less than or equal to R.

In ISO 140-2 there is a statement on the reproducibility R to be expected, based on the results of various inter-laboratory tests. The reproducibility of the single figure rating $R_{s,w}$ is about 3 dB.

4.4 Environmental conditions during the measurements

t4.1 *Environmental conditions during the measurements (at June 5th, 2019)*

room	temperature [°C]	relative humidity [%]
3	21	56
4	20	63

4.5 Results

The results of the measurements are given in table 4.2 and in the figures 4 up to and including 7. In the tables and graphs the values of the insulation found are presented in 1/3 octave bands. From these values the weighted sound reduction index $R_{s,w}$ according to ISO 717-1 including the spectrum adaptation terms C and C_{tr} have been calculated and stated.
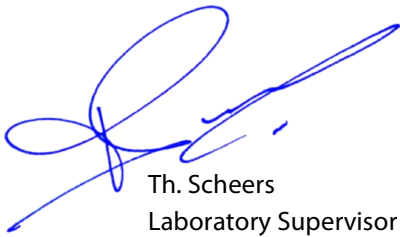
The calculation results of the other single number quantities (R_w and $D_{n,e,w}$) are given in appendix I to this report.

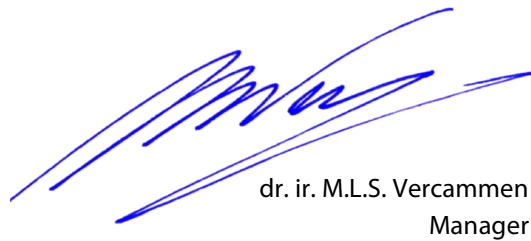*t4.2   Measurements results* **Bostik FP 404 Fire Retardant PU (Gun)Foam**

	airborne sound insulation R [dB]							
joint width	40 mm		30 mm		20 mm		10 mm	
joint depth	100 mm		100 mm		100 mm		100 mm	
record nr.	#153		#160		#181		#250	
see figure	4		5		6		7	
frequency [Hz]	1/3 oct.	1/1 oct.	1/3 oct.	1/1 oct.	1/3 oct.	1/1 oct.	1/3 oct.	1/1 oct.
50	28,4		27,0		27,3		29,1	
63	30,8	30,8	30,4	29,9	31,0	30,2	29,6	30,5
80	36,8		37,2		37,1		34,5	
100	37,5		36,3		36,5		36,4	
125	40,2	39,5	40,0	39,0	40,0	39,2	38,8	38,7
160	41,8		43,5		43,9		43,2	
200	40,2		42,4		42,5		43,6	
250	40,0	40,1	42,3	42,3	43,7	43,2	43,7	44,0
315	40,2		42,3		43,6		44,8	
400	42,7		44,3		45,6		47,2	
500	41,5	42,4	45,4	45,2	46,1	46,5	47,9	48,1
630	43,3		46,0		48,0		49,6	
800	44,4		46,4		50,0		52,5	
1000	40,8	42,4	45,7	46,2	51,3	51,4	54,5	54,3
1250	42,6		46,5		53,9		57,0	
1600	41,1		45,9		56,7		60,0	
2000	37,4	38,2	44,2	43,8	58,1	57,1	62,3	61,5
2500	37,2		42,2		56,7		62,8	
3150	38,7		40,0		53,3		64,5	
4000	40,0	40,2	42,1	41,6	48,7	47,7	65,3	65,2
5000	43,1		43,6		44,8		66,0	
$R_{s,w}(C;C_{tr})$	41(-1;0) dB		45(-1;-1) dB		51(-1;-3) dB		53(-1;-4) dB	
$C_{100-5000};C_{tr,100-5000}$	(-1;0) dB		(-1;-1) dB		(-2;-3) dB		(0;-4) dB	
$C_{50-3150};C_{tr,50-3150}$	(-1;-1) dB		(-1;-2) dB		(-1;-5) dB		(-1;-7) dB	
$C_{50-5000};C_{tr,50-5000}$	(-1;-1) dB		(-1;-2) dB		(-2;-5) dB		(0;-7) dB	

The results as presented here are based on a testing length of 2,2 m. In situations where different dimensions and/or method of mounting differ from the ones tested, different results may be found.

Mook,
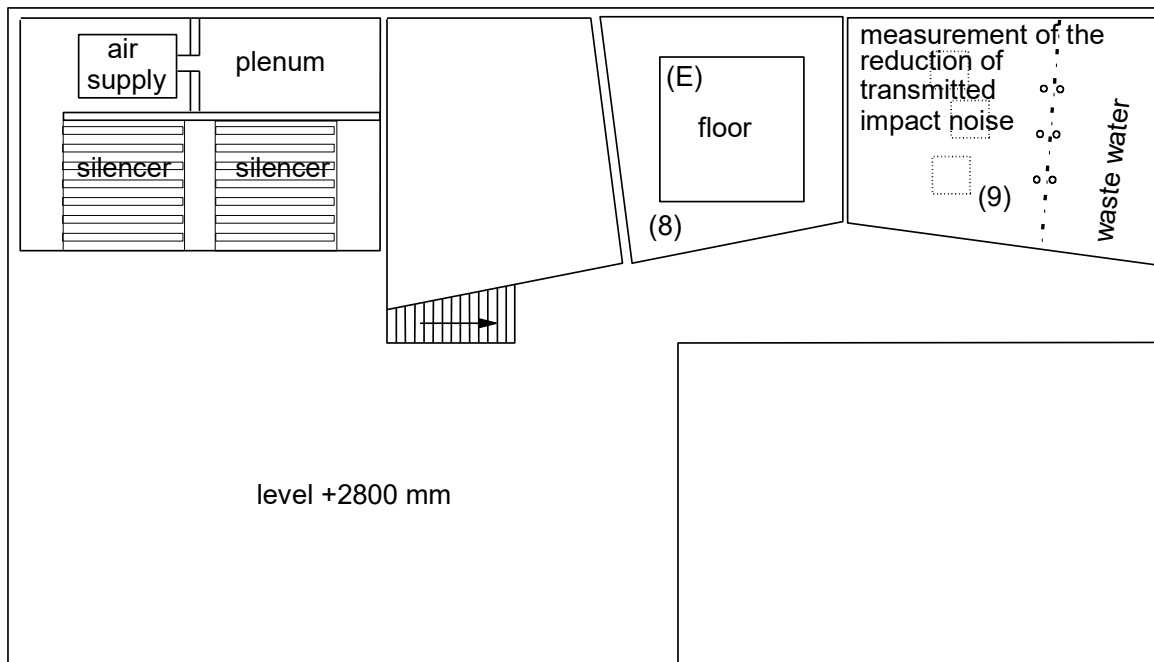
Th. Scheers
Laboratory Supervisor

dr. ir. M.L.S. Vercammen
Manager

This report contains 11 pages, 7 figures and 1 Appendix.

LABORATORY FOR ACOUSTICS

PEUTZ

PEUTZ bv
Lindenlaan 41, NL-6584 AC MOLENHOEK (LB), THE NETHERLANDS

OVERVIEW

Story

air supply

plenum

silencer   silencer

(E) floor

(8)

measurement of the reduction of transmitted impact noise

waste water

(9)

level +2800 mm

Ground level

opening (A) (closed)
w x h = 1300 x 1905 mm

plenum

air supply installations
(6)

(A)

(C)   (D)

sanitairy installations

reverberation room

receiving room

sending room

(5)   (4)

(B)   (3)

(2)

(1)   (7)

suspended ceilings
or raised floors

workshop

heating

wc

shower

conference room

analyses

overhead door
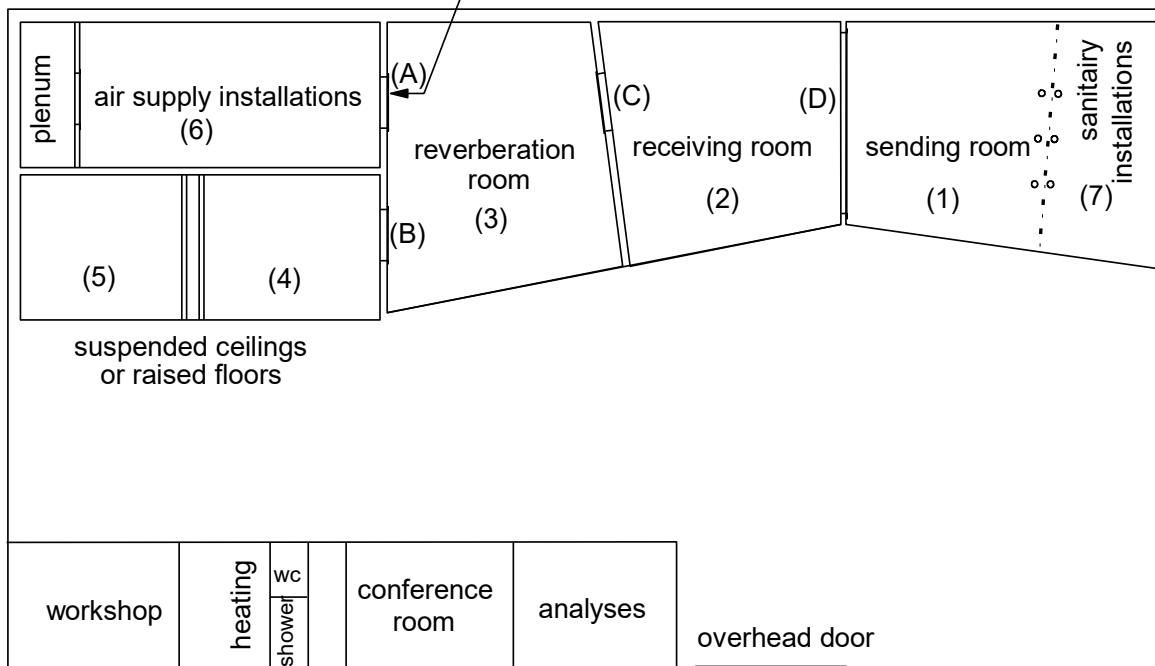
TEST OPENINGS (w x h in mm)
      (B) 1000 x 2200
      (C) 1500 x 1250
      (D) 4300 x 2800
      (E) 4000 x 4000

0 1 2 3 4 5 m
scale

SOUND INSULATION TEST FACILITIES: DOOROPENING

the test rooms meet the requirements of ISO 10140-5.

additional data :
- volume of room (4)   68 m³
- volume of the reverberation room (3)   214 m³
- area of the test specimen   2.2 m²

Both rooms are isolated for vibrations by using so called room-in-room construction.
Flanking transmission is thus minimised.
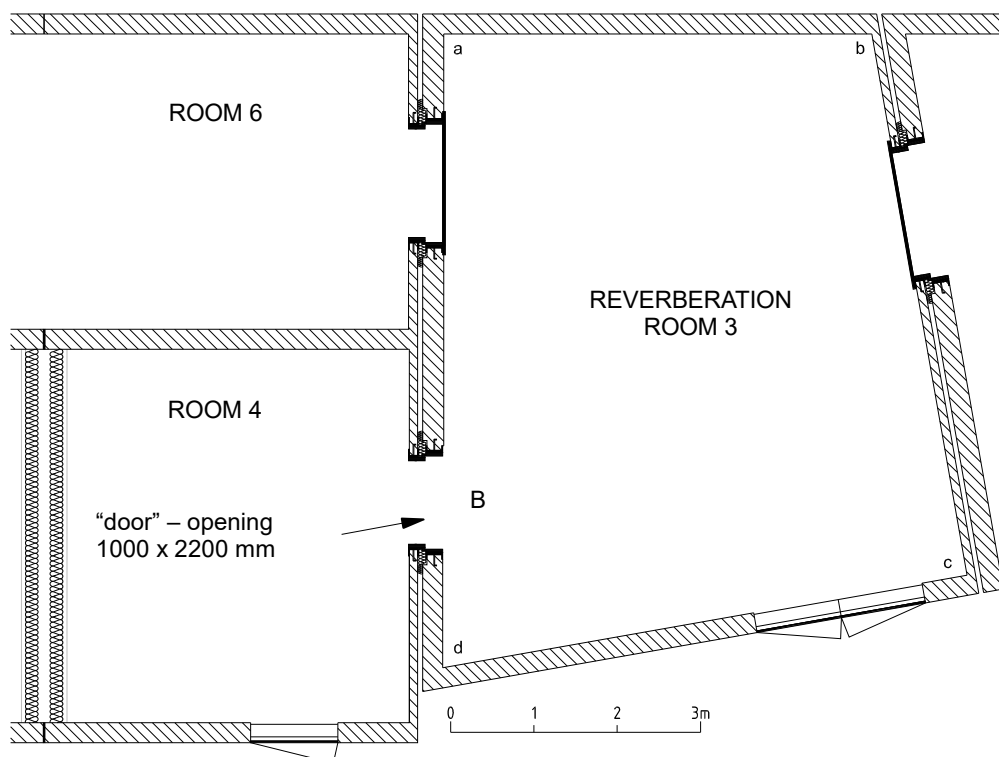
View from room 4   View from room 3

LABORATORY FOR ACOUSTICS

PEUTZ

MEASUREMENT OF THE SOUND REDUCTION INDEX OF JOINTS
ACCORDING TO ISO 10140-1:2012

principal: Bostik B.V.

---

construction tested: Maximal measurable sound reduction index of joints with used measurement set-up

—— 1/3 oct.
✳ 1/1 oct.

volume measuring room: 68 m^3

 volume measuring room: 214 m^3

 length of joint: 2,2 m

measured at:
Peutz Laboratory for Acoustics

signal: broad-band noise

bandwidth: 1/3 octave

ISO 717-1:2013

$R_{s,w}(C;C_{tr}) = 54(-1;-5)$ **dB**

$C_{100-5000};C_{tr,100-5000} = (0;-5)$ **dB**

$C_{50-3150};C_{tr,50-3150} = (-2;-8)$ **dB**

$C_{50-5000};C_{tr,50-5000} = (-1;-8)$ **dB**
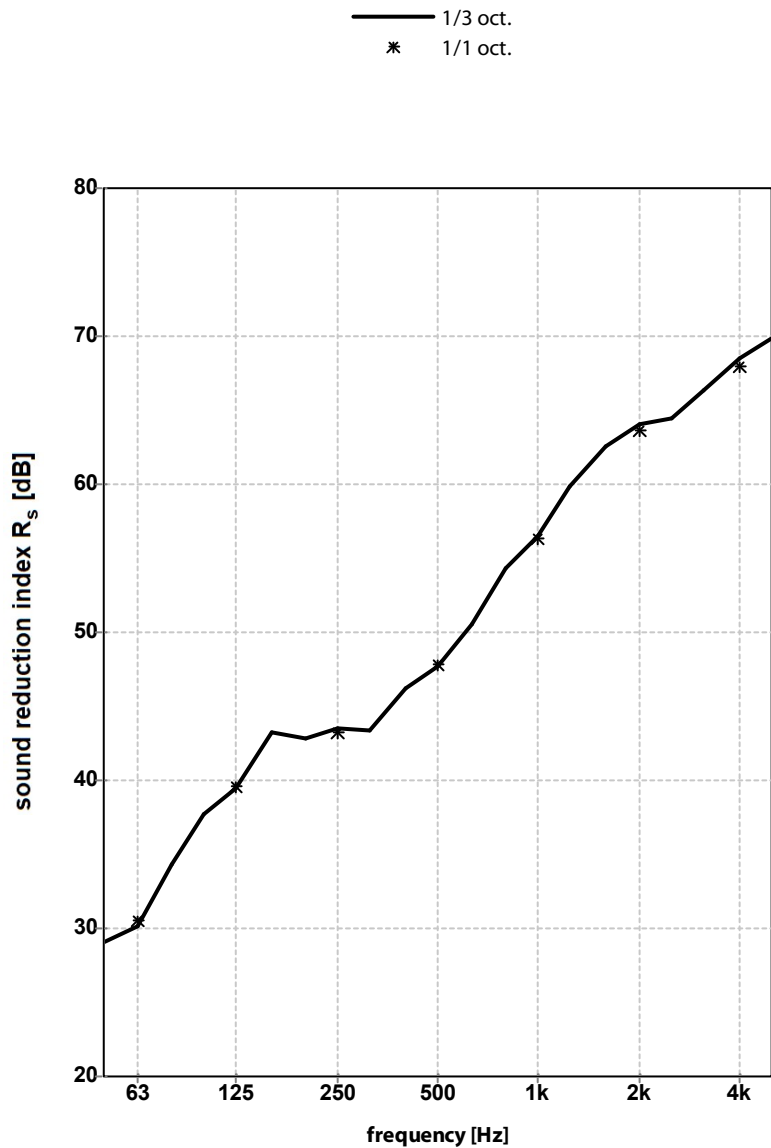
	63	125	250	500	1k	2k	4k	
	29,0	37,7	42,9	46,2	54,3	62,6	66,4	
1/3 oct.	30,2	39,5	43,5	47,7	56,5	64,1	68,5	dB
	34,3	43,3	43,4	50,6	59,9	64,4	69,8	
1/1 oct.	**30,6**	**39,6**	**43,3**	**47,8**	**56,3**	**63,6**	**68,0**	**dB**

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figure 3

LABORATORY FOR ACOUSTICS

PEUTZ

MEASUREMENT OF THE SOUND REDUCTION INDEX OF JOINTS
ACCORDING TO ISO 10140-1:2012

principal: Bostik B.V.

construction tested: **Bostik FP 404 Fire Retardant PU (Gun)Foam**   joint width 40 mm

joint depth 100 mm

volume measuring room: 68 m^3

volume measuring room: 214 m^3

length of joint: 2,2 m

measured at:
Peutz Laboratory for Acoustics

signal: broad-band noise

bandwidth: 1/3 octave

ISO 717-1:2013

$R_{s,w}(C;C_{tr}) = 53(-1;-4)$ **dB**

$C_{100-5000};C_{tr,100-5000} = (0;-4)$ **dB**

$C_{50-3150};C_{tr,50-3150} = (-1;-7)$ **dB**

$C_{50-5000};C_{tr,50-5000} = (0;-7)$ **dB**
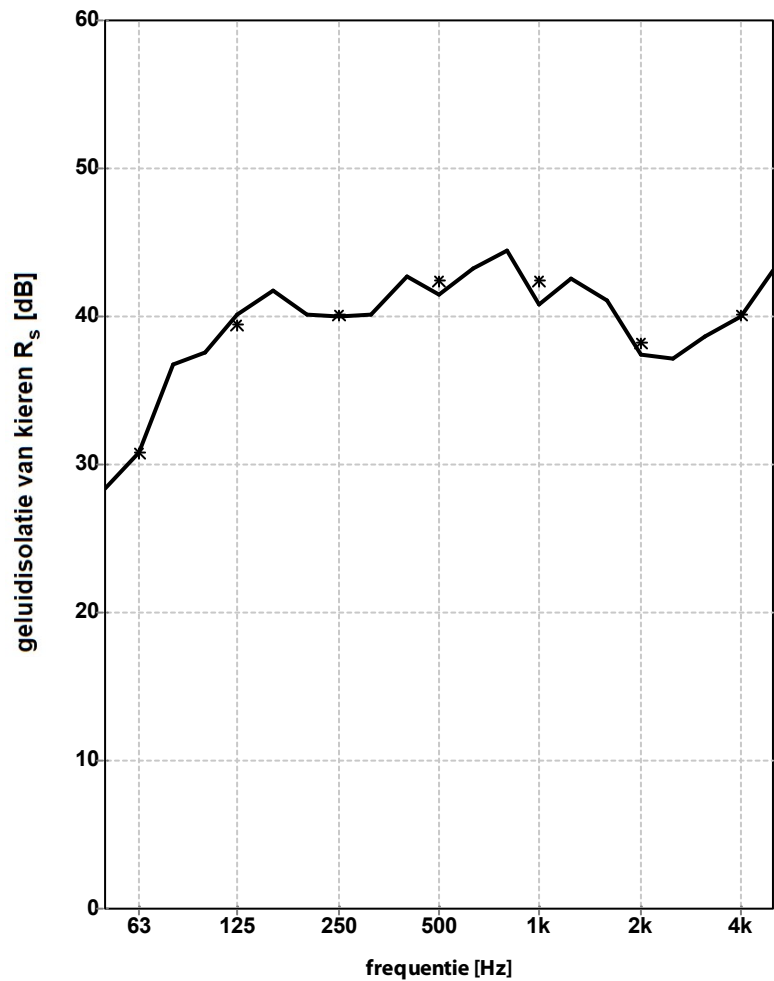
	63	125	250	500	1k	2k	4k	
	28,4	37,5	40,2	42,7	44,4	41,1	38,7	
1/3 oct.	30,8	40,2	40,0	41,5	40,8	37,4	40,0	dB
	36,8	41,8	40,2	43,3	42,6	37,2	43,1	
1/1 oct.	**30,8**	**39,5**	**40,1**	**42,4**	**42,4**	**38,2**	**40,2**	**dB**

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figure 4

LABORATORY FOR ACOUSTICS

PEUTZ

MEASUREMENT OF THE SOUND REDUCTION INDEX OF JOINTS
ACCORDING TO ISO 10140-1:2012

principal: Bostik B.V.

construction tested: **Bostik FP 404 Fire Retardant PU (Gun)Foam**   joint width 30 mm
                                                                                                                                joint depth 100 mm

volume measuring room: 68 m^3

volume measuring room: 214 m^3

length of joint: 2,2 m

measured at:
Peutz Laboratory for Acoustics

signal: broad-band noise

bandwidth: 1/3 octave

ISO 717-1:2013

$R_{s,w}(C;C_{tr}) = 45(-1;-1)$ **dB**

$C_{100\text{-}5000};C_{tr,100\text{-}5000} = (-1;-1)$ **dB**

$C_{50\text{-}3150};C_{tr,50\text{-}3150} = (-1;-2)$ **dB**

$C_{50\text{-}5000};C_{tr,50\text{-}5000} = (-1;-2)$ **dB**
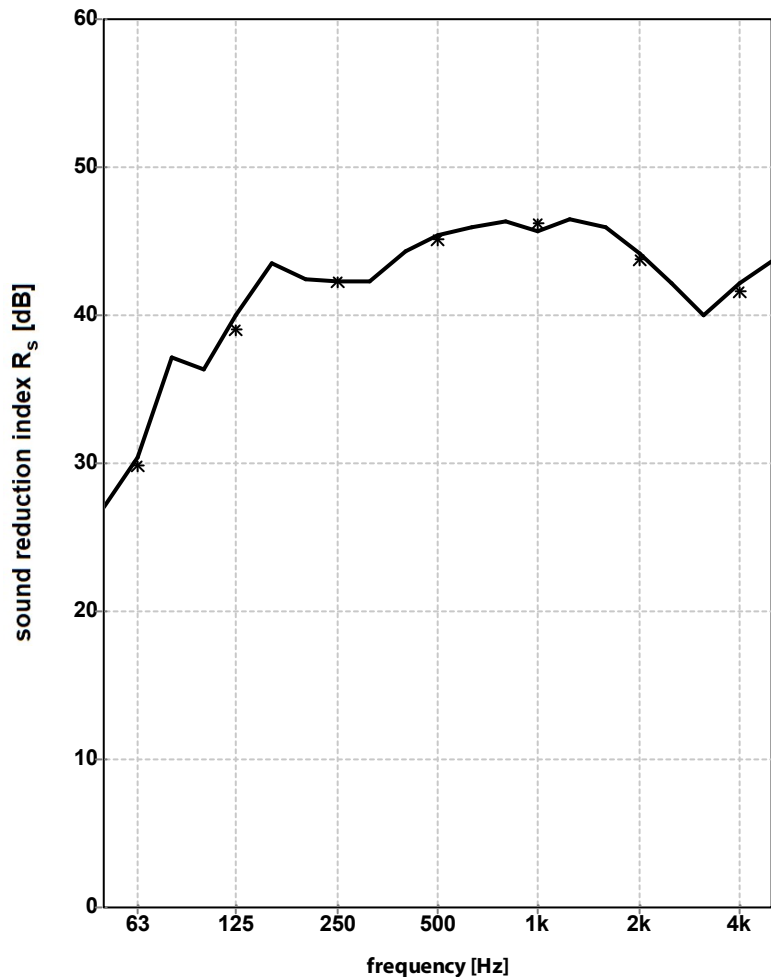
	63	125	250	500	1k	2k	4k	
	27,0	36,3	42,4	44,3	46,4	45,9	40,0	
1/3 oct.	30,4	40,0	42,3	45,4	45,7	44,2	42,1	dB
	37,2	43,5	42,3	46,0	46,5	42,2	43,6	
1/1 oct.	**29,9**	**39,0**	**42,3**	**45,2**	**46,2**	**43,8**	**41,6**	**dB**

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report A 3646-4E   figure 5

LABORATORY FOR ACOUSTICS

PEUTZ

MEASUREMENT OF THE SOUND REDUCTION INDEX OF JOINTS
ACCORDING TO ISO 10140-1:2012

principal: Bostik B.V.

construction tested: **Bostik FP 404 Fire Retardant PU (Gun)Foam**   joint width 20 mm
joint depth 100 mm

volume measuring room: 68 m³

 volume measuring room: 214 m³

 length of joint: 2,2 m

measured at:
Peutz Laboratory for Acoustics

signal: broad-band noise
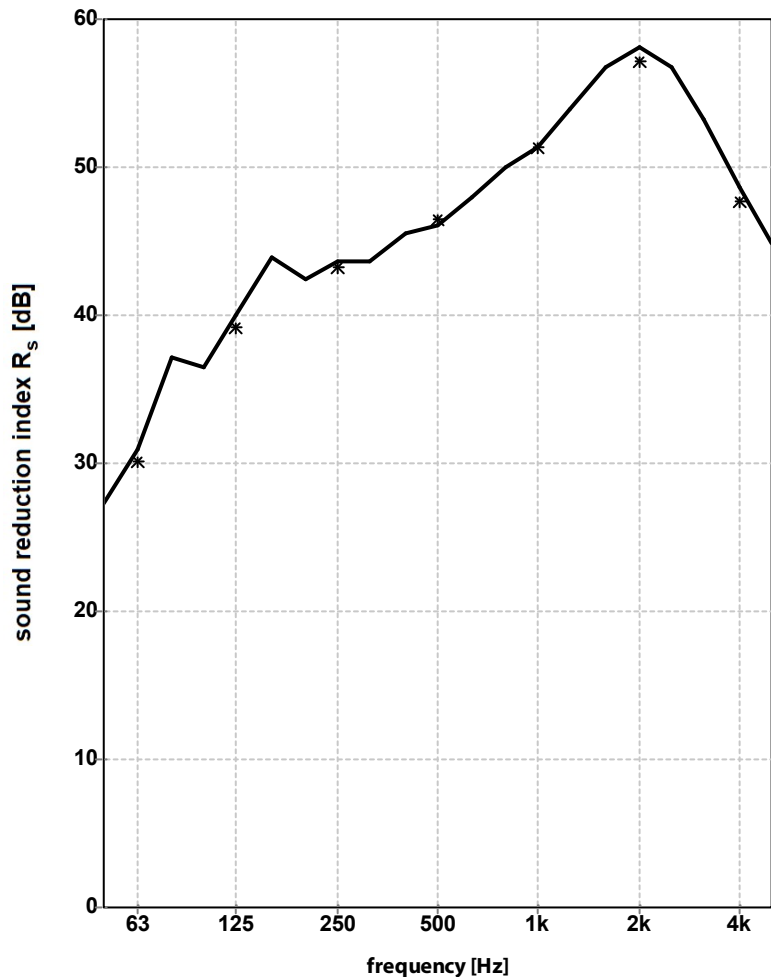
bandwidth: 1/3 octave

ISO 717-1:2013

$R_{s,w}(C;C_{tr}) = 51(-1;-3)$ **dB**

$C_{100-5000};C_{tr,100-5000} = (-2;-3)$ **dB**

$C_{50-3150};C_{tr,50-3150} = (-1;-5)$ **dB**

$C_{50-5000};C_{tr,50-5000} = (-2;-5)$ **dB**

	63	125	250	500	1k	2k	4k	
	27,3	36,5	42,5	45,6	50,0	56,7	53,3	
1/3 oct.	31,0	40,0	43,7	46,1	51,3	58,1	48,7	dB
	37,1	43,9	43,6	48,0	53,9	56,7	44,8	
1/1 oct.	**30,2**	**39,2**	**43,2**	**46,5**	**51,4**	**57,1**	**47,7**	**dB**

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report A 3646-4E   figure 6

LABORATORY FOR ACOUSTICS

PEUTZ

MEASUREMENT OF THE SOUND REDUCTION INDEX OF JOINTS
ACCORDING TO ISO 10140-1:2012

principal: Bostik B.V.

construction tested: **Bostik FP 404 Fire Retardant PU (Gun)Foam**

joint width 10 mm
joint depth 100 mm

volume measuring room: 68 m³

 volume measuring room: 214 m³

 length of joint: 2,2 m

measured at:
Peutz Laboratory for Acoustics
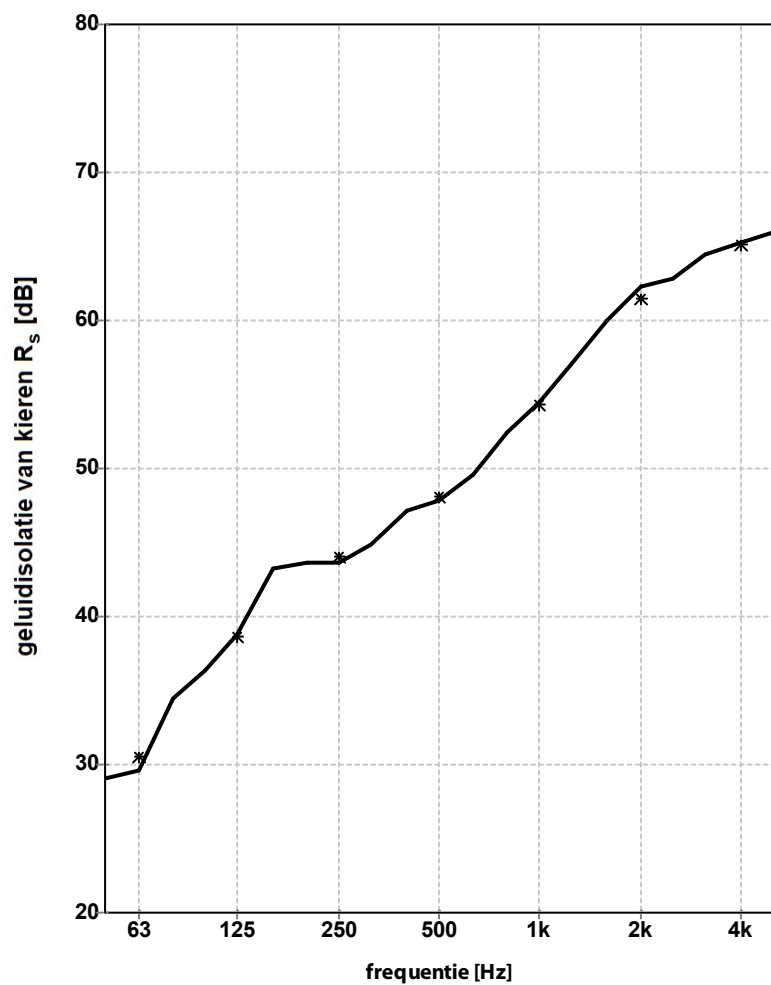
signal: broad-band noise

bandwidth: 1/3 octave

ISO 717-1:2013

$R_{s,w}(C;C_{tr}) = 53(-1;-4)$ **dB**

$C_{100-5000};C_{tr,100-5000} = (0;-4)$ **dB**
$C_{50-3150};C_{tr,50-3150} = (-1;-7)$ **dB**
$C_{50-5000};C_{tr,50-5000} = (0;-7)$ **dB**

	63	125	250	500	1k	2k	4k	
	29,1	36,4	43,6	47,2	52,5	60,0	64,5	
1/3 oct.	29,6	38,8	43,7	47,9	54,5	62,3	65,3	dB
	34,5	43,2	44,8	49,6	57,0	62,8	66,0	
1/1 oct.	**30,5**	**38,7**	**44,0**	**48,1**	**54,3**	**61,5**	**65,2**	**dB**

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figure 7

Appendix

Quantities

The determined prime quantity is the sound reduction index of joints, R_s per metre of a sealed gap or joint. This quantity is evaluated from Equation (J.1) of Annex J of ISO 10140-1:2016.

$$R_s = L_1 - L_2 + 10 \ lg\left(\frac{(S_n l)}{(A \ l_n)}\right) \tag{J.1}$$

where :

L_1	=	the energy average sound pressure level in the source room	[dB]
L_2	=	the energy average sound pressure level in the receiving room	[dB]
l	=	the length of the joint (l = 2,2 m) in the used measurement set up	[m]
l_n	=	reference length (l_n = 1 m)	[m]
S_n	=	reference area (S_n= 1 m^2)	[m^2]
A	=	equivalent absorption area in the receiving room	[m^2]

The single number ratings ($R_{S,w}$) are determined in accordance with ISO 717-1. The results are summarized in Table 1. In this table some additional single-number values are given, first being the element-normalized level difference $D_{n,e,w}$ which is often used for sound transmission through small technical elements evaluated from Equation (5) from ISO 10140-2:2010

$$D_{n,e} = L_1 - L_2 + 10 \ lg\left(\frac{A_0}{A}\right) \tag{5}$$

where :

L_1, L_2 and A are the same as in equation (J.1)

A_0 = the reference absorption area (here A_0 = 10 m^2)

Further the sound reduction index R_w is given in table 1 , evaluated from Equation (2) from ISO 10140-2:2010

$$R = L_1 - L_2 + 10 \ lg\left(\frac{S}{A}\right) \tag{2}$$

where :

L_1, L_2 and A are the same as in equation (J.1)

S = the free area of the joint (width x length) in which the tested joint filler is installed

Results

t1 *Measurement / calculation results*

tested sealant	width of the joint	$R_{S,w}$	$D_{n,e,w}$	R_W
Bostik FP 404 Fire Retardant PU (Gun)Foam	40 mm	41 dB	48 dB	27 dB
	30 mm	45 dB	52 dB	30 dB
	20 mm	51 dB	58 dB	34 dB
	10 mm	53 dB	60 dB	33 dB
maximum	-	54 dB	61 dB	-