DOI: 10.61782/fa.2023.0276

forum acusticum 2023

REVISION OF FINNISH STANDARD SFS 5907 ON ACOUSTICAL DESIGN AND QUALITY CLASSES OF BUILDINGS

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ABSTRACT

The second edition of the Finnish standard SFS 5907 was published in December 2022. The first edition was made public in 2004. Since the decree of the Ministry of the Environment on the Acoustic Environment of Buildings was given in 2017, several sections and definitions of the first edition of the standard had gone out of date. The classification system introduced in 2004 consisting of four acoustical classes had also turned out to be too fine-grained. Thus, the second edition of the standard introduces a new classification system consisting of three acoustical classes. Another major change is updating the single-number quantities for sound insulation so that both the requirements for airborne and impact sound insulation are now given as standardized values $D_{nT,w}$ and $L'_{nT,w} + C_{I,50\text{-}2500}$. In the second edition, special attention has been paid to the limiting values for railway induced vibration and ground-borne noise in different buildings, like apartments, hospitals, schools, and office buildings.

Keywords: *building acoustics, classification, noise, room acoustics, vibration*

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1. INTRODUCTION

In Finland, the drawing up of the sound insulation requirements was first suggested in 1948, and some drafts were done in the 1950's and 1960's [1]. However, the first official Finnish sound insulation regulations came into force not earlier than in 1976. The regulations have been renewed in the year 1984 and in 1998. During this period, the measurement methods have remained the same excluding few differences in the reference curve methods. The requirements for airborne sound insulation between rooms were given as weighted apparent sound reduction index R'_w and for impact sound insulation as weighted normalized impact sound pressure levels $L'_{n,w}$ [2].

The revision of the regulation in 1998 was significant: earlier, regulation concerned basically all building types except theaters, cinemas and concert halls. Thus, there were requirements given as single-number quantities for apartments, hotels, schools, offices, hospitals etc. [3]. In 1998, the regulation became functional. This meant that only requirements for apartment buildings were given as single-number quantities. For other buildings, sufficiently good acoustic environment was required. The acoustic environment had to correspond to the function of the building and room. In couple of years, problems occurred especially in schools and day-care centers [4]. A solution to these problems was publication of standard SFS 5907 *Acoustic Classification of Spaces in Buildings* (2004) which complemented the regulations by presenting guidelines for schools, day-care centers, hospitals, offices and industrial workplaces [4–5].

New building acoustic regulation took effect in Finland in 2017 when *the Decree of the Ministry of the Environment on the Acoustic Environment of Buildings* was given [3, 6]. Based on scientific results [7–9], the single-number quantities were changed: the regulation is now based on weighted standardized level difference $D_{nT,w}$ concerning airborne sound insulation and sum of weighted standardized impact sound pressure level and spectrum adaptation term $L'_{nT,w} + C_{I,50\text{-}2500}$ for impact sound insulation.
The revision of the Finnish regulation made necessary to revise the standard SFS 5907, too. The working group started its work in the beginning of 2021 and the revised standard was published in December 2022 with a new title *Acoustical Design and Quality Classes of Buildings* [10].

2. MAJOR REVISIONS OF THE STANDARD

2.1 Overview of the revised standard

The major changes in the scope and coverage between the first and second edition of SFS 5907 are shown in Tab. 1. Since the publication of the first edition, also new room types have occurred which has been taken into account in the revision. The revised standard covers all the conventional building and room types, but concert halls, cinemas, theaters, libraries and museums are excluded as more or less unique buildings.
One notable change in the revision is the amount of the references. The first edition was mostly based on regulation, other standards, either international or Nordic. The revised standard and its guidelines are mostly based on research presented in scientific articles.

Table 1. Dimensional inspection of the first and second editions of the standard SFS 5907.

Quantity	2004	2022
Pages	36	56
Definitions	6	65
References	24	41
Appendices	8	0
Acoustical classes	4	3
Building types	8	12

2.2 Classification

Probably most notable change between the first and second edition of the standard is the amount of acoustic classes. Just a few years before the publication of the first edition, Nordic countries had co-operated in preparation of an acoustic classification scheme for dwellings [11]. The classification was soon adopted in other Nordic countries and in Baltic countries, too. In Finland, the classification was introduced in the first edition of SFS 5907 [4–5]. The classification consisted of four classes. Class C corresponded to the building regulation, classes A and B were believed to produce better acoustic environment and class D was meant for classification of old buildings only [5].
In the revised standard, the amount of acoustic classes has been dropped from four to three. The reason for this is that buildings fulfilling the previous class A have not been designed or built. On the other hand, it is not at all clear how well people can experience the changes between the acoustic classes. In order to avoid confusion between the previous four-level and the new three-level classification, new notation is used. In the present classification, class A2 corresponds to the building regulation, class A1 is meant for better acoustic environment and class A3 is used in classification of old buildings [10]. The sound insulation level of class A3 corresponds approximately to the level given in Finnish building regulations in 1984 [2].

2.3 Railway induced vibration and ground-borne noise

During the last decade, railway induced vibration and ground-borne noise have become an important engineering problem in Finland because of new railway and tram projects and supplementary construction of the urban areas.
In Finland, there has not been building regulation giving limiting values for vibration and ground-borne noise of all building types. The standard gives such values for each building and room type. According to the authors' knowledge, classification for railway induced vibration and ground-borne noise has not been adopted in the corresponding standards, at least not to this extent.
The limiting values for railway induced vibration are given as maximum allowed weighted vibration velocity level of 95 % confidence interval $v_{w,95}$ [mm/s]. For ground-borne noise, the limiting values are given as maximum allowed ground borne-noise level of 95 % confidence interval L_{prm} [dB] in buildings.

2.4 Example of classification of apartments

As an example of acoustic quantities to be classified according to the revised standard SFS 5907 [10], the limiting values in the three classes for apartment buildings are given in Table 2. The limiting values for airborne and impact sound insulation are given as standardized single-number quantities $D_{nT,w}$ and $L'_{nT,w} + C_{I,50\text{-}2500}$. The sound insulation values are given for insulation between

dwellings. More situations for sound insulation are found in the standard.
Concerning the measurements of impact sound insulation, the low-frequency procedure in rooms having a volume below 25 m^3 presented in ISO 16283-2 [12] is not applied in the standard [10] as there is no scientific evidence of its applicability in impact sound insulation measurements [13].

Table 2. Limiting values for different acoustic quantities for apartment buildings in acoustic classes according to the revised standard SFS 5907 [10].

Situation Quantity	Acoustic class		
	A1	A2	A3
Airborne sound $D_{nT,w}$ [dB]	≥ 60	≥ 55	≥ 53
Impact sound $L'_{nT,w} + C_{I,50\text{-}2500}$ [dB]	≤ 48	≤ 53	≤ 58
HVAC noise $L_{A,eq,T}$ [dB]	≤ 24	≤ 28	≤ 30
Outdoor noise inside $L_{A,eq,07\text{-}22}$ [dB] $L_{A,eq,22\text{-}07}$ [dB]	≤ 30 ≤ 25	≤ 35 ≤ 30	≤ 35 ≤ 30
Ground-borne noise L_{prm} [dB], from tunnel L_{prm} [dB], form track	≤ 25 ≤ 30	≤ 30 ≤ 35	≤ 35 ≤ 35
Railway vibration $v_{w,95}$ [mm/s]	≤ 0,15	≤ 0,30	≤ 0,60

3. CONCLUSIONS

The revision of the Finnish standard SFS 5907 *Acoustical Design and Quality Classes of Buildings* [10] has brought the standard and its scientific basis to the state-of-the-art level of present knowledge on building acoustics. The working group believes that its impact on the construction industry in Finland and acoustic design of buildings will be significant as was in the case of its predecessor published in 2004 [4–5].

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