

# Evidence of Performance

## Airborne sound insulation of flat roofs

### Test Report

No. 15-002251-PR01

(PB X03-F01-04-en-01)



Client **Knauf Insulation, D.O.O.**  
Trata 32  
4220 Skofja Loka  
Slovenia

Product	Flat roof as green roof
Designation	Urbanscape Green Roof
Cover	20 – 40 mm Vegetation mat, $m' = 23.0 \text{ kg/m}^2$ 20 mm Green roof substrate of mineral wool fibre, $m' = 2,3 \text{ kg/m}^2$
Insulation	
2 <sup>nd</sup> separation layer	12.5 mm Drainage system, $m' = 0.72 \text{ kg/m}^2$
1 <sup>st</sup> separation layer	0.5 mm LD PE-film, $m' = 0.5 \text{ kg/m}^2$
Vapour barrier	2.5 mm EPDM, $m' = 3,4 \text{ kg/m}^2$
Supporting construction	160 mm Reinforced concrete floor, $m' = 400 \text{ kg/m}^2$
Overall dimensions	5,000 mm × 5,270 mm
Total thickness	216 – 236 mm
Area related mass	429,9 kg/m <sup>2</sup>

Result **Weighted sound reduction index  $R_w$**   
**Spectrum adaptation terms C and  $C_{tr}$**



$$R_w (C; C_{tr}) = 55 (-3; -7) \text{ dB}$$

ift Rosenheim  
16.10.2015

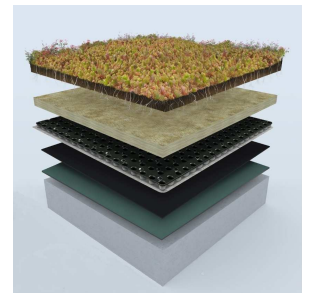
Dr. Joachim Hessinger, Dipl.-Phys.  
Head of Testing Department  
Building Acoustics

Stefan Bacher, Dipl.-Ing. (FH)  
Operating Testing Officer  
Building Acoustics

#### Basis

EN ISO 10140-1: 2010  
+A1: 2012 + A2:2014  
EN ISO 10140-2 : 2010  
EN ISO 717-1 : 2013  
15-002251-PR01 (PB X03-F01-  
de-01) dated 16<sup>th</sup> of October  
2015

#### Representation



#### Instructions for use

This test report serves to demonstrate the sound insulation of a flat roof. As set out by the German Bauregelliste (Construction Products List), evidence of compliance in Germany is possible only in the form of an AbP (national technical test certificate). This test report cannot be used as a substest to be included in a national technical test certificate (AbP).

#### 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 further characteristics of the present construction 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 abstract.

#### Contents

The test report contains a total of 9 pages

- 1 Object
- 2 Procedure
- 3 Detailed results
- 4 Instructions for use  
Data sheet (1 page)

**Airborne sound insulation of flat roofs**

Test Report 15-002251-PR01 (PB X03-F01-04-en-01) dated 16.10.2015

Client **Knauf Insulation, D.O.O.**, 4220 Skofja Loka (Slovenia)**1 Object****1.1 Description of test specimen**

<b>Product</b>	Flat roof as green roof
Product designation	Urbanscape Green Roof
Overall dimensions (w x h)	5,000 mm × 5,270 mm concrete floor
Clear dimensions (w x h)	4000 mm x 5000 mm
Area related mass	429,9 kg/m <sup>2</sup>
Total thickness	216 – 236 mm
Construction (from outside to inside)	20-40 mm Vegetation mat of different sedum species 20 mm Green roof substrate of mineral wool fibre 12.5 mm Drainage system of HDPE 0.5 mm Root membrane LDPE 2.5 mm Vapour barrier of EPDM 160 mm Reinforced concrete floor
<b>Cover</b>	
Material	Vegetation mat of 10-12 different sedum species
Manufacturer	Sempergreen, Netherland
Product designation*	Urbanscape sedum-mix vegetation mat
Size (w x l)*	1,000 mm × 2,000 mm
Thickness*	20 – 40 mm
Area related mass*	m' = 23.0 kg/m <sup>2</sup>
Mounting	Laid all-over, narrow-face with tight joints
<b>Insulation</b>	
Material	Green roof substrate of mineral wool fibre
Manufacturer	Knauf Insulation d.o.o. Skofja Loka
Product designation*	Urbanscape Green-Roll Substrat (HTC GR)
Size (w × l)	1,000 mm x 6,000 mm
Thickness	20 mm, nominal thickness d <sub>N</sub>
Area related mass	m' = 2.3 kg/m <sup>2</sup>
Dynamic stiffness s'	s' = 38 MN/m <sup>3</sup> [15-002251-PR01 (P01-SD-K04-09-de-01)]
Linear airflow resistance r	r = 77 kPa s/m <sup>2</sup> [15-002251-PR01 (P01-AF-K04-09-de-01)]
Mounting	Roll the sheets tightly, narrow-face with tight joints
<b>2<sup>nd</sup> Separation layer</b>	
Material	Drainage system of black Polyethylen (HDOP) with laminated filter fleece
Manufacturer	Nophadrain
Product designation*	Urbanscape Dränage Universal (ND 200 lts)
Size (w x l)*	1,200 mm x 10,000 mm
Thickness*	12.5 mm
Area related mass	m' = 0.72 kg/m <sup>2</sup>

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Client Knauf Insulation, D.O.O., 4220 Skofja Loka (Slovenia)

Mounting Laid all-over, narrow-face with tight joints, fleece with overlapping approx. 200 mm

**1<sup>st</sup> Separation layer**

Material LD PE-film  
 Manufacturer Joosten  
 Product designation\* Urbanscape root membrane (FLW 500)  
 Size\* 4,000 mm × 5,000 mm  
 Thickness\* 0.5 mm  
 Area related mass\*  $m' = 0.5 \text{ kg/m}^2$   
 Mounting Laid all-over

**Vapour barrier**

Material EPDM  
 Manufacturer Phoenix Dichtungstechnik GmbH  
 Product designation\* Resitrix SK W  
 Size\* 1,000 mm x 10,000 mm  
 Thickness\* 2.5 mm  
 Area related mass  $m' = 3.4 \text{ kg/m}^2$   
 Mounting Sheets laid all-over with overlapping approx. 100 mm

**Supporting construction**

Material Reinforced concrete floor  
 Manufacturer Ift Rosenheim  
 Size (l × w) 5,000 mm × 5,270 mm  
 Thickness 160 mm  
 Center-to-center distance of 4,800 mm  
 Area related mass  $m' = 400 \text{ kg/m}^2$

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

**1.2 Mounting to test rig**

Test rig Floor test rig ("X-wall"): Test rig with suppressed flanking sound transmission acc. to EN ISO 10140-5: 2010+A1:2014. The flanking lightweight walls completely de-coupled from test floor.  
 Test rig as lightweight construction.

Mounting of test specimen Test specimen mounted by the client.

Mounting position Roof mounted without contact to flanking walls. Load transfer by external steel structure.

**Airborne sound insulation of flat roofs**

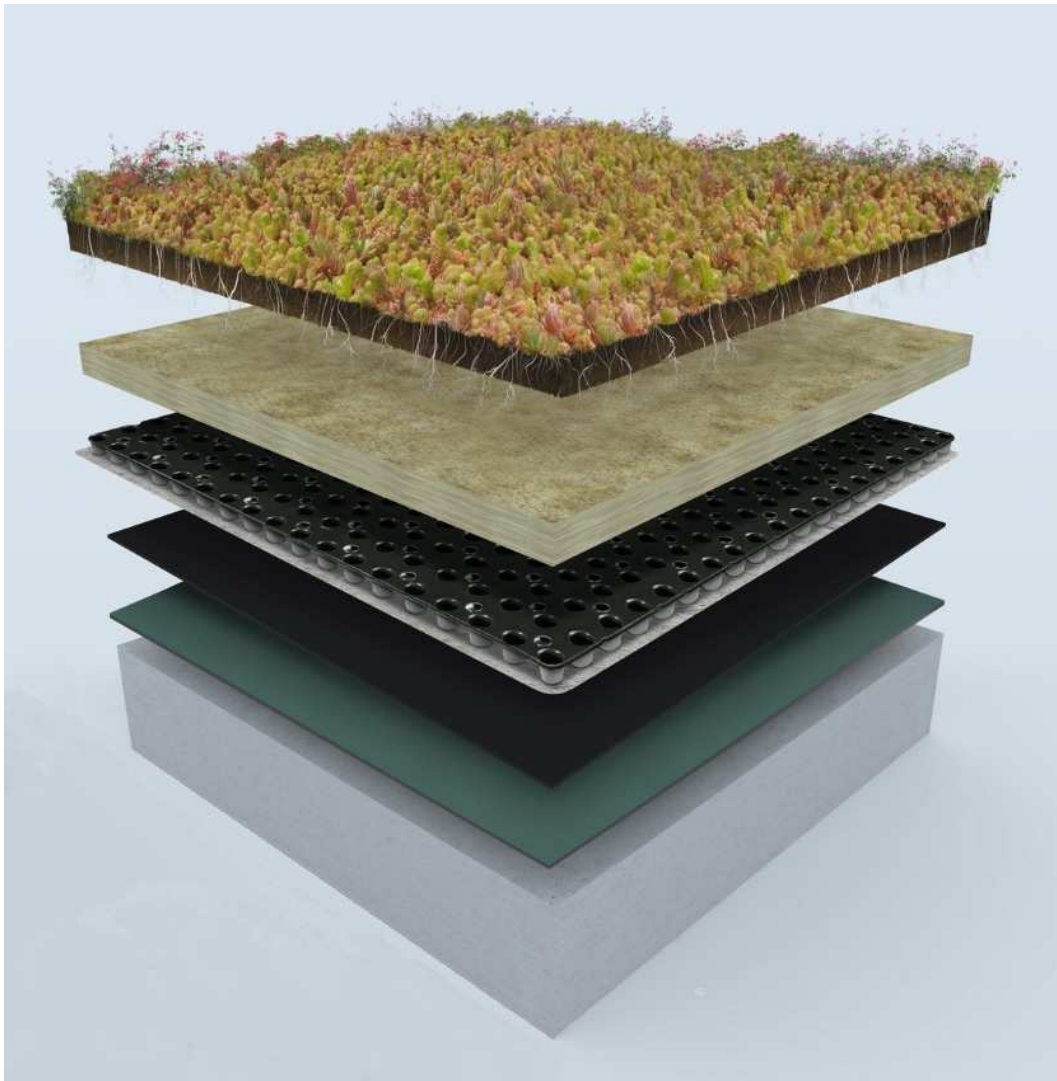
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Sealing of test rig	Perimeter joint between supporting construction and flanking wall was filled with mineral wool and sealed using permanently resilient sealant.	
Drying time	Reinforced concrete floor	> 21 days (prefabricated)

**1.3 Representation of test specimen**

The structural details were examined solely on the basis of the characteristics to be classified. The illustrations are based on unchanged documentation provided by the client



**fig 1** Construction drawing of flat roof

**Airborne sound insulation of flat roofs**

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Client **Knauf Insulation, D.O.O.**, 4220 Skofja Loka (Slovenia)**2 Procedure****2.1 Sampling**

Sampling	The samples were selected by the client
Quantity	1
Manufacturer	Knauf Insulation D.O.O:
Manufacturing plant , Site of manufacturing	4220 Skofja Loka, Slowenien
Date of manufacture / date of sampling	12 <sup>th</sup> of August 2015
Responsible for sampling	Mr. Gorazd Sebenik
Delivery at ift	7 <sup>th</sup> of September 2015 by the client via forwarding agency
ift registration number	39904/002

**2.2 Process****Basis**

- EN ISO 10140-1: 2010 + A1: 2012 + A2: 2014 Acoustics; Laboratory measurement of sound insulation of building elements - Part 1: Application rules for specific products (ISO 10140-1: 2010+Amd. 1: 2012+Amd. 2: 2014)
- 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: 2014-09, DIN EN ISO 10140-2:2010-12 and DIN EN ISO 717-1 : 2013-06

Procedure and scope of measurement are, except for the below deviation, in conformity with the principles of the Working Group of sound insulation testing bodies approved by the national building supervisory authorities in cooperation with the standardization committee NA 005-55-75-AA (subcommittee UA 1 - DIN 4109).

Boundary conditions	Except for the deviations mentioned, in conformity with the requirements set out by the standards
Deviation	The structural reverberation time was not determined.
Test noise	Pink noise
Measuring filter	One-third-octave band filter

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Client **Knauf Insulation, D.O.O.**, 4220 Skofja Loka (Slovenia)**Measurement limits**

- Low frequencies** The dimensions of the receiving room were 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). Two fixed loudspeaker positions were 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 10140-4: 2010 Clause 4.3.
- Maximum sound insulation** The difference between the measured sound reduction index and the maximum sound reduction of the test setup was partially less than 15 dB. These values are marked "≥" in the data sheet.  
Not corrected by calculation.

**Measurement of reverberation time**

Arithmetical mean: 6 measurements each of 2 loudspeaker positions with fixed microphone (total of 12 measurements).

**Measurement equation A**  $A = 0,16 \cdot \frac{V}{T} \text{ m}^2$

**Measurement of sound level difference**

2 loudspeaker positions and rotating microphones

**Measurement equation R**  $R = L_1 - L_2 + 10 \cdot \lg \frac{S}{A} \text{ dB}$

**KEY**

- A Equivalent absorption area in  $\text{m}^2$   
 $L_1$  Sound pressure level source room in dB  
 $L_2$  Sound pressure level receiving room in dB  
R Sound reduction index in dB  
T Reverberation time in s  
V Volume of receiving room in  $\text{m}^3$   
S Testing area of the specimen in  $\text{m}^2$

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Client **Knauf Insulation, D.O.O.**, 4220 Skofja Loka (Slovenia)**2.3 Test apparatus**

<b>Device</b>	<b>Type</b>	<b>Manufacturer</b>
Integrating sound meter	Type Nortronic 830	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 2013. The sound level meter used, Series No. 12712, was calibrated by the Dortmund Eichamt (calibration agency) on 12<sup>th</sup> of March 2015. The calibration is valid until 31st of December 2017. LBME NW (Eichamt Dortmund) meets the requirements for measurement traceability in connection with DIN EN ISO/IEC 17025.

**2.4 Testing**Date 10<sup>th</sup> of September 2015

Operating Testing Officer Mr. Stefan Bacher

**3 Detailed results**

The values of the measured sound reduction index of the tested flat roof are plotted as a function of frequency in the annexed data sheet and tabled.

As per EN ISO 717-1 the weighted sound reduction index  $R_w$  and the spectrum adaptation terms  $C$  and  $C_{tr}$  for the frequency range 100 Hz to 3150 Hz obtained by calculation are as follows:

$$R_w (C; C_{tr}) = 55 (-3; -7) \text{ dB}$$

According to EN ISO 717-1 the following additional spectrum adaptation terms are obtained

$$\begin{array}{lll}
 C_{50-3,150} = -3 \text{ dB} & C_{100-5,000} = -2 \text{ dB} & C_{50-5,000} = -2 \text{ dB} \\
 C_{tr,50-3,150} = -8 \text{ dB} & C_{tr,100-5,000} = -7 \text{ dB} & C_{tr,50-5,000} = -8 \text{ dB}
 \end{array}$$

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Client **Knauf Insulation, D.O.O.**, 4220 Skofja Loka (Slovenia)

## **4 Instructions for use**

### **4.1 Safety margin according to DIN 4109**

Basis

DIN 4109:1989-11 Sound insulation in buildings, requirements and verifications

This test report does not represent verification of applicability as per DIN 4109: 1989-11.  
A calculated value is not indicated.

### **4.2 Construction Product List (Bauregelliste)**

As set out by the German Bauregelliste (Construction Products List), evidence of compliance in Germany is possible only in the form of an AbP (national technical test certificate). This test report cannot be used as a subtest to be included in a national technical test certificate (AbP).

### **4.3 Test standards**

The standard series EN ISO 10140:2010 supersedes those, until the respective date, applicable parts of the standards series EN ISO 140 which describe laboratory tests. According to the two standard series, the test methods are identical.

**ift** Rosenheim  
Laboratory for Building Acoustics  
16.10.2015



# Sound reduction index according to ISO 10140 - 2

Laboratory measurements of airborne sound insulation of building components



Client: **Knauf Insulation, D.O.O.**, 4220 Skofja Loka (Slovenia)

Product designation Urbanscape Green Roof

Flat roof as green roof

Configuration

20-40 mm	Vegetation mat of different sedum species
20 mm	Green roof substrate of mineral wool fibre
12.5 mm	Drainage system of HDPE
0.5 mm	Root membrane LDPE
2.5 mm	Vapour barrier of EPDM
160 mm	Reinforced concrete floor

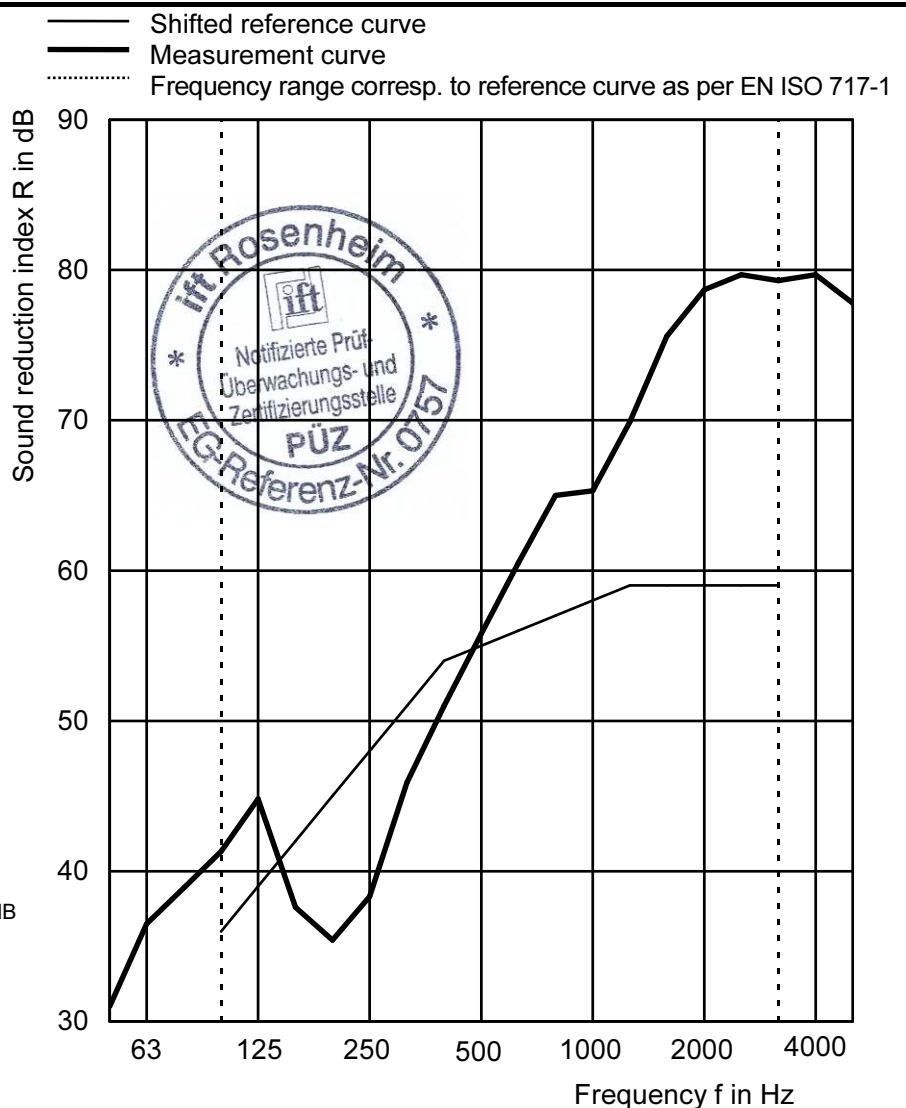
Total thickness 216 – 236 mm

Area related mass 429,9 kg/m<sup>2</sup>

Test date	10th of September 2015	
Test surface	S = 4.0 m × 5.0 m = 20 m <sup>2</sup>	
Test rig	As per EN ISO 10140-5	
Test noise	Pink noise	
Volumes of test rooms	Source room	V <sub>S</sub> = 54 m <sup>3</sup>
	Receiving room	V <sub>R</sub> = 62 m <sup>3</sup>
Maximum sound reduction index	R' <sub>w,max</sub> = 83 dB (related to test surface)	
Mounting	Test specimen mounted by the client	
Climate in test rooms	19 °C / 52 % RH / 964 hPa	

f in Hz	R in dB	R' <sub>max</sub> in dB
50	≥ 31.0	27.9
63	≥ 36.5	36.6
80	≥ 38.9	48.0
100	41.3	60.6
125	44.8	62.8
160	37.6	69.7
200	35.4	74.1
250	38.3	76.6
315	45.9	79.8
400	51.0	83.9
500	55.8	86.0
630	60.5	87.5
800	65.0	87.8
1,000	65.3	89.8
1,250	69.9	89.7
1,600	75.6	91.1
2,000	≥ 78.7	91.0
2,500	≥ 79.7	88.5
3,150	≥ 79.3 <sup>x</sup>	88.9
4,000	≥ 79.7 <sup>x</sup>	90.3
5,000	≥ 77.8 <sup>x</sup>	87.6

<sup>x</sup> Background noise level difference < 6 dB  
 ≥ Flanking transmission effect



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

**R<sub>w</sub> (C; C<sub>tr</sub>) = 55 (-3; -7) dB**  
 C<sub>50-3,150</sub> = -3 dB; C<sub>100-5,000</sub> = -2 dB; C<sub>50-5,000</sub> = -2 dB  
 C<sub>tr,50-3,150</sub> = -8 dB; C<sub>tr,100-5,000</sub> = -7 dB; C<sub>tr,50-5,000</sub> = -8 dB

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Data Sheet 1

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Laboratory for Building Acoustics

16.10.2015

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 Operating Testing Officer