DOI: 10.61782/fa.2025.0858

THE CONSTRUCTION OF A STANDARDIZED ACOUSTIC TESTING ROOM FOSTERS INNOVATIVE SOLUTIONS MEETING FUTURE MARKET TECHNICAL DEMANDS.

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ABSTRACT

The construction of a standardized acoustic testing room is a key development in fostering innovative solutions that meet the current technical demands of the market. This presentation details the design and construction process of a specialized facility that provides controlled conditions for the precise evaluation of acoustic technologies. The room enables the research and enhancement of materials and technologies that improve acoustic comfort and soundproofing, contributing to the advancement of acoustic engineering in key sectors such as construction. Additionally, the presentation highlights how this infrastructure serves as a crucial tool for complying with technical standards and addressing the growing market demands. It also emphasizes the important role manufacturers play in promoting initiatives from technical committees, working closely with governments to ensure that acoustic solutions improve the quality of life for the population. Through this approach, the collaboration between industry and authorities is key to creating healthier and more comfortable living conditions, contributing to the continuous improvement of urban and residential environments.

Keywords: *acoustic testing room, soundproofing, technical standards, construction.*

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1. INTRODUCTION

This article presents the development of specialised acoustic rooms for the evaluation of construction solutions. The creation of these facilities responds to the growing need to investigate new alternatives within the field of lightweight and industrialised construction, understanding 'lightweight' as one in which the structural elements are mainly composed of wood, sheet metal or other low-mass materials. Furthermore, this initiative is linked to the future update of the Spanish Technical Building Code (Código Técnico de la Edificación), scheduled for 2026, which drives the need to adapt construction solutions to the new regulatory requirements.

2. DRIVING ACOUSTIC INNOVATION BY DANOSA GROUP S.A.

The new acoustic rooms are being constructed in Fontanar, a small village in the province of Guadalajara (Spain) , with a population of just over a hundred inhabitants, where the facilities of Danosa Group S.A. are located, the company behind this project. Founded over 60 years ago, Danosa Group S.A. has been a pioneer in the development of acoustic insulation since the 1980s, specialising in the manufacture of elastic materials such as polyethylene foams and anti-resonant elements like acoustic membranes and multi-layer products.

Throughout its history, Danosa Group S.A. has played a key role in the development of various national technical standards, contributing to the advancement of the industry and the establishment of benchmarks in the sector. Furthermore, the company has introduced innovative solutions to the market by creating integrated acoustic systems that combine different materials to improve both airborne and impact sound insulation in construction. Its approach has always been to provide value-added proposals, adapting to the growing needs of the sector and contributing to the improvement of acoustic quality in built environments.

3. DEVELOPMETN CONTEXT

3.1 New construction systems

The increasing adoption of new lightweight construction solutions, such as thin sheet metal (1 mm to 1.5 mm thickness), laminated wood panels (CLT), sandwich panels with rigid insulation cores, and traditional timber beam systems, presents significant challenges in accurately modelling their acoustic performance using specialised software. These novel construction methods necessitate substantial research and development efforts from acoustic insulation manufacturers to ensure effective soundproofing. This situation mirrors the developments of the 1980s, when the industry pioneered decoupling solutions for compression layers on floors and structural elements to mitigate impact noise, or replaced lead sheets with bituminous membranes for improved airborne noise insulation. Today, manufacturers are once again called upon to innovate and design new solutions to address the acoustic complexities associated with these lightweight construction systems. This ongoing demand for technological advancements continues to drive the evolution of acoustic insulation products and methodologies.

3.2 Regulatory change

The second factor driving the creation of this project is the knowledge of an imminent significant change in Spanish acoustic regulations[1], which involves an increase of approximately 2 dB in airborne sound levels (DnTa 52 dBA) and a reduction of 5 dB in impact noise (Lntw 60 dB) in protected rooms, along with new restrictions on tolerances in measurements. This change is accompanied by a renewed focus from the National Technical Committees, emphasizing the importance of manufacturers actively collaborating in the development of new acoustically justified solutions. The goal is to create "standard" solution catalogs that can serve as references for designing future constructions, ensuring compliance with the new regulatory requirements.

3.3 Improving quality of life

The involvement of construction manufacturers in technical committees, associations, forums, and various markets, alongside architects and building designers, provides a realistic representation of the impact on people's quality of life. In this context, without delving into purely commercial matters, manufacturers position themselves as innovative entities with the financial capacity to allocate resources towards the development of testing and measurement elements for future systems. Furthermore, they possess extensive knowledge of diverse products and solutions used worldwide, which allows them to contribute to society by providing solutions that enhance quality of life. These solutions are also closely aligned with environmental sustainability, as they often incorporate new materials that reduce the ecological footprint of the products.

3.4 Participants in project development

The following paragraph describes the participants who have directly contributed their expertise to the design and construction of the testing rooms.

3.4.1 Danosa Group S.A.

As the promoting and contracting entity, is represented by Álvaro Martínez, a member of the Technical Standardization Committee CTN-74 and Head of Acoustics at the company. Advocates for the construction of an acoustic measurement facility where new solutions for the market can be developed.

3.4.2 Tecnalia

As one of the leading companies in innovation at the national level and one of the main institutes, it has Marta Fuente as the head of acoustics.

3.4.3 Gikesa

As an acoustic measurement laboratory and a benchmark in technical support for the construction sector.

3.4.4 Maribel Castro (Architect)

Architect in charge of the projects and construction management of the buildings and constructions at Danosa Group S.A.

4. TESTIGN ROOM DESIGN

4.1 Regulation

The design of the testing chambers is based, as expected, on the ISO 10140 standards, both with regard to the requirements for installations and equipment [UNE-EN ISO

[1] Incomming regulation January 2026. New CTE DB-HR

10140-5] and the measurement methodology itself [UNE-EN ISO 10140-2 and 4], enabling the comparison of results with those obtained by other laboratories.
Although the aforementioned standards do not specifically address the design of acoustic transmission chambers, they do specify, either quantitatively or qualitatively, a set of requirements that significantly influence the design, such as:

- Minimum dimensions and volumes.
- Controlled reverberation time in both chambers.
- The need for the acoustic field inside the chambers to be diffuse.
- Minimisation of indirect transmissions between chambers.
- Background noise as low as possible in the receiving chamber.
- Energy dissipation (loss factor) for heavy samples.

4.2 Sizing

Regarding the dimensions and volumes, a separator element measuring 3.4 x 4.6 meters has been chosen, which closely resembles the standard surface area of a residential space. The volume difference between the chambers is maintained within 10%, in compliance with the requirements set out by the standard.

4.2.1 Minimisation of Indirect Sound Transmission

One of the key aspects in the design of an acoustic laboratory is the minimisation of indirect sound transmission between chambers. Unlike real-world construction, where sound is transmitted between spaces through multiple transmission paths, the goal in a laboratory setting is to ensure that the sound only travels through the test sample, thereby characterising the material or construction solution. The joints between elements of the different chambers are specifically designed to achieve this by using structural decoupling components with very low dynamic stiffness. This approach effectively isolates the chambers, ensuring that the measurements accurately reflect the acoustic properties of the sample under test.

4.2.2 Energy Dissipation (Loss Factor)

Another important parameter is the loss factor (energy dissipation) of the sample once placed between the transmission chambers. While this aspect is primarily relevant for heavy samples, it has also been considered in the design to ensure the accuracy and reliability of the test results.

4.2.3 Reverberation Time

The reverberation time is carefully controlled in both chambers, set between 1 and 2 seconds, achieved through the strategic placement of absorbent materials in both the emitter and receiver rooms. The acoustic field within each chamber is diffuse, meaning that a large number of reflected waves, originating from all directions, combine in such a way that, at any given point and in any instantaneous direction of the sound wave, the average density of acoustic energy is equally probable. This is first achieved through appropriate chamber sizing, which accounts for the potential for standing waves or dominant modes, particularly at low frequencies. Additionally, once the laboratory is constructed, this diffuse field is further ensured by the placement of curved reflective elements, whose positioning and orientation are determined through a statistical testing process.

As part of the design development, a model of the potential indirect transmissions has been created, which integrates the defined construction solution. Based on this model, the maximum acoustic parameters R’w and L’nTw have been estimated, yielding a value of 94 dB for R’w and 23 dB for L’nTw.
It is important to highlight that these values represent the measurement limit due to flanking transmissions, but they are subject to the influence of background noise in the receiving room. This factor is controlled through the configuration of the room envelope, as well as by the influence of external noise generated outside.

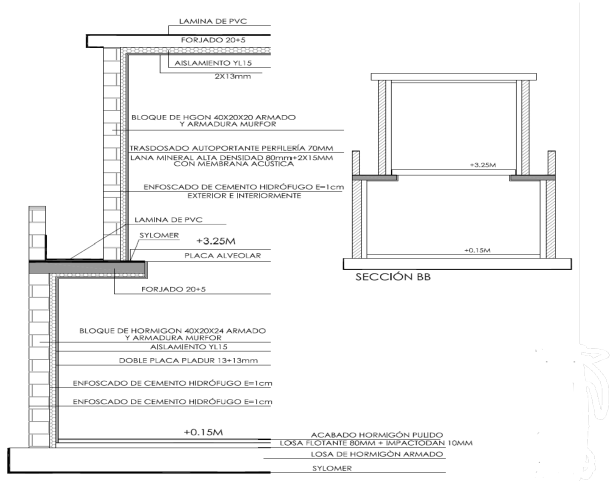

Figure 1. Construction section of the testing rooms (1)

4.2.4 Isolation of the chambers

Finally, yet equally important, the isolation of the chambers from external noise sources ensures the lowest possible background noise in the receiving chamber. This allows for the accurate measurement of high levels of sound insulation without any interference, ensuring the reliability of the test results.

Once the testing room is designed, constructed, and calibrated, the measurement procedure and the equipment to be used will be established. Following this, the results of the insulation tests will be validated. To achieve this, tests will be conducted on various items with known insulation properties, ensuring that the measurements align with the expected values.

Figure 2. Construction interior of the testing rooms (2)

5. SOLUTIONS TO BE TESTED

5.1 Light or industrialised construction

Lightweight construction solutions are increasingly in demand within the sector. The rapid construction time, coupled with the reduced cost of buildings due to the use of fewer materials, has driven the adoption of new building systems. However, the limited acoustic insulation offered by these structures, combined with the rigidity of their connections, necessitates the integration of additional elements with insulating properties. Within the category of "lightweight" systems, the following can be considered.

5.1.1 CLT (Cross-Laminated Timber)

Innovative and sustainable building material that has gained popularity in modern architecture. CLT is manufactured by bonding layers of wood (typically pine, spruce, or other types of wood) arranged in alternating directions (crosswise), which provides greater strength and dimensional stability compared to traditional wood.

5.1.2 Wood beam structure

Construction system primarily used in buildings and other infrastructures to support loads and distribute them efficiently. Beams are horizontal or inclined components responsible for transferring the loads from the structure to the ground or other supporting elements, such as columns or walls. In a wood beam structure, wood is the primary material used due to its mechanical properties, aesthetics, and sustainability.

5.1.3 Deck-type sheet structure

Construction system that uses steel panels (or, in some cases, other metallic materials) to form a strong and continuous surface that serves both to support loads and as part of the structural element of a building, typically in floor or roof slabs. This system is commonly used in the construction of industrial, commercial, residential buildings, and certain infrastructure applications due to its efficiency, speed of execution, and structural performance.

5.1.4 Prefabricated panel structure

A construction system that uses panels manufactured off-site (in a prefabrication plant) which are then transported and assembled at the construction site. These panels can be made from various materials, such as concrete, wood, steel, or composite materials, and are designed to serve structural, aesthetic, or both functions. Prefabricated panels are modular elements produced in series under controlled conditions, ensuring their quality and dimensional accuracy.

The rigid elements to be used as separation layers and/or supports include OSB boards and fibre cement boards.

The acoustic components employed will consist of cross-linked polyethylene, acoustic membranes, rubber mats, multi-layer panels, anti-resonant elements, and other sound-absorbing materials. These can be placed in structural gaps or used as spring elements between masses. Additionally, vibration isolation systems will be integrated into certain solutions where low-frequency performance is required.

Figure 3. Last days of construction. (2)

6. REFERENCES

[1] Esquema de Construcción. Proyecto constructivo salas de ensayo (Danosa)

[2] Pictures of testing rooms in Danosa, Fontanar (Guadalajara – Spain)