Evidence of Performance
Joint sound reduction of filling material

Test report
No. 17-001757-PR03
(PB Z3-K02-04-en-01)

ROSENHEIM

Client **Hilti Entwicklungsgesellschaft mbH**
Hiltistr. 6
86916 Kaufering
Germany

Product	Fire stop tape
Designation	Hilti Firestop Wrap CFS-W (SG or EL) / CP 648 (S or E)
Density	0.60 kg/rm
Special features	-/-

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

$$[R_{s,w}\ (C;\ C_{tr}) \geq 61\ (-3;\ -5)\ \text{dB}]$$

Determined for 10 mm width of joint

ift Rosenheim
19.07.2017

Dr. Joachim Hessinger, Dipl.-Phys.
Head of Testing Department
Building Acoustics

Bernd Saß, Dipl.-Ing. (FH)
Operating Testing Officer
Building Acoustics

Basis

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

Test report 17-001757-Pr03 (PB Z3-K02-04-de-01) dated 29.06.2017

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:

ift Rosenheim GmbH
Theodor-Gietl-Str. 7-9
D-83026 Rosenheim

Kontakt
Tel. +49.8031.261-0
Fax +49.8031.261-290
www.ift-rosenheim.de

1 Object

1.1 Description of test specimen

Product	Fire stop tape, sealed on one side
Date of manufacturing of test specimen	7th of June 2017
Product designation	Hilti Firestop Wrap CFS-W (SG or EL) / CP 648 (S or E)
Item code	304310
Description	The fire stop tape is a strip with the cross-section 4.5 mm x 45 mm. Two of these are glued together in the joint. It is used for the fire protection of a flammable pipe with diameter up to 160 mm which is passed through a wall- or floor opening. No further seal is provided between the strips, the two strips are sealed with an acrylate sealant.
Dimension	
Joint of length l	1,200 mm
Depth of joint d	100 mm, therefrom 45 mm fire stop tape
Width oj joint w	10 mm
Joint cover	On one side with sealant type HILTI CFS-S ACR
Joint sealing material	Joint filled with two stripes fire stop tape and with acrylate – sealant on source room side.
Curing time	19 days
Density	0.60 kg/rm (determined at test element)

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 (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).

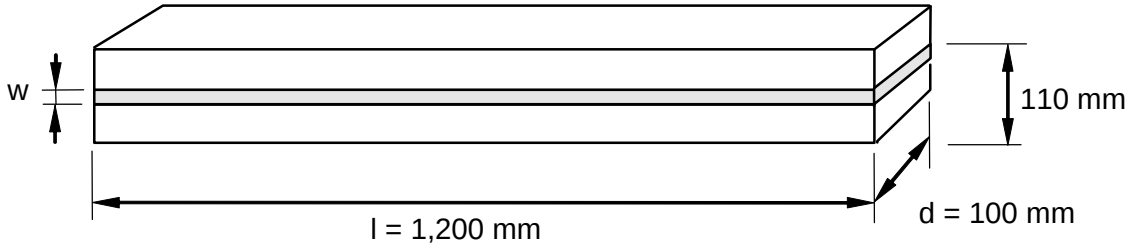


fig 1 slide-in cassettes

These slide-in cassettes were filled 19 days before the test by **ift** Laboratory for Building Acoustics and employees of the client with the filling material acc. to the guideline of the manufacturer. 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 10 140-5. The joints to the test opening were filled with cellular material and sealed with plastic sealant on both sides.

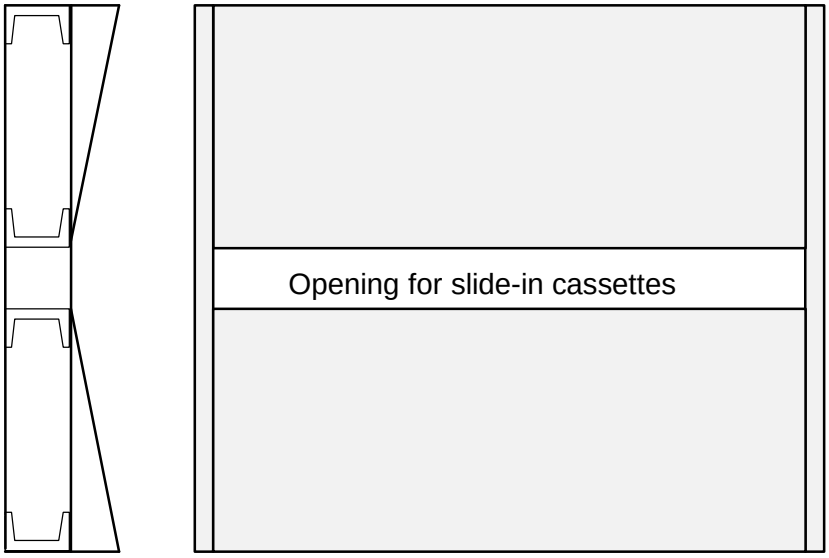


fig 2 Set-up of joint testing apparatus (high performance sound insulating element)

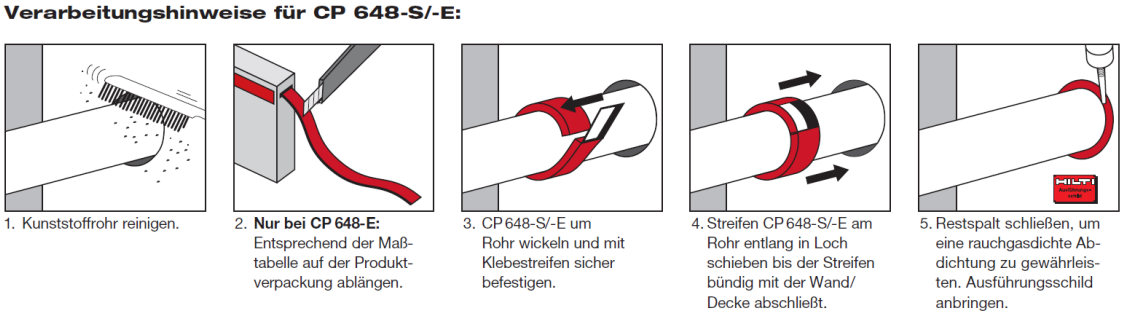


fig 3 Extract from the assembly instructions for illustration

fig 4 Photo(s) of the mounted element, taken by **ift** Laboratory for Building Acoustics, before sealing with acrylate - sealant

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	Hilti AG, BU Fire Protection, Feldkircherstr. 100, FL-9494 Schaan
Manufacturing plant	Hilti Plant 5a
Date of manufacture / Date of sampling	28.3.2017
Batch	HW041317
Responsible for sampling	Mr. Schulze
Delivery at **ift**	7.6.2017 by the client
ift registration number	43840/3

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

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 90:2009.
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_{ST}	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 121	Norsonic-Tippkemper
Microphone preamplifiers	Type 1201	Norsonic-Tippkemper
Microphone unit	Type 1220	Norsonic-Tippkemper
Calibrator	Type 1251	Norsonic-Tippkemper
Dodecahedron loudspeakers	Own design	-
Amplifier	Type E120	FG Elektronik
Rotating microphone boom	Own design / Type 231-N-360	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. 31423, was DKD calibrated by the company Norsonic Tippkemper (DKD - Deutscher Kalibrierdienst “German Calibration Service”) on 22nd of May 2017.

2.4 Testing

Date	26th of June 2017
Operating Testing Officer	Mr. Bernd Saß

3 Detailed results

The values of the measured sound reduction index R_S of the joint for the tested filler 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 = 1.20 m, 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 = 1.20 m), plotted with a maximum weighted sound reduction index $R_{S,w\ max}$ (C;C_{tr}) = 63 (-2;-5) 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, joint depth *d* = 100 mm

Weighted joint sound reduction index $R_{S,w}$ (C; C_{tr}) in dB	Measures taken, comments
63 (-2;-5)	Maximum sound insulation
≥ 61 (-3;-5)	Joint width 10 mm, filled with Hilti Firestop Wrap CFS-W (SG or EL) / CP 648 (S or E)

On order of the client supplementary to the rating as per EN ISO 717-1 a weighting according to ASTM E 413-10 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 56

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: 2016-07

Basis

DIN 4109-1: 2016-07	Sound insulation in buildings - Part 1: Minimum requirements
DIN 4109-2: 2016-07	Sound insulation in buildings - Part 2: Verification of compliance with the requirements by calculation

The weighted joint sound reduction index determined in accordance with Section 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. This gives:

$R_{S,w}$ = 61.3 dB (width of joint 10 mm)

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:

$R_{S,w}$ = 61.3 dB ± 1.2 dB (width of joint 10 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.

$$R_{S,w}\ (C;C_{tr}) \geq 61\ (-3;-5)\ \text{dB (width of joint 10 mm)}$$

4.3 Conversion table

As requested by the client, the effect of the sound transmission through an installation joint of a pipe penetration through a wall should be determined by calculation.
Table 2 lists the reduction of the sound insulation of a wall ΔR_w by an opening that has been sealed with the fire resistant tape described in Section 1.1. The reduction was determined by calculation in accordance with DIN EN 12354-3 and/or the formula context presented in Section 4.1. The result of this calculation is determined by the sound insulation of the wall, the details of the installation joint, the pipe diameter and the number of openings. An opening for a pipe with a diameter of 160 mm corresponding to a perimeter joint length of 0.5 m was considered. The calculation assumes that the geometry, surface quality and sealing of the installation joint is as specified in Section 1 (e.g. 10 mm joint width, 100 mm joint depth, sealing using 2 layers of fire-resistant tape and permanently resilient sealant). The intrinsic reduction in sound insulation by the pipe itself was not considered.

The calculation was made for a wall area of 10 m² (100 mm wall thickness) with 1, 3 or 6 pipe penetrations.

Table 2 Reduction of weighted sound reduction index R_w of a wall by the influence of an installation joint (sealed with fire resistant tape of type CP 648-S/-E as specified in Section 1).

R_w of wall in dB without pipe penetration	Reduction in sound insulation ΔR_w in dB for **one** pipe penetration	Reduction in sound insulation ΔR_w in dB for **three** pipe penetrations	Reduction in sound insulation ΔR_w in dB for **six** pipe penetrations
45	0	0	0
50	0	0	0
55	0	0	-1
57	0	-1	-1
60	-1	-1	-1
62	-1	-1	-2
65	-1	-2	-3

The conversion table includes only the impact of the installation joint around the opening for a pipe Ø of 160 mm; the reduction in sound insulation by the penetrating pipe was not considered and must be included in a separate calculation step.

4.4 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

Remark on transfer of the test results

Assessments as per ASTM E 413-10 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
19.07.2017

Joint sound reduction index according to ISO 10140-1

Determination of sound reduction index of joints

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

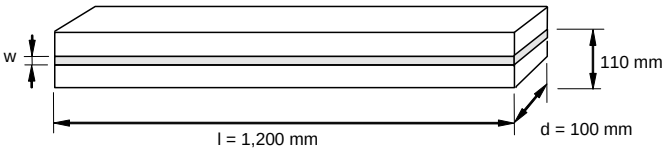
Product designation Hilti Firestop Wrap CFS-W (SG or EL) / CP 648 (S or E)

Design of test specimen

Fire stop tape
Joint size

Length l	1,200 mm
Depth d	100 mm, therefrom 45 mm fire stop tape
Width w	10 mm
Density	0.60 kg/rm

Drawing of the test arrangement

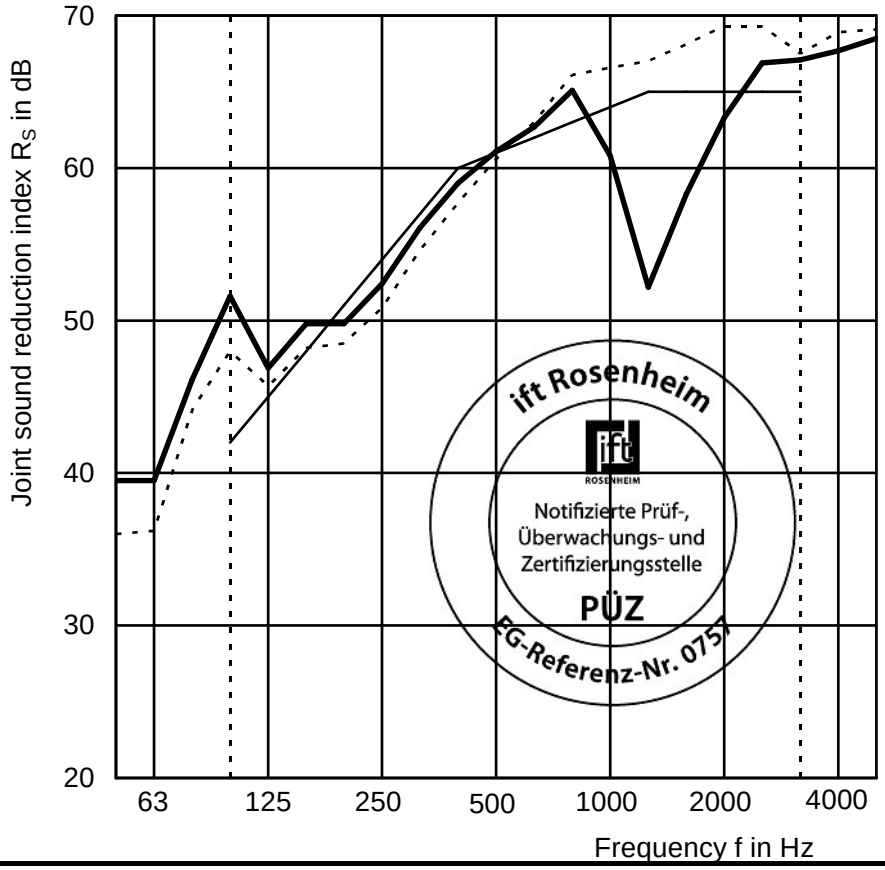


Test date 26th of June 2017
Test length l 1.2 m
Test rig as per EN ISO 10140-5
Test rig separation wall Double-leaf concrete wall, insert frame
Test noise Pink noise
Volumes of test room V_S = 104 m³, V_R = 67.5 m³
Maximum sound reduction index
$R_{S,w,max}$ = 63 dB (related to test length)
Mounting conditions
Mounting of the cassette in high performance sound insulating element.
Climate in test rigs 24℃ / 50 % RH
Static air pressure 959 hPa

f in Hz	R_S in dB
50	(≥ 39.5)
63	(≥ 39.5)
80	(≥ 46.1)
100	(≥ 51.6)
125	(≥ 46.9)
160	(≥ 49.8)
200	(≥ 49.8)
250	(≥ 52.4)
315	(≥ 56.1)
400	(≥ 59.0)
500	(≥ 61.1)
630	(≥ 62.7)
800	(≥ 65.1)
1,000	60.8
1,250	52.2
1,600	58.3
2,000	63.3
2,500	(≥ 66.9)
3,150	(≥ 67.1)
4,000	(≥ 67.7)
5,000	(≥ 68.5)

(≥ = minimum value)

Shifted reference curve
Measurement curve
maximum joint sound reduction
Frequency range corresp. to reference curve as per EN ISO 717-1



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

[$R_{S,w}$ (C; C_{tr}) ≥ 61 (-3;-5) dB] $C_{50\text{-}3,150}$ = -3 dB; $C_{100\text{-}5,000}$ = -2 dB; $C_{50\text{-}5,000}$ = -2 dB
$C_{tr,50\text{-}3,150}$ = -6 dB; $C_{tr,100\text{-}5,000}$ = -5 dB; $C_{tr,50\text{-}5,000}$ = -6 dB

ift Rosenheim
Laboratory for Building Acoustics
19. July 2017

Dipl. Ing. (FH) Mr. Bernd Saß
Operating Testing Officer