Evidence of Performance
Joint sound reduction of filling material

Test Report
No. 18-000823-PR01
(PB Z02-K05-04-en-01)

Client	**Hilti Entwicklungsgesellschaft mbH** Hiltistr. 6 86916 Kaufering Germany
Product	1K PU-Foam
	CF 125-50 CF 125 5W50 CF 126 CF 126N CF-I 750 B2
Designation	CF ISO 750
Density	13.4 g/l
Special features	-/-

Weighted sound reduction index of joints $R_{s,w}$
Spectrum adaptation terms C and C_{tr}

$$[R_{s,w}\,(C;\,C_{tr}) \geq 62\ (-1;-5)\ \text{dB}]$$

Determined for 20 mm width of joint

ift Rosenheim
22.05.2018

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Basis

EN ISO 10140-1: 2016
EN ISO 10140-2 : 2010
EN ISO 717-1 : 2013

ASTM E 90-09
ASTM E 413-10
ASTM E 1332-10a

Test report no. 18-000823-PR01 (PB Z02-K05-04-de-01)

Representation

Instructions for use

This procedure is suitable for the comparison of construction products designed for sealing (e.g. gaskets/seals, fillers for joints). The results can be used to evaluate the sound power ratio τ_e according to EN 12354-3 Annex B.
Using the calculated sound reduction of the joint for the calculation of the overall sound reduction is not a substitute for the sound reduction verification of the overall construction.

Validity

The data and results given relate solely to the tested and described specimen.

Testing the sound insulation does not allow any statement to be made on any further characteristics of the construction submitted regarding performance and quality.

Notes on publication

The **ift** Guidance Sheet "Conditions and Guidance for the Use of **ift** Test Documents" applies.

The cover sheet can be used as an abstract.

Contents

The test report contains a total of 11 pages:

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1 Obect

1.1 Description of test specimen

Product	1K PU-Foam
Date of manufacturing of test specimen	13. April 2018
Product designation	CF 125-50 CF 125 5W50 CF 126 CF 126N CF-I 750 B2 CF ISO 750
Dimension	
Length of joint l	1,200 mm
Depth of joint d	100 mm
Width of joint w	20 mm
Joint cover	Without, foam cut flush with slide-in cassette
Curing time	6 days
Density	13.4 g/l

The description is based on inspection of the test specimen at the **ift** Laboratory for Building Acoustics. Item designations / numbers as well as material specifications were provided by the client. Additional data provided by the manufacturer are marked with *.

1.2 Mounting to test rig

The sound reduction index R_S of the joint was measured in a mobile joint measuring apparatus as per EN ISO 10140-1:2016, Annex J (see Figs. 1 and 2). This mobile measuring apparatus consists of a high-performance sound insulating element made of metal profiles and Bondal sheet with slide-in cassettes. The profiles of the slide-in cassettes are filled with sand. Using these cassettes, a great variety of joints with varying joint widths w can be created (Fig. 1).

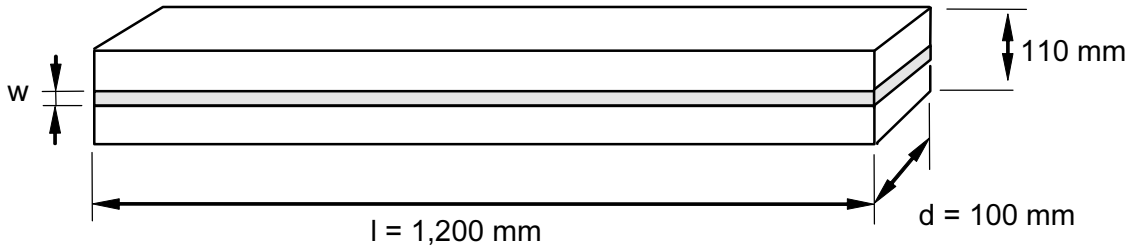


fig 1 slide-in cassettes

These slide-in cassettes were produced by the **ift** Laboratory for Building Acoustic and employees of the client 6 days before the date of test using the filling material to be tested. After hardening the material was cut on the edges and mounted in the highly sound insulating element (Fig. 2), which was mounted in the test opening of the window-test rig

(Z-wall) acc. to EN ISO 10140-5. The joints to the test opening were filled with cellular material and sealed with plastic sealant on both sides.

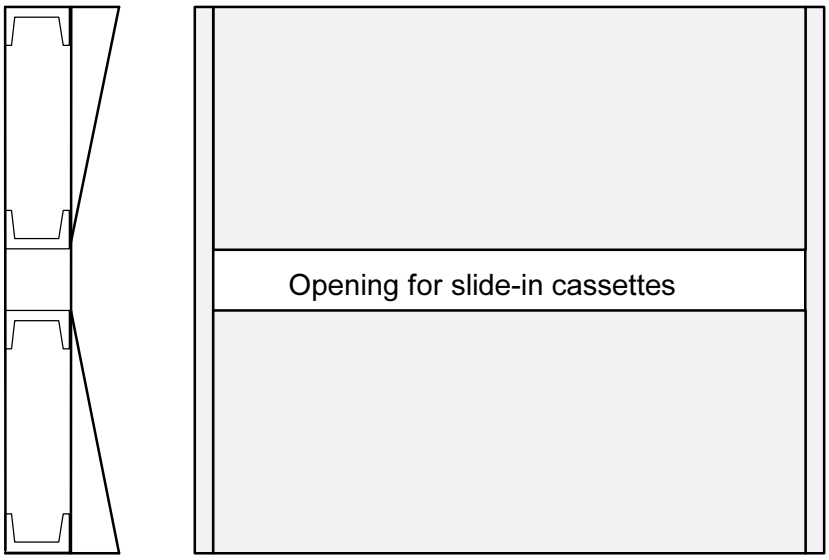


fig 2 Set-up of joint testing apparatus (high performance sound insulating element)

fig 3 Photos of the mounted element, taken by **ift** Laboratory for Building Acoustics

2 Procedure

2.1 Sampling

Sampling	The samples were selected by the client. The slide-in cassettes were filled by the **ift** Laboratory for Building Acoustics with the filler to be tested according to the instructions of the manufacturer.
Quantity	1
Manufacturer	The manufacturer is known to the ift Rosenheim and has been retained
Manufacturing plant	-
Date of manufacture / Date of sampling	-
Responsible for sampling	Mr. Schulze
Delivery at **ift**	3rd April 2018 by the client via forwarding agency
ift registration number	45656/02

2.2 Process

Basis

EN ISO 10140-1:2016	Acoustics; Laboratory measurement of sound insulation of building elements - Part 1: Application rules for specific products (ISO 10140-1: 2016); German version EN ISO 10140-1:2016
EN ISO 10140-2:2010	Acoustics; Laboratory measurement of sound insulation of building elements - Part 2: Measurement of airborne sound insulation (ISO 10140-2:2010)
EN ISO 717-1: 2013	Acoustics; Rating of sound insulation in buildings and of building elements - Part 1: Airborne sound insulation

Corresponds to the national German standard/s:
DIN EN ISO 10140-1:2016-12, DIN EN ISO 10140-2:2010-12 and DIN EN ISO 717-1 : 2013-06

Additional basis

ASTM E 90-09	Standard test method for laboratory measurement of airborne sound transmission loss of building partitions and elements
ASTM E 413-10	Classification for rating sound insulation
ASTM E 1332-10a	Standard Classification for Determination of Outdoor-Indoor Transmission Class

Boundary conditions	As specified by the standard.
Deviation	There are no deviations from the test method/s and/or test conditions acc. to EN ISO 10140. The volume of the test room falls below the minimum volume of 80 m³ as defined in ASTM E 90-09.

Test noise	Pink noise
Measuring filter	One-third-octave band filter
Measurement limits	
Low frequencies	The dimensions of the receiving room are smaller than recommended for testing in the frequency range from 50 Hz to 80 Hz as per EN ISO 10140-4:2010 Annex A (informative). A moving loudspeaker was used.
Background noise level	The background noise level in the receiving room was determined during measurement and the receiving room level L_2 corrected by calculation as per EN ISO 10140-4: 2010 Clause 4.3.
Maximum insulation	The maximum insulation of the test rig is partly within the range of the test results. Therefore the tested values are minimum values. A correction by calculation was performed for maximum sound insulation.
Measurement of reverberation time	Arithmetical mean: two measurements each of 2 loudspeaker and 3 microphone positions (a total of 12 independent measurements).
Measurement equation A	$A = 0{,}16 \cdot \frac{V}{T}$ m²
Measurement of sound level difference	Minimum of 2 loudspeaker positions and rotating microphones.
Measurement equation	$R_S = L_1 - L_2 + 10 \log \frac{S_N \cdot l}{A \cdot l_N}$ dB

KEY

R_S	Joint sound reduction index in dB
L_1	Sound pressure level source room in dB
L_2	Sound pressure level receiving room in dB
l	Length of joint in m
S_N	Reference area (1 m²)
l_N	Reference length (1 m)
A	Equivalent absorption area in m²
V	Volume of receiving room in m³
T	Reverberation time in s

2.3 Test apparatus

Device	Type	Manufacturer
Integrating sound meter	Type Nortronic 840	Co. Norsonic-Tippkemper
Microphone preamplifiers	Type 1201	Co. Norsonic-Tippkemper
Microphone unit	Type 1220	Co. Norsonic-Tippkemper
Calibrator	Type 1251	Co. Norsonic-Tippkemper
Dodecahedron loudspeakers	Own design	-
Amplifier	Type E120	Co. FG Elektronik
Rotating microphone boom	Own design / Type 231-N-360	Co. Norsonic-Tippkemper

The **ift** Laboratory for Building Acoustics participates in comparative measurements at the Physikalisch-Technische Bundesanstalt (PTB) in Braunschweig every three years. The last one was in April 2016. The sound level meter used, Series No. 24842, was DKD calibrated by the company Norsonic Tippkemper (DKD - Deutscher Kalibrierdienst “German Calibration Service”) on 28th February 2017.

2.4 Testing

Date	19th April 2018
Operating Testing Officer	Mr. Florian Brechleiter

3 Detailed results

The values of the measured sound reduction index R_S of the joint for the tested seals are plotted against frequency in the data sheets (Annex). Based on EN ISO 717 - 1, this is used to calculate the weighted sound reduction index $R_{S,w}$ of the joint and the spectrum adaptation terms C and C_{tr}, related to joint length l = 1,200 for the frequency range 100 Hz to 3,150 Hz.

The diagram includes the maximum sound reduction of the test set-up (related to l = 1,200 mm), with a maximum weighted sound reduction index $R_{S,w\ max}$ (C; C_{tr}) = 62 (-2;-6) dB.

The resulting sound reduction indices for joints are within the range for maximum sound insulation; in these cases the values obtained are minimum values. For maximum insulation, it has been corrected by calculation as per EN ISO 10140-1:2016, Annex J. Table 1 lists the weighted sound reduction indices of the different joint designs.

Table 1 Test results, Depth of joint *d* = 100 mm

Weighted joint sound reduction index $R_{S,w}$ (C; C_{tr}) in dB	Measures taken, comments
62 (-2;-6)	Maximum sound insulation
≥ 62 (-1; -5)	Joint width 20 mm, filled with CF 125-50 CF 125 5W50 CF 126 CF 126N CF-I 750 B2 CF ISO 750

On order of the client supplementary to the rating as per EN ISO 717-1 an evaluation according to ASTM E 413-10 and ASTM E 1332-10a was carried out. The sound transmission class STC according to ASTM E 413-10 was determined for the frequency range from 125 Hz up to 4,000 Hz

STC 62

The Outdoor-Indoor transmission class OITC according to ASTM E 1332-10a for the frequency range from 80 Hz up to 4000 Hz was calculated to

OITC 55

The rating was done with spectrum of joint sound reduction index which is tabled in annexed data sheet.

4 Instructions for use

4.1 Application for DIN 4109: 2018

Basis

DIN 4109-1: 2018-01	Sound insulation in buildings - Part 1: Minimum requirements
DIN 4109-2: 2018-01	Sound insulation in buildings - Part 2: Verification of compliance with the requirements by calculation

The weighted joint sound reduction index determined in accordance with chapter 3, can be directly used for verification of sound insulation by calculation in accordance with DIN 4109-2.

This sound reduction index of joints is comparable to the linear sound reduction index of a building component with 1 m joint length for each m^2 area and where the sound is transmitted only through the joint.

If the joint is combined with a building component (e.g. window with area S and weighted sound reduction index R) and assuming the building component's area S_1 >> than the opening area of the joint (w · l, w = joint width), for the associated joint length l and a reference length l_0 = 1 m the resulting sound reduction index $R_{i,w}$ of the i-th-window with installation joint is calculated as follows:

$$R_{i,w} = -10 \cdot \log\left(10^{-\frac{R_w}{10}} + \frac{l \cdot l_0}{S} \cdot 10^{-\frac{R_{s,w}}{10}}\right) \text{dB}$$

For calculation of the total weighted apparent sound reduction index $R'_{w,ges}$ in accordance with DIN 4109-2 Clause 4, the input data obtained from laboratory measurements must be stated in $^1/_{10}$ dB. For the involvement of sound transmission via installation joint the resulting weighted joint sound reduction index can then be applied directly to the joint sound insulation. Single number values in 1/10 dB are given in section 4.2.

4.2 Uncertainty of measurement, single number ratings in $^1/_{10}$ dB

Basis

EN ISO 12999-1: 2014	Acoustics; Determination and application of measurement uncertainties in building acoustics, part 1: sound insulation (ISO 12999-1: 2014)

The resulting weighted sound reduction index of joints (in $^1/_{10}$ dB with measurement uncertainty), determined on the basis of EN ISO 717-1:2013-06 is:

$R_{S,w}$ = 62.8 dB ± 1.2 dB (width of joint 20 mm)

The specified measurement uncertainty is the average standard deviation of laboratory measurements (standard measurement uncertainty σ_R for measurement situation A:

Characterisation of a building component by laboratory measurements as per EN ISO 12999-1:2014, Table 3 σ_R = 1.2 dB).

The product declaration must use the integral value of the joint sound reduction index and the spectrum adaptation terms as given in Section 3.

$$R_{S,w}\ (C;C_{tr}) = 62\ (-1;\ -5)\ \text{dB (width of joint 20 mm)}$$

4.3 General remarks:

The method is suitable for comparing construction products designed for sealing purposes (e.g. seals/gaskets, fillers to seal joints). The results can be used to evaluate the sound power ratio τ_e as per EN 12354-3 Annex B. Using the calculated sound reduction of the joint for the calculation of the overall sound reduction is not a substitute for the verification of the overall construction

In practice, e.g. when combining the sound insulation of a window with that of a joint in an existing opening, the following must be taken into account:

a) for physical reasons, the sound reduction index of joints must be corrected by approx. –3 dB in the area of corners and edges;
b) the existing thickness of the window frame profile (joint depth d) must be adapted with a correction between –1 dB and –2 dB.
c) experience shows that the filling of window niches in edges and difficult reachable areas are weak points by handling

From this results, that in practice the measured sound reduction index of joint has to be

a) either corrected by –4 dB or
b) increased by additional sealing with backfilling tape with or without bar or elastic sealant with filling band.

Remark on transfer of the test results

According to the experience of **ift** the following correction reduction has to be applied for a window with an area of 1.82 m^2 and a surrounding joint length of 5.5 m (conditions in laboratory) with the sound reduction index of a window of $R_w \geq 40$ dB:

$R_{w,res} = R_{w,Fe} - 2$ dB

The correction of –2 dB is inapplicable if a sealing is carried out on both sides additionally to the foaming. For windows with $R_w \geq 48$ dB higher reductions may apply.

Assessments as per ASTM E 413-10 and ASTM E 1332-10a were based on sound insulation testing as per EN ISO 10140-1. For some details there are deviations from test

standard ASTM E 90-09, in particular as regards the required room volume (min. 80 m³) and regards the sound reduction index of joints (length related sound reduction index)

ift Rosenheim
Laboratory for Building Acoustics
22.05.2018

Joint sound reduction index according to ISO 10140-1

Determination of sound reduction index of joints

Client: **Hilti Entwicklungsgesellschaft mbH**, 86916 Kaufering (Germany)

Product designation CF 125-50, CF 125 5W50, CF 126, CF 126N, CF-I 750 B2, CF ISO 750

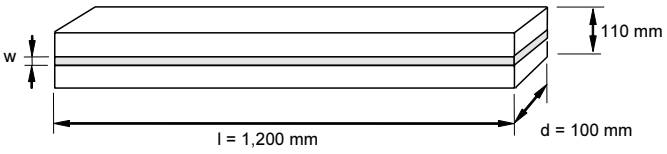
Design of test specimen

1K PU-Foam

Joint size

Length l	1,200 mm
Depth d	100 mm
Width w	20 mm
Density	13.4 g/l

Drawing of the test arrangement



Test date	19th April 2018
Test length l	1.2 m
Test rig	as per EN ISO 10140-5
Partition wall	Double-leaf concrete wall, insert frame
Test noise	pink noise
Volumes of test rooms	V_S = 104 m³ V_R = 67.5 m³

Maximum sound reduction index of joints

$R_{S,w,max}$ = 62dB (related to test length)

Mounting conditions

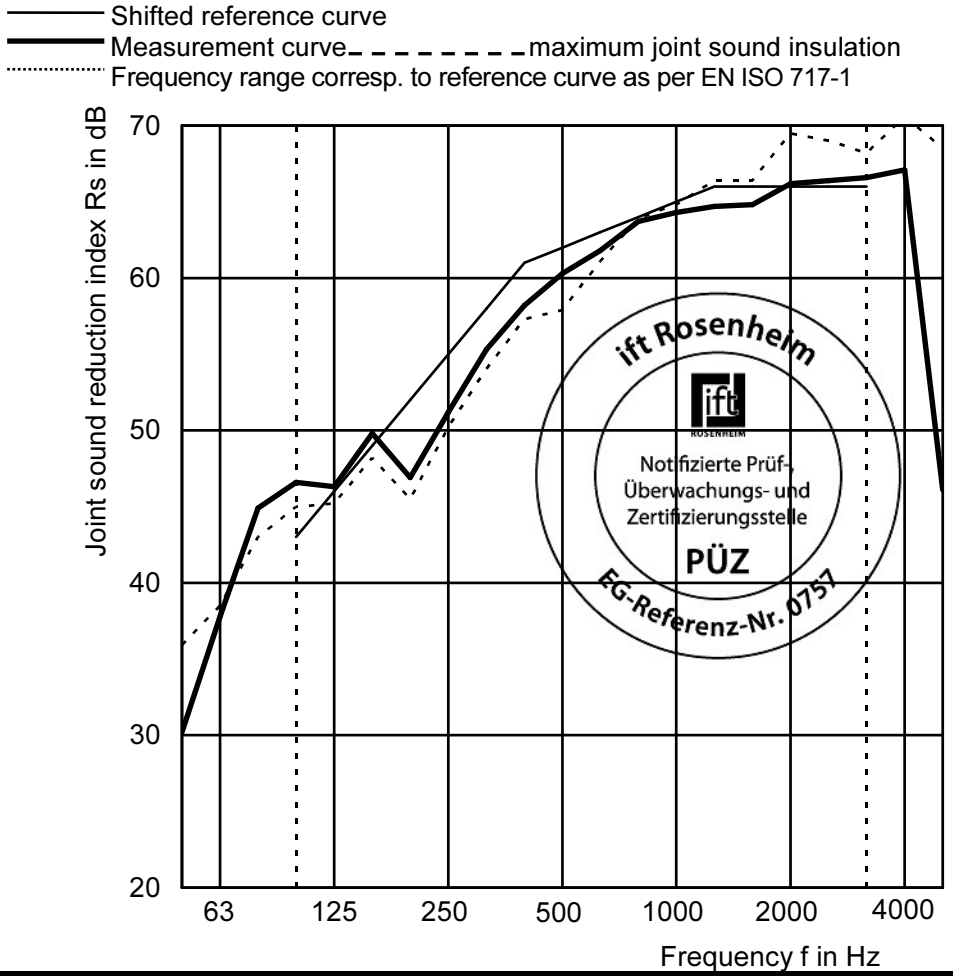
Mounting of the cassette in high performance sound insulating element.

Climate of test rooms 20°C / 40 % RH

Static air pressure 974 hPa

f in Hz	R_S in dB
50	30.2
63	(≥ 37.8)
80	(≥ 44.9)
100	(≥ 46.6)
125	(≥ 46.3)
160	(≥ 49.8)
200	(≥ 46.9)
250	(≥ 51.2)
315	(≥ 55.3)
400	(≥ 58.2)
500	(≥ 60.3)
630	(≥ 61.8)
800	(≥ 63.7)
1,000	(≥ 64.3)
1,250	64.7
1,600	(≥ 64.8)
2,000	66.2
2,500	66.4
3,150	(≥ 66.6)
4,000	67.1
5,000	46.1

(≥ = Minimum value)



Rating according to EN ISO 717-1 (in third octave bands):

[$R_{S,w}$ (C; C_{tr}) ≥ 62 (-1;-5) dB] $C_{50-3,150}$ = -2 dB; $C_{100-5,000}$ = -7 dB; $C_{50-5,000}$ = -7 dB

$C_{tr,50-3,150}$ = -10 dB; $C_{tr,100-5,000}$ = -6 dB; $C_{tr,50-5,000}$ = -10 dB

ift Rosenheim
Laboratory for Building Acoustics

Dipl. Ing. (FH) Mr. Florian Brechleiter
Operating Testing Officer