ASSESSMENT

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Date
2017-11-24

Reference
7P02435B

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Joint sealant sound insulation - Examples of usage of measured laboratory value

This document is an assessment to the measurement report 7P02435 (RISE 2017), where joint sound insulation of the product ***ESSVE Byggfog akustik*** – an acrylic-based joint sealant – was measured.

Introduction

RISE has been asked to assist in interpreting the measurand for joint sealants according to ISO 10140-1:2016, $R_{s,w}$, and in addition, perform some example calculations on how to apply the measured result in a real situation.

In practice these types of calculations shall be performed in the detail planning phase of a real building project by a person having sufficient knowledge to do so. RISE does not have the responsibility for the acoustic performance of any real in-situ building or part of building on the basis of the content of this document.

This assessment only look at the case of joints between wall and window-/door frame. This is because the measurements were made under these circumstances. The effect of a joint between the wall and other floor/roof/other walls are not considered here.
It should be noted though that in normal building procedures, the sound transmission through the sealant in those joints is normally considered to be neglectable for the total sound insulation, assuming they are completely sealed and the sealant is correctly applied .

As stated in the report (7P02435), the measured value $R_{s,w}$ is defined as follows:

$$R_s = L_1 - L_2 + 10 \lg (S_n l / A l_n)$$

where

L_1 is the average sound pressure level in the source room (dB),

L_2 is the average sound pressure level in the receiving room (dB),

l is the length of the joint (m),

S_n is the reference area ($S_n = 1$ m^2),

l_n is the reference length ($l_n = 1$ m),

A is the equivalent absorption area of the receiving room (m^2).

$\boldsymbol{R_{s,w}}$ is the weighted single-number quantity in accordance with ISO 717-1:2013
(R_s is defined for each frequency band in the spectrum).

The formula shows that the parameter $R_{s,w}$ is normalised to 1 meter of joint length and 1square meter of area.

In practice the (Swedish) building regulations apply on the acoustic performance of the *entire* dividing structure, taking all of its building elements into account (windows, doors, air inlets, etc.).
For facades (walls facing outdoors) and rooms containing noise sources/machines, the regulations also take into account the sound level of the noise source (e.g. the road traffic noise).

Example 1. Outdoor noise

Following is a table of different outdoor road traffic noise levels that can be handled for different measured Rs,w of a joint around a window, while still fulfilling the minimum building regulations for noise levels inside. The sound insulation is (among others) dependant on the amount of the total room façade surface that consists of the window surface. The facade construction in this case is assumed to have a very high sound insulation compared with the window, and is practically not considered in this example.

The table is based on an example of a representative real situation, defined with the following conditions:

- Only equivalent outdoor free-field sound levels are considered (road traffic noise, 50 km/h).
- Indoor noise level is set to L_{pAeq} = 30 dB in a small dwelling (BBR chapter 7). For sound class (“ljudklass”) B according to SS 25267, the same table can be used having subtracted 4 dB from the resulting value.
- Window size 1,2 x 1,2 m, total façade size w x h 3,0 x 2,4 m, room depth 3,0 m.
- Façade sound insulation: R_w+C_{tr} = 50 dB.

Rw + Ctr, window \ Rs,w	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
22	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56
23	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57
24	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58
25	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59
26	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
27	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61
28	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62
29	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63
30	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
31	64	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65
32	65	65	65	66	66	66	66	66	66	66	66	66	66	66	66	66
33	66	66	66	66	67	67	67	67	67	67	67	67	67	67	67	67
34	67	67	67	67	67	67	67	68	68	68	68	68	68	68	68	68
35	68	68	68	68	68	68	68	68	68	68	69	69	69	69	69	69
36	68	68	69	69	69	69	69	69	69	69	69	69	69	69	69	69
37	69	69	69	70	70	70	70	70	70	70	70	70	70	70	70	70
38	69	70	70	70	70	71	71	71	71	71	71	71	71	71	71	71
39	70	70	71	71	71	71	71	71	72	72	72	72	72	72	72	72
40	70	71	71	71	72	72	72	72	72	72	72	72	73	73	73	73
41	71	71	71	72	72	72	73	73	73	73	73	73	73	73	73	73
42	71	71	72	72	73	73	73	73	73	74	74	74	74	74	74	74
43	71	72	72	73	73	73	74	74	74	74	74	74	74	74	74	74
44	71	72	73	73	73	74	74	74	74	74	75	75	75	75	75	75
45	72	72	73	73	74	74	74	74	75	75	75	75	75	75	75	75
46	72	72	73	73	74	74	75	75	75	75	75	76	76	76	76	76
47	72	73	73	74	74	74	75	75	75	76	76	76	76	76	76	76
48	72	73	73	74	74	75	75	75	76	76	76	76	76	76	76	76
49	72	73	73	74	74	75	75	75	76	76	76	76	76	77	77	77
50	72	73	74	74	75	75	75	76	76	76	76	77	77	77	77	77

Table 1 – **Highest A-weighted equivalent outdoor free-field sound level $L_{pAeq,24h}$** that can be insulated against for different sound insulation of windows (R_w+C_{tr}) and different joint sound insulations ($R_{s,w}$). Window size 1,2 x 1,2 m, façade size w x h 3,0 x 2,4 m, room depth 3,0 m. Indoor level according to regulations in BBR chapter 7. See text for further conditions and assumptions.

As seen in the table the measured $R_{s,w}$-value has little influence on the total sound insulation. It is relevant only in cases with windows/glass having exceptionally high sound insulation.
A standard insulated glass window with no specific acoustic performance will have an R_w+C_{tr} of around 27 dB. A window with R_w+$C_{tr} \geq 32$ dB would be considered to have a "good" sound insulation, and somewhere around R_w+C_{tr} 40 dB we approach the limit of what is achievable with a window in the normal sense.

The $R_{s,w}$ of the joint sets a limit on the outdoor sound level being possible to protect against. With an $R_{s,w}$ of 45 dB, it doesn't really get higher than 72 dB, even though the sound insulation of the window is increased. It should be noted here that 72 dB is a very high outdoor sound level (it seldom reaches levels above 70 dB) and that we are already in the area of almost unreasonable high window/glass sound insulation.

The acoustic performance of the window(s) and wall, the window(s) surface size, the fresh air-intake (if applicable), the properties of the sound source and the room dimensions/room properties are all considerably more decisive than the joint sound insulation in determining the demand for acoustic performance in most real cases.
To be able to assess the sound level indoors given certain outdoor levels, one could find guidance in the figures on page 58 in the compendium from Boverket about noise protection (*Bullerskydd i bostäder och lokaler, Boverket 2008*).

Example 2. Internal door

To assess perhaps the most normal indoor case, we look at the sound insulation of an internal door. We cannot relate it to sound level in this case since the sound source is unknown. We consider instead the weakening of the sound insulation of the actual door or window from a joint with a certain sound insulation R_s according to this formula.

$$R_{tot} = -10 \lg(10^{-0,1R} + (l/S)10^{-0,1Rs})$$

where

R is the sound reduction index of the door (dB),

l is the length of the joint (m),

S is the area of the window/door (m²).

Note that this only applies to the joint between wall and door frame, the sealing between door leaf and frame is expected to perform according to the declared sound insulation of the door.

The following table shows the resulting sound reduction index R_w after taking the joint sound reduction $R_{s,w}$ into account. The door size is standard w x h 1,0 x 2,1 m. Again, the wall is assumed to have a very high sound insulation compared with the doorset (R_w = 50 dB).

Rw, door \ Rs,w	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
32	31	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32
33	32	32	33	33	33	33	33	33	33	33	33	33	33	33	33	33
34	33	33	33	34	34	34	34	34	34	34	34	34	34	34	34	34
35	34	34	34	34	35	35	35	35	35	35	35	35	35	35	35	35
36	35	35	35	35	35	36	36	36	36	36	36	36	36	36	36	36
37	35	36	36	36	36	36	37	37	37	37	37	37	37	37	37	37
38	36	36	37	37	37	37	37	38	38	38	38	38	38	38	38	38
39	37	37	37	38	38	38	38	38	39	39	39	39	39	39	39	39
40	37	38	38	38	39	39	39	39	39	40	40	40	40	40	40	40
41	38	38	39	39	39	40	40	40	40	40	41	41	41	41	41	41
42	38	39	39	40	40	40	41	41	41	41	41	42	42	42	42	42
43	39	39	40	40	41	41	41	42	42	42	42	42	43	43	43	43
44	39	40	40	41	41	42	42	42	43	43	43	43	43	44	44	44
45	39	40	41	41	42	42	43	43	43	44	44	44	44	44	45	45
46	40	40	41	42	42	43	43	44	44	44	45	45	45	45	45	46
47	40	41	41	42	43	43	44	44	45	45	45	46	46	46	46	46
48	40	41	42	42	43	44	44	45	45	46	46	46	47	47	47	47
49	40	41	42	43	43	44	45	45	46	46	47	47	47	48	48	48
50	40	41	42	43	44	44	45	46	46	47	47	48	48	48	49	49

Table 2 – **Resulting total sound insulation $R_{w,tot}$** of a door considering the weakening effect of the joint sound insulations ($R_{s,w}$). Door size w x h 1,0 x 2,1 m.

We can see that also in this case, the door sound insulation at which the joint start to affect acoustic performance is high – but it could be relevant in the case of a heavy (steel)-door between rooms with loud noise sources adjacent to noise-sensitive areas.

Further comments

It is expected that the one-sided joint with added mineral wool has an $R_{s,w}$ of ca. 56 dB under the conditions in the measurement conducted (7P02435). The mineral wool will add ca. 4 dB to the measured value of 52 dB. This is based on experience and previous measurements.

It is safe to expect that a double sided sealing with mineral wool will have better sound insulation than the one-sided case with mineral wool, and that the tables are applicable for the case of double sided sealing with mineral wool too.
This statement is supported by the measurements of optimal joint sealing, $R_{s,w,max}$ from the conducted measurements (7P02435).

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