

3. Cinema-halls. Soundproofing of walls and floors

3.1. Introduction

Long-term practice of designing sound insulation of walls, partition walls and ceilings of multi-room Cinema halls based on light frame partition walls, suspended ceilings and plasterboard linings has shown that actual values of sound insulation on objects ($R'_{w,Dnta}, Dntw$) are significantly lower than laboratory derived airborne noise insulation indexes (R_w) of these structures. The reasons for this are indirect ways of transferring noise from the room to the room, without removing or minimizing the effect of which on the real object can not be achieved by constructing high (≥ 65 dB).

To increase the accuracy of design and ensure the required sound insulation of enclosing structures, Acoustic Group has developed and successfully applied a method based on the principle of integrated soundproofing of cinema halls.

In the auditorium, complete sound insulation of all surfaces of the floor, walls and ceiling is performed. Additional sound insulation, in order to exclude indirect noise propagation, is subject to the floor, ceiling, or walls of the cinema, even if there are no serviced rooms behind them. Only in this way, in real construction conditions, it is possible to provide actual isolation of air noise by enclosing structures in the range $R_w = 67 - 72$ дБ.

Tables 3.1 and 3.2 show the required laboratory values for airborne noise isolation indices, in which, according to the **Acoustic Group**, the Cinema halls will meet the standards of **Dolby Laboratories Inc.*** regarding the rationing of levels of penetrating noise into the rooms of the auditoriums of Cinema halls.

Table 3.3 gives the required values of the indices of the reduced level of impact noise in Cinema halls. Practice shows that laboratory-measured values for the structures of separate floors are in good agreement with field measurements of correctly executed structures. At the same time, the measurement procedure in accordance with ISO 717-2: 2006 has a small but necessary «margin of safety» for the results, which allows the use of laboratory values for practical design.

Therefore, the following procedure is recommended when designing enclosing structures of multi-hall Cinema halls in part of walls, partition walls and floors:

- in accordance with the technical specification, the design standard is chosen: the requirements of Acoustic Group for the halls of a given category of comfort in terms of providing the required value of sound insulation (category A - high comfort conditions, B - comfort conditions and C - conditions that are acceptable for operation);
- according to tables 3.1 and 3.2 for the relevant types of premises required laboratory values of the sound insulation index are selected for building structures;
- cells of the table, for each value of the laboratory index, contains a list of references to schemes of constructions of various types is indicated. All of them, either digit to number, or with a small margin satisfy the acoustic requirements and can be chosen at the discretion of the designer;
- maximum heights of partition walls and linings are indicated on the diagram sheets 1.02-1.40, 2.02-2.10 and 3.02-3.04. Reference is also given to the values of the mass of one square meter of the construction of partition walls, linings or false ceilings;
- in cases when the room requires the decoration of non-combustible materials, the constructions having the letters «NC» at the end of the code and containing in their design non-combustible lining - Glasroc F boards;
- material consumption rates for each type of construction is given in Section 6.

Selection of structures for soundproofing is also possible using the summary tables: L1.01 on sheets 1.01.1 and 1.01.2, L2.01 on sheet 2.01, L3.01 on sheet 3.01 and L4.01 on sheet 4.01. These tables show the insulation values of air noise for different types of partition walls, linings, suspended ceilings and Gyproc floating floors.

Table L4.01 on sheet 4.01 contains values of indices of the reduced level of impact noise for different types of constructions of floating floors.

Engineering solutions for the arrangement of soundproof structures in Cinema halls in the album are coordinated and recommended for use by Nevafilm, a recognized expert in the design of commercial Cinema halls in the Russian Federation and CIS countries.

It is recommended to clarify the requirements for the enclosing designs of Cinema halls by calculations made by specialists in the field of film technology and architectural and building acoustics.

* Dolby Laboratories Inc. is recognized expert in standards development and recording and playback technologies for Cinema halls.

3.2. Cinema halls. Tables with specifications and numbers of schemes of sound-proofing structures

Table 3.1. Cinema halls. Required indexes of airborne sound insulation and numbers of structure schemes			
Type of enclosing structure	Laboratory values of weighted sound reduction index R_w , dB according to Acoustic Group standards and numbers of structural schemes :		
	Comfort category of the cinema according to the requirements of soundproofing:		
	A The highest category of comfort	B Comfort conditions	C Conditions permissible for operation
Light plasterboard partition walls			
1. Walls between cinema halls, between the cinema and the restaurant with live music, karaoke halls	72 AW 45.48 sheet 1.40	70 AW 45.44 sheet 1.38 AW 42.46 sheet 1.26	69 AW 35.46 sheet 1.37 AW 45.44 sheet 1.38
2. Walls between the cinema and the foyer, between the cinema and the restaurant with a background music, between the cinema and shops	69 AW 35.46 sheet 1.37 AW 45.44 sheet 1.38	67 AW 25.46 sheet 1.33 AW 35.44 sheet 1.35 AW 23.36 sheet 1.17 AW 22.46 sheet 1.21 AW 32.44 sheet 1.23 AW 32.47HT sheet 1.25	65 AW 25.44 sheet 1.31 AW 21.26 sheet 1.13 AW 22.44 sheet 1.19 AW 23.35HT sheet 1.18
3. Wall between the cinema and the projection room, between the cinema and the technical room	67 AW 25.46 sheet 1.33 AW 35.44 sheet 1.35 AW 23.36 sheet 1.17 AW 22.46 sheet 1.21 AW 32.44 sheet 1.23 AW 32.47HT sheet 1.25	65 AW 25.44 sheet 1.31 AW 21.26 sheet 1.13 AW 22.44 sheet 1.19 AW 23.35HT sheet 1.18	65 AW 25.44 sheet 1.31 AW 21.26 sheet 1.13 AW 22.44 sheet 1.19 AW 23.35HT sheet 1.18
Combined walls and partition walls of massive walls and plasterboard linings			
4. Walls between the cinema halls, between the cinema and the restaurant with live music, karaoke halls	72 ALA 54.12 + ALA 54.13 sheet 5.04 ALA 54.12 + ALA 54.13HT sheet 5.05	70 ALA 11.12 + ALA 11.12 sheet 5.01 ALB 72.22 + ALB 72.22 sheet 5.06 ALC 72.22 + ALC 72.23 sheet 5.07	69 ALA 11.12 + ALA 11.12 sheet 5.01 ALC 54.12 + ALC 54.12 sheet 5.03 ALB 11.12 + ALB 11.13HT sheet 5.02
<p>NOTE: Selection of the design of the partition walls for the required value of sound insulation is determined by the maximum height of the structure, the type of the base and the upper abutment, as well as the need for non-combustible lining.</p> <p>Selection of required structures is also possible using summary tables: L1.01 on sheets 1.01.1 and 1.01.2, L2.01 on sheet 2.01. These tables show the insulation values for air noise for different types of Gyproc soundproof walls and linings.</p>			

Table 3.1. CONTINUED. Cinema halls. Required indexes of airborne sound insulation and numbers of structure schemes

Type of enclosing structure	Laboratory values of weighted sound reduction index R_w , dB according to Acoustic Group standards and numbers of structural schemes:		
	Comfort category of the cinema according to the requirements of soundproofing:		
	A The highest category of comfort	B Comfort conditions	C Conditions permissible for operation
Continued. Combined walls and partition walls of massive walls and plasterboard linings			
5. Walls between cinema and foyer, between cinema and restaurant with a background music, between cinema and shops	69 ALA 11.12 + ALA 11.12 sheet 5.01 ALB 11.12 + ALB 11.13HT sheet 5.02 ALC 54.12 + ALC 54.12 sheet 5.03	67 ALA 72.23 лист 2.09 ALC 11.12 + ALC 54.12 лист 5.08 ALC 11.13HT + ALC 54.12 лист 5.09	65 ALA 54.12 sheet 2.05 ALA 54.13HT sheet 2.07 ALA 72.22 sheet 2.08
6. Walls between cinema and projection room, between cinema and technical room	67 ALA 72.23 sheet 2.09 ALC 11.12 + ALC 54.12 sheet 5.08 ALC 11.13HT + ALC 54.12 sheet 5.09	65 ALA 54.12 sheet 2.05 ALA 54.13HT sheet 2.07 ALA 72.22 sheet 2.08	65 ALA 54.12 sheet 2.05 ALA 54.13HT sheet 2.07 ALA 72.22 sheet 2.08
Combined floors of reinforced concrete boards, floating floors and plasterboard ceilings			
7. Floors between cinema halls, between cinema and restaurants with live music, karaoke halls	72 AFB 221 + AC 64.22 лист 5.12 AFB 222/AFB 227 + AC 64.22 лист 5.13	70 AC 64.32 sheet 3.04 AFB 221 + AC 64.12 sheet 5.10 AFB 222/AFB 227 + AC 64.12 sheet 5.11	69 AC 64.22 sheet 3.03 AFB 221 + AC 64.12 sheet 5.10 AFB 222/ AFB 227 + AC 64.12 sheet 5.11
8. Floors between cinema halls and cafes, restaurants with background music, shops	69 AC 64.22 sheet 3.03 AFB 221 + AC 64.12 sheet 5.10 AFB 222/AFB 227 + AC 64.12 sheet 5.11	67 AC 64.12 sheet 3.02 AFB 221 + AC 64.12 sheet 5.10 AFB 222/AFB 227 + AC 64.12 sheet 5.11	65 AFA 225 sheet 4.10 AC 64.12 sheet 3.02 AFB 221 + AC 64.12 sheet 5.10 AFB 222/ AFB 227 + AC 64.12 sheet 5.11
9. Floors between cinema halls and technical rooms	67 AC 64.12 sheet 3.02 AFB 221 + AC 64.12 sheet 5.10 AFB 222/AFB 227 + AC 64.12 sheet 5.11	65 AFA 225 sheet 4.10 AC 64.12 sheet 3.02 AFB 221 + AC 64.12 sheet 5.10 AFB 222/ AFB 227 + AC 64.12 sheet 5.11	65 AFA 225 sheet 4.10 AC 64.12 sheet 3.02 AFB 221 + AC 64.12 sheet 5.10 AFB 222/ AFB 227 + AC 64.12 sheet 5.11

NOTE: Selection of the design of the partition walls for the required value of sound insulation is determined by the maximum height of the structure, the type of the base and the upper abutment, as well as the need for non-combustible lining.

Selection of required structures is also possible using summary tables: **L1.01** on sheets **1.01.1** and **1.01.2**, **L2.01** on sheet **2.01**, **L3.01** on sheet **3.01** and **L4.01** on sheet **4.01**. These tables show the insulation values for air noise for different types of soundproofing linings, **Gyproc** suspended ceilings and «floating» floors.

Table 3.2. Cinema halls. Required indexes of airborne sound insulation and numbers of structure schemes

<p>Types of enclosing structures for all categories of cinema halls: Wall lining, suspended ceilings and soundproofing floors</p>	<p>Weighted sound reduction index improvement ΔR_w, dB, according to Acoustic Group standards and numbers of structural schemes:</p>
<p>1. Walls, floors and ceilings, cinema halls adjacent to unprotected premises (roof, basement, unexpired rooms, etc.)</p>	<p style="text-align: center;">$\geq 10^*$</p> <p>ALA, ALB, ALC 11.12 sheet 2.02 ALA, ALB, ALC 54.12 sheet 2.05 ALA, ALB, ALC 72.22 sheet 2.08</p> <p style="text-align: center;">AC 64.12 sheet 3.02</p> <p>AFA, AFB 222 sheet 4.07 AFA, AFB 225 sheet 4.10 AFA, AFB 227 sheet 4.12</p>

* – value of additional insulation of airborne noise measured on the base wall / floors with its own sound insulation is not lower **R_w = 49 dB**.

NOTE: Selection of lining design for the required sound insulation value is determined by the maximum height of the structure.

Selection of required constructions is also possible using the summary tables: **L1.01** on sheets **1.01.1** and **1.01.2**, **L2.01** on sheet **2.01**, **L3.01** on sheet **3.01** and **L4.01** on sheet **4.01**. These tables show the insulation values for air noise for different types of soundproofing linings, suspended ceilings and **Gyproc** floating floors.

Table 3.3. Cinema halls. Required indexes of airborne impact insulation and numbers of structure diagrams

<p>Types of enclosing structures for all categories of cinema halls:</p>	<p>Airborne impact insulation indexes of soundproofing structures, $L_{n,w}$ dB, at which compliance with actual sound insulation is met according to Acoustic Group standards:</p>
<p>1. Floors between cinema halls</p>	<p style="text-align: center;">40</p>
<p>2. Floors between cinema halls, restaurants, shops, karaoke halls</p>	<p>AFA 223 sheet 4.08 AFA 224 sheet 4.09 AFB 225 sheet 4.10 AFA 227 sheet 4.12 ** AFA, AFB 221 sheet 4.06 ** AFA, AFB 222 sheet 4.07</p>
<p>3. Floors between technical rooms and cinema halls</p>	<p>** AFB 223 sheet 4.08 ** AFB 227 sheet 4.12</p>

** – In the case of location of the cinema hall at the bottom and presence of a soundproof ceiling structure in it, in combination with the use of a complex soundproofing system in the cinema hall, it is allowed in the upper room to apply the construction of a floating floor with an index of the given level of impact noise by **10 dB** more.

NOTE: Selection of required structures is also possible with the help of the summary table **L4.01** on sheet **4.01**, which shows the values of airborne impact insulation for different types of **Gyproc** floating floors.