TECHNICAL REPORT

Acoustic evaluation of Lightweight Building Structures

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Foreword

EOTA Technical Reports are developed as supporting reference documents to European Technical Approval Guidelines and can also be applicable to a Common Understanding of Assessment Procedure, an EOTA Comprehension Document or a European Technical Approval, as far as reference is made therein.

EOTA Technical Reports go into detail in some aspects and express the common understanding of existing knowledge and experience of the EOTA bodies at a particular point in time.

Where knowledge and experience is developing, especially through approval work, such reports can be amended and supplemented.

When this happens, the effect of the changes upon the European Technical Approval Guidelines will be laid down in the relevant comprehension documents, unless the European Technical Approval Guideline is revised.

This EOTA Technical Report has been prepared by the EOTA Project Team for Acoustic issues and endorsed by EOTA.

1. Scope

This Technical Report specifies the acoustic evaluation of lightweight building structures as defined in ETAGs 007, 012, 023 as well as 025 and gives recommendations for the presentation of the acoustic characteristics in the ETA.

The acoustic performance of lightweight building structures in relation to the Essential Requirement 5 will normally be required to correspond with national regulatory requirements for the works relevant to the intended use of the product in, for example, dwellings, office buildings, schools, hospitals and medical buildings, dormitories (list not exhaustive).

The numerical terms of these national regulatory requirements will vary between the Member States, but the acoustic performance of the structures will be expressed in the acoustic characteristics given in table 1 and 2.

In the case where at least one Member State has no regulated requirement against an acoustic characteristic for a specific intended use then the 'No Performance Determined (NPD) option can be used in the ETA.

Limitation of the acoustic evaluation in such systems:

- Except if equipment is already included in the "kit", the service equipment noise level is not evaluated.
- The performances given are assessed for the main structure. The incorporation of elements (ventilation devices, electric elements…) can decrease these performances, if they are not well designed and mounted.

2. ETAG acoustic approach

1. *Introduction:*

   For the five classical acoustic parameters (see below) used by Member States, different approaches are used.
   - Airborne sound insulation between inside and outside: use the same approach as for a heavy-structure building; measurement in laboratory of the components and calculation of the performance of the system (building) according EN 12354-3.

     NOTE: This does not work for facades of high insulation, because the lateral transmission will start to have influence and this will not be correctly estimated by EN 12354-3.
   - Airborne sound insulation between rooms: use reference building mockup approach (see below).
   - Impact noise level: use reference building mockup approach (see below).
   - Service equipment noise level: not in the scope of the evaluation if no equipment is sold in the kit. If the service equipment is a part of the "kit" then use the reference building mockup approach.

- Acoustic correction (A or Tr): use the same approach as for heavy structure building; measurement in laboratory of the components and calculation of the performance of the system (building) according to EN 12354-6 (if necessary).

2. *First step:*

Technical description and acoustic evaluation in the laboratory of each component of the kit (floors, walls,…) and at least the main separating elements.

Table 1 – Acoustic performance of the components

Component	Measured performance	Index	Test Method
Vertical components			
Separating wall N°1 (see Figure XXX)	Airborne sound insulation – Sound reduction index R	$R_w(C;C_{tr};C_{50\text{-}3150};C_{tr,50\text{-}3150})$ in dB	EN ISO 10140-1,2,4 and 5, surface around 10 m² (Vertical)
Façade wall N°1 (See Figure YYY)	Airborne sound insulation – Sound reduction index R	$R_w(C;C_{tr};C_{50\text{-}3150};C_{tr,50\text{-}3150})$ in dB	EN ISO 10140-1,2,4 and 5, surface around 10 m² (Vertical)
…			
Horizontal components			
Separating floor N°1 (see Figure ZZZ)	Airborne sound insulation – Sound reduction index R	$R_w(C;C_{tr};C_{50\text{-}3150};C_{tr,50\text{-}3150})$ in dB	EN ISO 10140-1,2,4 and 5, surface in-between 10 m² and 20 m² (Horizontal)
	Impact noise level	$L_{n,w}$ (C_I) in dB	EN ISO 10140-1,3,4 and 5, surface in-between 10 m² and 20 m² (Horizontal)
Roof N°1 (see Figure TTT)	Airborne sound insulation – Sound reduction index R	$R_w(C;C_{tr};C_{50\text{-}3150};C_{tr,50\text{-}3150})$ in dB	EN ISO 10140-1,2,4 and 5, surface in-between 10 m² and 20 m² (Horizontal)
…			

NOTE: As lightweight building structures are concerned, most of the traditional laboratory test methods used to characterize the acoustic power level of service equipment do not work, so only the reference building mockup approach is used, with the performance characteristics as shown in Table 1.

3. *Second step:*

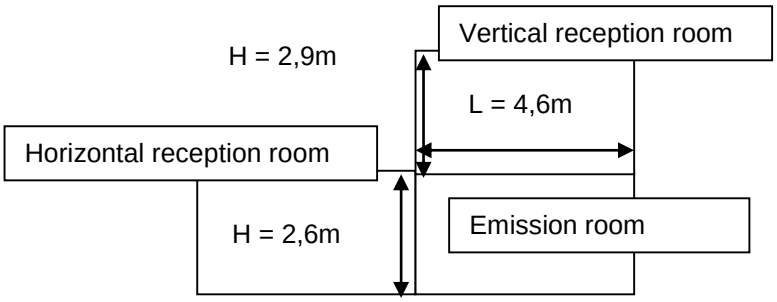
Technical description of the junctions and acoustic evaluation (measurement) in a reference building mockup.

Table 2 – Acoustic performance of the building			
Component	**Measured performance**	**Index**	**Test Method**
Horizontal sound transmission			
Separating wall N°1 (see Figure XXX) + Junctions N°XX	Airborne sound insulation	$R'_w(C;C_{tr};C_{50\text{-}3150};C_{tr,50\text{-}3150})$ in dB	EN ISO 140-4, surface around 10 m²
…			
Vertical sound transmission			
Separating floor N°1 (see Figure ZZZ) + Junctions N°XX	Airborne sound insulation	$R'_w(C;C_{tr};C_{50\text{-}3150};C_{tr,50\text{-}3150})$ in dB	EN ISO 140-4, surface in-between 10 m² and 20 m² (Horizontal)
	Impact noise level	$L'_{nw}(C_I)$ in dB	EN ISO 140-7 surface in-between 10 m² and 20 m² (Horizontal)
…			
Service equipment			
Service equipment N°1 (see Figure www) + fixation N°FFF	Service equipment noise	LAeq,T in dB(A)	EN ISO 10052
…			

For the measurement in low frequencies, diffusers shall be added in each room (minimum two large elements, typically two (plaster) boards around 1200 mm x 2500 mm, one per room) to improve the reproducibility.

3. Reference building mockup

If the roof junction between two rooms is described as an interrupted one (decoupled), then build three rooms in L shape with the exact volume and size given below, except for a 3-D structure under ETAG 007 where the smallest size of the product range shall be chosen. If not, build a four room mockup based on the same approach and add one horizontal measurement on the first floor for the continuous roof effect.



Room	Dimensions		Volume (m^3)	Area between Emission and Reception room (m^2)
Emission Room	H	2,6	50,2	-
	L	4,6		
	W	4,2		
Horizontal reception room	H	2,6	56,0	10,9
	L	5,1		
	W	4,2		
Vertical reception room	H	2,9	55,7	19,3
	L	4,6		
	W	4,2		

Table 3 – Dimensions of the mockup

All the dimensions of the mockup in Table 3 can have a tolerance of +/- 0,3 m, keeping a similar ratio between H, L and W and a minimum internal volume of 50 m^3.

If the roof is pitched then the two top modules shall have dimensions adapted to obtain a minimum internal volume of 50 m^3 but not more than 80 m^3.

The mockup is built without windows and with a single access to each room, but one side of the mockup (the same side for the three volumes) should be the façade wall. For the access to each room, their location shall be as far as possible from each other and their airborne sound insulation shall not decrease any measured performance on the mockup.

Usually the floors for lightweight buildings are not isotropic, but orthotropic. There is usually one direction worse than the others regarding the flanking / flanking transmission through the floors between emission and horizontal reception room. The wall and floor between Emission and Reception rooms shall be constructed so that they represent this worse direction. As an example, if the floor has joist, the joists shall be perpendicular to the party wall.

If technical linings are included in the kit, they have to be included in the test mockup.

If service equipment is a part of the “kit”, install it in the “Emission room” and measure the service equipment noise in the two reception rooms. The worse result shall be indicated in the ETA.

4. Rules of calculation

See EN ISO 717-1 and EN ISO 717-2.

5. Rules of extension

- Replacement of floating floor by another one: yes for Floating floor of equivalent or greater ΔL_{ti} according to EN ISO 10140-3.
- Replacement of wall and floor boards: yes by boards of equivalent or greater mass per square metre, lower dynamic Young's modulus (according to EN ISO PAS 16940 adapted to boards) and greater loss factor (according to EN ISO PAS 16940 adapted to boards).
- Replacement of porous materials in a cavity: if the porous material is not compressed in the cavity it can be replaced by another material with equivalent airflow resistivity (±50 %).
- If the wall is a double sided system filled with soft porous material, the performance of the thinnest one could be used for the thicker one; for a more complicated wall structure the rule is not valid.

6. Presentation of the results in the ETA

Table 1 and 2 and associated figures (vertical and horizontal cross section) shall be given in the ETA.