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TÜRKİYE CUMHURİYETİ
ÇEVRE, ŞEHİRCİLİK VE
İKLİM DEĞİŞİKLİĞİ BAKANLIĞI

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BLX ACOUSTIC RESEARCH LABORATORY

BLX Acoustic Research Laboratory is the first and only R&D laboratory in Turkey with special status where acoustic performance of materials is tested in accordance with ASTM and ISO standards.

Reverberation room to test the sound absorption performance of materials in the laboratory where the activities are carried out accredited; Sound transmission loss rooms are available for acoustic tests in structures and building elements.

The technical specifications of the laboratory rooms serving in accordance with the relevant international standards are as follows.

ISO 10140-2 & ASTM E90 SOURCE AND RECEIVER ROOM

BLX ARL can perform measuring the airborne sound insulation of building products, such as walls, floors, doors, windows, shutters, façade elements, façades, glazing, small technical elements, for instance transfer air devices, airing panels (ventilation panels), outdoor air intakes, electrical raceways, transit sealing systems and combinations, for example walls or floors with linings, suspended ceilings, or floating floors.

The test results can be used to compare the sound insulation properties of building elements, classify elements according to their sound insulation capabilities, help design building products which require certain acoustic properties and estimate the in situ performance in complete buildings.

The features of the Source and Receiver Room are as follows:

@ The measurement mechanism of ISO 10140-2 contains 2 room and 1 frame.

@ Frame is using for opening.

@ Source room, receiving room and frame are isolated from airborne sound and structure borne sound.

@ Source room, receiving room and frame are not rigidly connected to each other.

@ The receiving room is designed in accordance with minimum volume requirement in ISO 10140-2 relevant clause

@ The Source room is designed to be %10 percent different from Receiving room volume. The volume of source room is 63 cubic meter.

@ The opening area is 12 square meter.

@ For lightweight wall system, BLX Acoustic Research Laboratory's R'max value is determined as 78.1 dB.

@ Reverberation time of 500 Hz in receiving room is 0.8 second.

@ Background noise level of receiving room is 22.6 dB.

The features of the Reverberation Room are as follows:

@ The reverberation room has a volume of 223 cubic meters with a floor area of 44.5 square meters and a height of 5 m. At least 223 cubic meters are provided for 100 Hz in the relevant section of the standard.
@ No surfaces other than the floor and ceiling are positioned parallel to each other.
@ Surfaces are designated as reflective.
@ In accordance with ISO 3741 Standard the reverberation time of the reverberation room is greater than the ratio of volume to the total surface area.
@ The environmental conditions of the reverberation room are between humidity and temperature tolerance values.
@ As specified in ISO 3741, source is placed 8 different positions. Standard deviation control is applied for measure microphone position. All of standard deviation are appropriate for broad-band sound measurement.

BLX ARL can perform determining the sound power level or sound energy level of a noise source from sound pressure levels measured in a reverberation test room. The sound power level (or, in the case of noise bursts or transient noise emission, the sound energy level) produced by the noise source, in frequency bands of width one-third octave, is calculated using required measurements, including corrections to allow for any differences between the meteorological conditions at the time and place of the test and those corresponding to a reference characteristic impedance.
In general, the frequency range of interest includes the one-third-octave bands with mid-band frequencies from 100 Hz to 10 000 Hz.
The noise source under test can be a device, machine, component or sub-assembly. ISO 3741:2010 is applicable to noise sources with a volume not greater than 2 % of the volume of the reverberation test room. BLX ARL can measure samples with a maximum volume of 4.4 cubic meters.

ISO/IEC 17025 enables laboratories to demonstrate that they operate competently and generate valid results, thereby promoting confidence in their work both nationally and around the world.

It also helps facilitate cooperation between laboratories and other bodies by generating wider acceptance of results between countries. Test repoWWrts and certificates can be accepted from one country to another without the need for further testing, which, in turn, improves international trade.

ISO/IEC 17025 is useful for any organization that performs testing, sampling or calibration and wants reliable results. This includes all types of laboratories, whether they be owned and operated by government, industry or, in fact, any other organization. The standard is also useful to universities, research centres, governments, regulators, inspection bodies, product certification organizations and other conformity assessment bodies with the need to do testing, sampling or calibration.

ISO 16283-1

Acoustics — Field measurement of sound insulation in buildings and of building elements — Part 1: Airborne sound insulation

It replaces the old ISO 140-4, -5, -7 field methods; it is less dependent on the diffuse field assumption and clarifies the use of handheld/moving microphones, the conditions under which the operator is present in the room, etc.

During measurement, noise is generated using a loudspeaker in the source room, sound pressure levels are measured in the receiver room and source room, and the reverberation time of the receiver room is also measured to calculate performance metrics such as DnT, R'w.

Where do we use this measurement?

In short, whenever we want to see the airborne sound insulation between two spaces on site:

- Between flats and room-to-room partition wall/ceiling performance in residential buildings
- Acceptance measurements of sound insulation between rooms in buildings such as hotels, dormitories, hospitals, offices, etc.
- Complaint investigation in existing buildings (neighbour noise, plant room, lift shaft, etc.)
- Comparison of current status and improvement before and after reinforcement/renovation
- Verification of whether the targeted Rw/R'w/DnT,w classes are achieved according to the project/specification
- Therefore, instead of the laboratory (ISO 10140-2), we use ISO 16283-1 to see how well the separating elements perform in real building conditions.

ISO 16283-2

Acoustics — Field measurement of sound insulation in buildings and of building elements — Part 2: Impact sound insulation

The system measures how much impact noise from footsteps, heel sounds, chair scraping, etc. is reduced in the space below for floor/beam ceiling systems.

A 'standard tapping machine' is used as the standard impact source.

The machine is operated at specific positions on the upper (source) floor; quantities such as L'n,T, L'n,w are calculated in the lower (receiving) room on a frequency basis (normalised impact sound pressure level).

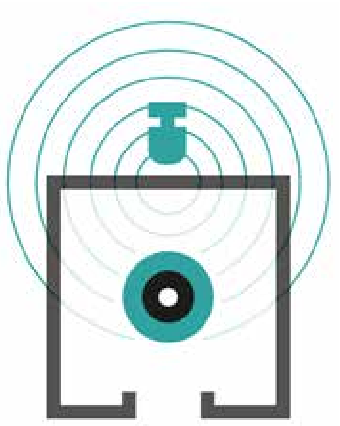
Position in the ISO 16283 series:

16283-2: Impact sound insulation (flooring)

Where do we use this measurement?

In all cases, when we want to check the impact noise performance between upper and lower floors on site:

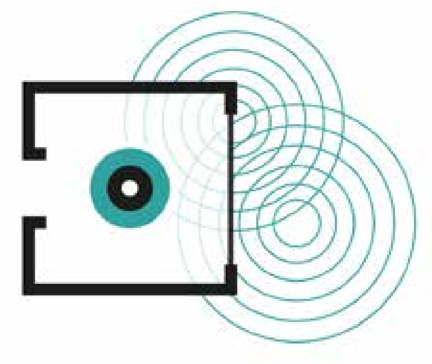
- Acoustic acceptance tests for floors between flats in residential buildings (e.g. does the regulation/specification L'n,w ≤ X dB apply?)
- In hotels, dormitories, hospitals, offices, etc., for diagnosis and reporting of complaints about noise from walking, running, or dragging chairs on the upper floor
- Measurement of the effectiveness of improvement solutions (floating flooring, carpet, acoustic screed, etc.) before and after installation
- Performance class verification measurements (e.g. 'Impact sound class' control) in project delivery and contractor/employer agreements



In short: To see numerically, under real building conditions, how little footfall/impact noise the flooring system transmits to the space below, we refer to ISO 16283-2.

ISO 16283-3

Acoustics — Field measurement of sound insulation in buildings and of building elements — Part 3: Façade sound insulation



- It measures how much external noise (traffic, trains, aircraft, industrial sources, etc.) penetrates from the façade into the interior space.
- The noise source may be actual traffic/environmental noise, or it may be an artificial sound source placed outside.
- Sound pressure levels are measured inside the room and evaluated together with the external environment level to obtain façade sound insulation quantities such as D_2m,nT,w, R'tr,w.

In the ISO 16283 series:

- 16283-1: Room-to-room airborne sound insulation
- 16283-2: Impact sound insulation (flooring)
- **16283-3: Facade sound insulation**

Where do we use this measurement?

In short, in buildings exposed to external noise, when we want to see if the façade design/application is truly adequate:

- Residential buildings exposed to traffic noise (main roads, motorways, intersections)
- Residential buildings, hotels, offices, etc. near airports/railways/ports.
- Buildings near industrial or entertainment facilities (nightclubs, concert venues, open-air restaurants/bars)
- Performance acceptance tests for facade details (glass, joinery, facade panels, etc.) in newly constructed buildings
- In complaint situations: Verification and reporting of situations such as 'Outside traffic/aircraft/facility noise is entering the home too much'

- To verify whether the designed/anticipated dB class (e.g., $D_2m,nT,w \geq$ X dB) is achieved on-site

Therefore, we use ISO 16283-3 to quantitatively assess the actual façade behaviour on the building rather than laboratory Rw values.

ISO 16251-1

Acoustics — Loboratory measurement of the reduction of transmitted impact noise by floor coverings on a small floor mock-up -Part 1: Heavyweight compact floor

The essence of ISO 16251-1 is as follows:

- **In a small reference room,**
- Using a standard tapping machine
- It defines the comparative measurement of the impact sound reduction effect of different floor coverings (carpet, vinyl, underlay beneath laminate, etc.).
- The aim is to provide a practical and repeatable assessment method in a smaller test room, rather than in large, expensive laboratories like the classic ISO 10140-3.
- The measurement output typically answers the question:
- "How much does this covering reduce impact sound compared to bare concrete?" on a frequency basis and with single-number indicators.

Where do we use this measurement?

In summary, when we want to see the impact sound performance of floor covering products for product development or comparison purposes:

- In acoustic R&D studies of floor covering products such as carpet, vinyl, PVC, rubber, laminate underlay, cork-based coverings, etc.
- When we want to compare different coverings to answer the question, 'Which product reduces footfall/impact noise more?' using a faster and more cost-effective method.
- To numerically specify the impact noise reduction performance in product declarations or catalogues
- In test laboratories that cannot establish a large-scale impact sound laboratory but can set up a small reference room
- While the field standard ISO 16283-2 provides us with the 'impact sound in a real building,'

ISO 16251-1 should be considered more of a product-focused, small room test method:

We use it to change the floor covering and compare their performance relatively.

ISO 3382-1 is the standard that **describes how to measure room acoustic parameters in performance spaces (concert halls, opera houses, theatres, etc.).**

- In summary:
- It describes impulse response-based measurement (omni source + measurement microphones).

It defines how the following basic **room acoustic parameters** are calculated:

- **T, T20, T30** (reverberation time)
- **EDT** (Early Decay Time)
- **C50, C80** (clarity – speech/music intelligibility)
- **D50** (definition)
- **ti** (ts) (centre time)

ISO 3382-1

Acoustics — Measurement of room acoustic parameters — Part 1: Performance spaces

- G (strength – sound intensity)

Parameters related to lateral energy (LF, LFC, etc.)

- It defines the measurement procedure, required equipment specifications, number and placement of sources/microphones, data evaluation, and report format.

Where do we use this measurement?

In short: **whenever we want to see the acoustic quality of medium to large volumes for stage performance in numerical terms:**

- Performance venues such as concert halls, opera houses, theatres design verification (project targets vs. measurement) acceptance/delivery measurements
- Multi-purpose halls, conference halls, convention centres, auditoriums
- Pre- and post-renovation/improvement acoustic comparisons of existing halls
- In room acoustics research and software calibration (ODEON, EASE, etc.) – used as a reference parameter set for comparing measured impulse response with simulation.

In other words: "How good is this hall acoustically for music and speech?" We rely on ISO 3382-1 to provide a standardised numerical answer to this question.Performance acceptance tests for facade details (glass, joinery, facade panels, etc.) in newly constructed buildings

In complaint situations: Verification and reporting of situations such

ISO 3382-2

Acoustics — Measurement of room acoustic parameters — Part 2: Reverberation time in ordinary rooms

TISO 3382-2 is the standard for "reverberation time measurement in ordinary rooms".

In short:

- It describes how to measure reverberation time (T, T20, T30) in small/medium-sized, everyday rooms.
- It defines the following:

Measurement conditions (room, noise level, equipment)

Source types (impulse noise, impulse response, etc.)

Number and distribution of measurement points

Processing of the decay curve, T20/T30, uncertainties, reporting.

Where do we use it?

To assess the acoustic quality of everyday spaces that are not 'performance venues':

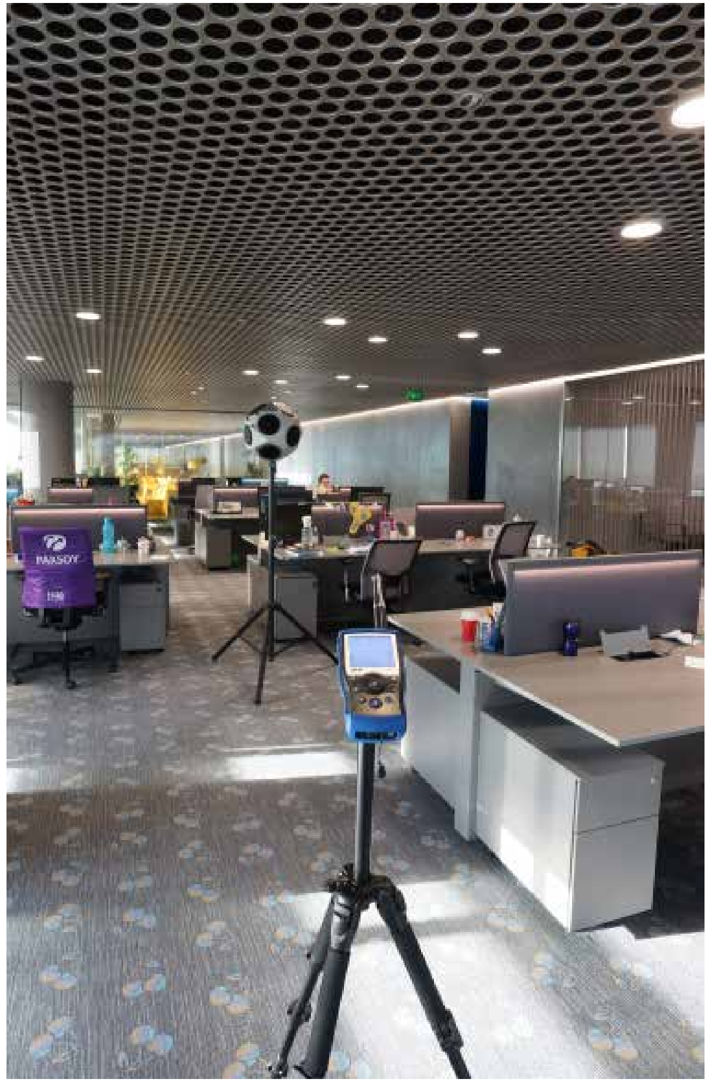
- Classrooms, lecture halls (for RT requirements)
- Offices, open-plan offices, meeting rooms
- Restaurants, cafeterias, lobbies, call centres
- Workshops, small gyms, foyers, terminals, etc.

Objectives:

- To assess the suitability of the room in terms of speech intelligibility and noise level
- To make the necessary room absorption correction for other measurements (e.g. sound insulation, sound power measurements)
- Project/specification RT target acceptance measurement

In summary: ISO 3382-1 is used to measure performance halls such as concert halls/theatres,

while ISO 3382-2 is used to measure 'everyday' rooms such as classrooms, offices, and restaurants in a standardised manner in terms of RT.



ISO 3382-3

Acoustics — Measurement of room acoustic parameters — Part 3: Open plan offices

ISO 3382-3 defines the method for measuring room acoustic parameters in open-plan offices.

This standard provides measurement procedures for specific parameters describing speech propagation and noise control in open offices. Typical parameters:

- D_2,S – Distance attenuation of speech
- L_p,A,S,4m – A-weighted sound pressure level 4 metres from the speaker
- L_p,A,B – Background noise level
- r_D – Effective speech propagation distance (distraction distance)

These parameters are directly related to "speech privacy" and "distracting speech propagation" in open-plan offices.

Where and why do we use them?

In short: to numerically evaluate open-plan office acoustics and perform acceptance measurements.

- In open-plan office designs:

To evaluate the acoustic effect of solutions such as partitions (screens), ceiling/wall absorbers, floor coverings, desk layout, etc.

- To check compliance with targets such as 'speech privacy' and 'distraction distance' included in employer/employee health standards.
- In existing open-plan offices:
- To diagnose complaints such as 'I can hear the conversation at the next desk very clearly' and 'telephone conversations spread throughout the office' with objective measurements.
- Conducting before-and-after comparisons

ISO 1996-1

Acoustics — Description, measurement and assessment of environmental noise — Part 1: Basic quantities and assessment procedures

ISO 1996-1 defines the **basic quantities and calculation principles for the definition, measurement and assessment of environmental noise.**

In summary:

- It defines the basic acoustic quantities to be used to define community/environmental noise (traffic, railways, aircraft, industry, entertainment, etc.).
- It provides assessment procedures: equivalent continuous level, L_Aeq, for long-term exposure, adjustments (tonal, impulsive, low frequency, etc.) and the resulting concept of "rating level" (L_r).
- It provides guidance on predicting the annoyance response of the community to long-term exposure from different source types.

The objective of the ISO 1996 series is to make the definition and assessment of environmental noise internationally compatible, so that countries can base their own limit values and regulations on these principles.

Note: **ISO 1996-2** describes **how to measure/determine the sound pressure levels** of these noises.

Where do we refer to this standard?

In short, whenever we want to describe, calculate and relate the environmental noise level in an area to regulations:

- **Road, railway, airport** noise assessments (zoning plan, new residential area, road project, etc.)
- Environmental impact assessments for **industrial facilities, entertainment facilities** (open-air concert venues, nightclubs, bars, restaurants)
- Calculation/reporting framework for **strategic noise maps and action plans**
- Definition and calculation of quantities such as 'daytime/evening/night L_den, L_night, L_r' mentioned in national/local regulations
- Objective assessment and reporting of community complaints (traffic noise, facility noise, etc.)

ISO 1996-1 can be considered the umbrella standard for the question, 'How do we define and evaluate environmental noise in terms of which quantities and principles?' The details of field measurement techniques are primarily defined in ISO 1996-2.

ISO 1996-2 is the **field measurement standard that explains how to determine sound pressure levels for environmental noise.**

In summary:

- It describes how sound pressure levels (particularly L_Aeq, etc.) to be used in environmental noise assessment should be measured and/or calculated.
- Levels can be obtained by:
- Direct measurement,
- Extrapolation of measurement results by calculation,
- Some versions also cover determination by calculation alone.
- The document is primarily designed for outdoor environments but also provides some guidance on measurements in enclosed spaces for specific situations.
- It also provides guidance on how to estimate and report measurement uncertainty.

In short: A guidance document that answers the question, 'How do we practically carry out environmental noise measurements, under what conditions, and how do we report them?'

Where do we refer to this standard?

In any case where we want to quantitatively determine the level of noise emitted from a source into the environment:

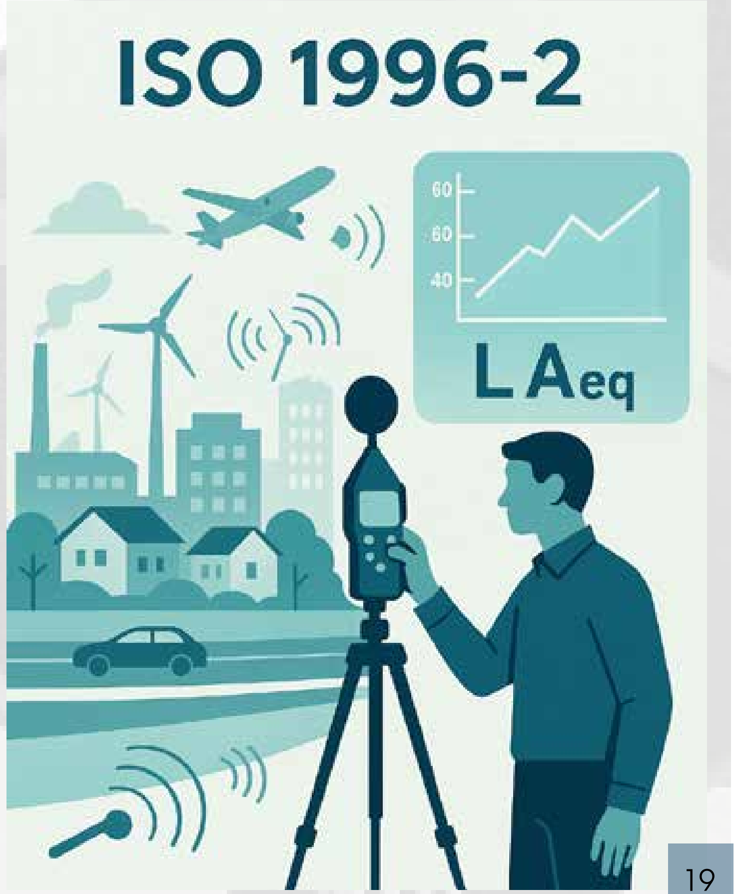
- **Road, rail, and airport** noise measurements (current situation assessment, new road/airport project, zoning plan, etc.)
- Measurement of noise generated in the environment by fixed facilities such as industrial plants, power plants, logistics centres, ports
- Noise assessments at neighbourhood/plot boundaries for entertainment facilities (open-air concert venues, festivals, stadiums, bars/discos, restaurant terraces)
- Field measurements for calibration purposes for strategic noise maps
- Basic reference for obtaining field data for quantities such as L_day, L_evening, L_night, L_den, L_r, etc., which are compared with the limit values given in environmental legislation

While ISO 1996-1 primarily outlines the framework of 'which parameters should we use for assessment?',

ISO 1996-2 clarifies the aspect of 'how do we measure/calculate these parameters in the field and report them?'.

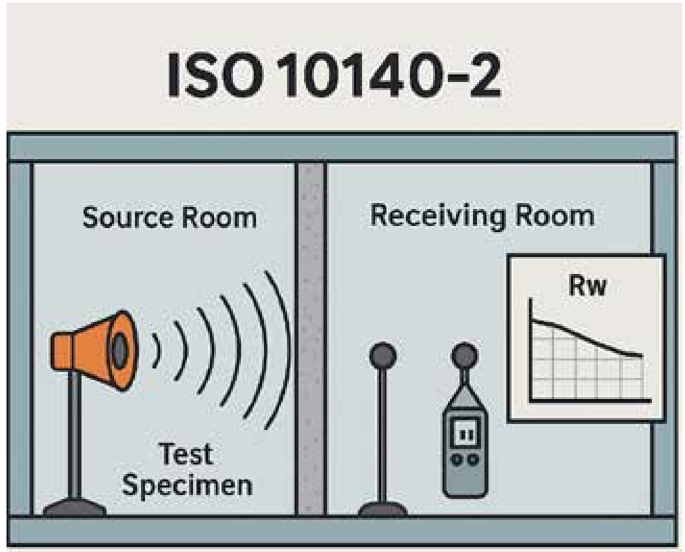
ISO 1996-2

Acoustics — Description, measurement and assessment of environmental noise — Part 2: Determination of sound pressure levels



ISO 10140-2

Acoustics — Laboratory measurement of sound insulation of building elements Part 2: Measurement of airborne sound insulation



ISO 10140-2 specifies the method for **measuring airborne sound insulation of building elements in a laboratory environment.**

In summary:

- It involves obtaining the airborne sound insulation (Rw) value of a building element (wall, floor, door, window, façade panel, etc.) placed between two rooms (source–receiver) in a laboratory.
- The standard defines:

room dimensions and characteristics,
source type, microphone positions,
level difference, background noise and reverberation measurement,
and the calculation and reporting of quantities such as R, Rw, C, Ctr.

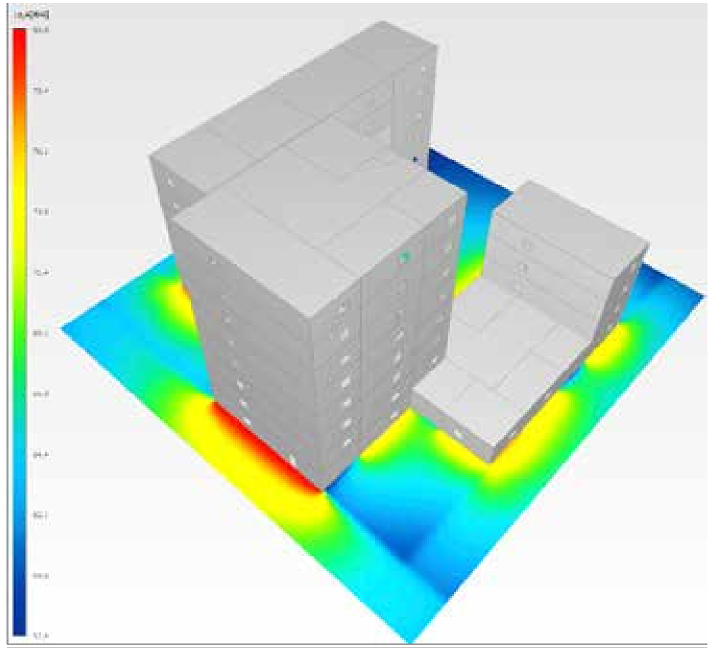
Where do we apply it?

In short, anywhere we need the 'laboratory Rw value' of an individual building element:

- Obtaining the Rw, Rw+Ctr values specified in the catalogue by manufacturers for wall panels, doors, windows, façade systems
- R&D testing for new product development (e.g., lightweight partition wall systems, acoustic doors)
- Laboratory testing to support specifications such as 'Walls shall have Rw ≥ X dB'
- Comparing the performance measured according to the field standard ISO 16283-1 with the element's laboratory reference
- In other words: ISO 10140-2 comes into play when we want to see the airborne sound insulation performance of a single building element under 'ideal laboratory conditions' in numerical form.

ISO 12354 (1-2-3-4-6)

Standard test method for laboratory measurement of airborne sound transmission loss of building partitions and elemnts



The ISO 12354 series generally defines models for 'calculating building acoustic performance from element performance.' Briefly, each part:

ISO 12354-1 – Airborne sound insulation between rooms Used to calculate airborne sound insulation between adjacent rooms (R', DnT, etc.) in buildings. It takes laboratory data (Rw, Kij, etc.) for elements such as walls, floors, doors, etc., and their joints as input; it estimates room-to-room performance using a model that includes direct + flanking transmission paths.

ISO 12354-2 – Impact sound insulation between rooms Calculates impact sound insulation (L'n, L'nT, L'n,w, etc.). Using measured data for reference flooring, cladding, beam systems and flanking paths, it predicts the impact sound level between upper and lower rooms (against a tapping machine); includes detailed band-based and simplified single-number models.

ISO 12354-3 – Airborne sound insulation against outdoor sound Calculates the airborne sound insulation of the façade/external surface against outdoor noise. Based on the R values of the elements forming the façade (window, wall panel, ventilation element, etc.), it estimates the façade performance (e.g., Ratr / $D_{2m,nT}$) and the indoor–outdoor level difference; includes direct + flanking components.

ISO 12354-4 – Transmission of indoor sound to the outside Calculates the sound power (Lw) of indoor-generated noise transmitted to the outside of the building. Using sound pressure levels measured in interior spaces and transmission data for shell elements, it determines the radiant sound power level of the building envelope; this Lw is then used in calculations of Lp radiated to the environment using models such as ISO 9613-2.

(EN) 12354-6 – Sound absorption in enclosed spaces Part 6 of the standard defines a model that calculates the total sound absorption area and/or reverberation time (RT) of enclosed spaces from the α/A values of materials and objects. It takes laboratory absorption data for panels, ceilings, furniture, and objects as input; it is used to estimate RT/Atoplam for 'normal' rooms such as residential, office, and technical spaces.

In summary:

-1, -2, -3 → room-to-room, impact, façade insulation
-4 → noise radiating from the building (building envelope = source)
-6 → room-internal sound absorption / RT calculation.

ISO 354

Acoustics — Measurement of sound absorption in a reverberation room

ISO 354, the fundamental laboratory standard specifying how to measure sound absorbers in a reverberation chamber.

In summary:

- In a large reverberation room,
  -first, the reverberation time (T_1) is measured when the room is empty,
  -then T_2 is measured with the test sample (e.g., acoustic panel, suspended ceiling, baffle, etc.) placed inside the room.
- Using Sabine-like formulas, the sample's frequency-based
  -equivalent sound absorption area A [m^2]
  -and the sound absorption coefficient α_s obtained by dividing this by the sample area are calculated.
- The environment operates under the assumption of random incidence; that is, it gives the average behaviour of the panel against sound coming from all angles.

Where do we use it?

In short, to determine the laboratory sound absorption performance of absorbent materials/products:

- Acoustic wall and ceiling panels
- Suspended ceiling systems
- Free-hanging baffle/raft systems
- To see the effect of other large surfaces/absorbent elements in the room, such as carpets, furniture, etc.
- As the first step in determining the α_s, α_p values in product catalogues and the sound absorption class (A, B, C...) according to ISO 11654.

In other words, ISO 354 is the answer to the question, 'How absorbent is this panel really?' provided through the laboratory and reverberation chamber.

ISO 3741 is the standard for determining the sound power level of noise sources in a reverberation chamber by measuring sound pressure.

In summary:

- It describes how to determine the sound power level Lw (and, if necessary, the sound energy level) of the noise produced by a machine/device in a reverberation test chamber.
- Lw is calculated in 1/3 octave bands; from this, the octave band, total, and A-weighted LwA can be derived.
- Both the direct method and the comparison method are defined.
- The frequency range is typically 100 Hz – 10 kHz; additional guidance is provided for extending to lower frequencies.
- According to ISO 12001, this is a precision grade 1 method.

Where do we use it?

In short, when we want to make an 'official' sound power declaration for a machine/product under laboratory conditions:

- To create Lw / LwA product data for fans, motors, HVAC indoor/outdoor units, pumps, white goods, office equipment, etc.
- To compare the noise emissions of different devices
- To obtain source Lw values to be entered into noise calculations/models (e.g. SoundPLAN, CadnaA)
- When the highest accuracy (precision) method is required, compared to other 374x series methods (3744, 3745, 3746, 3747, etc.)

Summary: ISO 3741 is a high-accuracy sound power measurement standard based on the principle of 'measure sound pressure in a reverberation chamber → calculate Lw'.

ISO 3741

Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure - Precision methods for reverberation test room

ISO 3743-2

Acoustics — Determination of sound power levels of noise sources using sound pressure — Engineering methods for small, movable sources in reverberant fields — Part 2: Methods for special reverberation test rooms

ISO 3743-2 describes the engineering method for determining the **sound power level of small and portable noise sources by measuring sound pressure in specially reverberant rooms.**

In summary:

- It provides a relatively simplified engineering method for determining the sound power level Lw / LwA of small, portable machines/devices (office equipment, small fans, household appliances, etc.).
- Measurements are carried out in 'special reverberation test rooms' as defined in the standard; design criteria for room geometry and acoustic properties are provided in the annexes.
- The defined methods are applicable for most continuous or random noise types within a specific frequency range; however, for impulsive noises consisting solely of isolated bursts, reference is made to ISO 3744 and ISO 3745.

Within the ISO 374x series:

- 3741: High precision method in a reverberation chamber
- 3743-1: Comparison method in a hard-walled test chamber
- 3743-2: Special reverberation chamber + engineering class method.

Where do we use it?

In short, when we want to make an official sound power declaration for small/portable devices in a laboratory environment:

- Office equipment, computers, printers, small fans and blowers
- Small household electrical appliances
- Small pumps, motors, HVAC indoor units, etc.
- When machine/device manufacturers need to provide the Lw / LwA value in their catalogues
- When generating the source Lw data to be used in noise modelling (SoundPLAN, CadnaA, etc.)

In other words, ISO 3743-2 is a practical 'sound power engineering method' that is not as complex as ISO 3741 but more controlled than ISO 3746/3747, making it very useful in your laboratory for small sources.

ISO 3744

Determination of sound power levels and sound energy levels of noise sources using sound pressure — Engineering methods for an essentially free field over a reflecting plane

ISO 3744 is an engineering method **that determines the sound power level (Lw, LwA) of noise sources by measuring sound pressure.**

In summary:

Sound pressure levels are measured around a machine/device, on a surrounding measurement surface (such as 6–12 points).

- The environment should be as close as possible to free field conditions over a reflecting plane; such as an open area over a hard surface or a semi-anechoic chamber.
- From these pressure values, the sound power level Lw (and, if necessary, the sound energy level) is calculated in frequency bands.
- Accuracy class: engineering grade (grade 2) according to ISO 12001.

The new (4th edition) version is currently in the process of being published and focuses solely on the term 'sound power levels,' but the principle remains the same: to determine sound power by integrating sound pressure.

Where is it used?

- For machine and equipment manufacturers: measurement of catalogue Lw / LwA values for devices such as fans, pumps, compressors, white goods, HVAC units, etc.
- Obtaining source sound power values to be entered into noise modelling software (SoundPLAN, CadnaA, etc.)
- Official test method for product noise declarations required by regulations (e.g. electrical household appliances, industrial machinery)
- Used alongside ISO 3741 (reverberation room, precision) and ISO 3745 (anechoic/semi-anechoic, precision) as a more practical engineering-class free-field method.

ISO 23351-1

Acoustics — Measurement of speech level reduction of furniture ensembles and enclosures - Part 1: laboratory method

ISO 23351-1 defines the measurement method for **'speech level reduction'** for office pods and acoustic furniture.

In summary:

In a laboratory environment, it measures how much products such as telephone booths, office pods, acoustic seating groups, and semi-enclosed workstations reduce speech within them to the outside environment.

The test consists of two sound power measurements (in a reverberation chamber according to ISO 3741):

1. With the room empty, Lw,1
2. The same source, with the product placed in the 'user' position and inside the product, Lw,2

The difference in octave bands D(f) = Lw,1 – Lw,2 is found; from this difference, the odd-numbered speech level reduction, DS,A [dB] is calculated. This value indicates how much the A-weighted sound power of standard speech is reduced.

Where is it used?

- **To make performance claims such as 'DS,A = ... dB, class A/B' in catalogues for office telephone booths, work/meeting pods, acoustic chairs and sofa groups.**
- To **compare and classify** such products used to enhance speech privacy in open-plan offices.
- Providing a complementary metric to the open-plan office room acoustics defined by ISO 3382-3 from the furniture-pod solution side.

In short: ISO 23351-1 is the standard that provides a standardised, single-number answer (DS,A) in laboratory conditions to the question, 'By how many dB does this telephone booth/office pod reduce speech outside?'

ISO 10847

Acoustics — In-situ determination of insertion loss of outdoor noise barriers of all types

This standard describes how to measure the insertion loss performance of any type of external noise barrier (road/railway barrier, industrial curtain, etc.) in situ.

In short:

- From measurements taken with and without the barrier,
- you obtain the IL(f) – insertion loss [dB] spectrum by calculating the sound level difference at the receiver point(s).
- There are no restrictions on barrier type: earth embankments, panel barriers, transparent barriers, hybrid systems, etc. are all included.
- Sources that can be used:

    -Artificial sources (speaker, array of speakers, sometimes pyrotechnic/special impulse sources),

    -Real sources such as traffic under appropriate conditions (conditions defined in the relevant sections of the standard).

Additionally:

- Microphone positions,
- Meteorological conditions (wind, temperature gradient),
- Control of background noise, and
- Evaluation of measurement uncertainty are defined in detail.

Where is it used?

In summary, for the answer to the question, 'How many dB does this noise barrier actually work in the field?'

- On-site performance verification of road/rail noise barriers:

Project/specification: 'The barrier shall provide IL ≥ X dB' → acceptance measurement.

- To evaluate the effectiveness of noise curtains installed in areas such as industrial facilities, ports, terminals, etc.
- For an existing barrier:

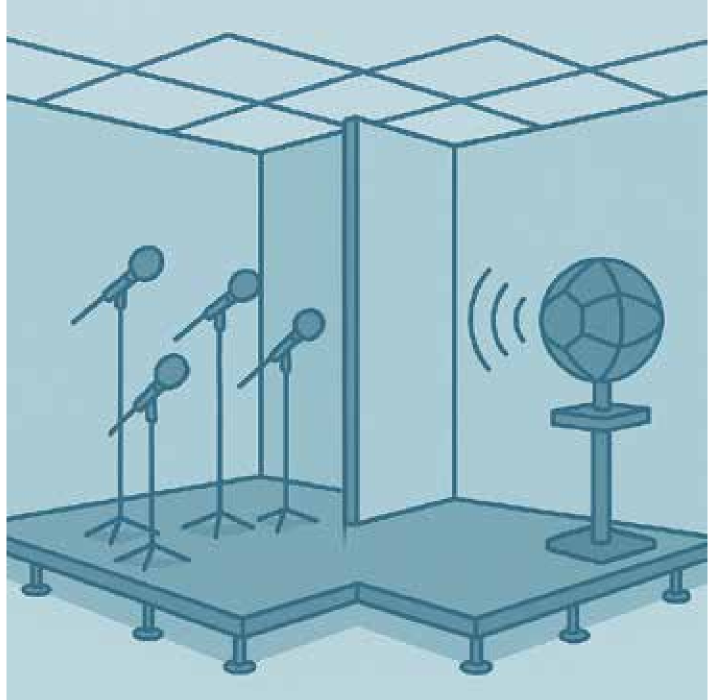
To examine performance loss over time (degradation, holes, reflective surrounding structures),

To make before-and-after comparisons for reinforcement or upgrading.

Calibrate/validate barrier models used in simulation software (SoundPLAN, CadnaA, etc.) with field data.

ISO 10848-2

Acoustics — Laboratory and field measurement of flanking transmission for airborne, impact and building service equipment sound between adjoining rooms - Part 2: Application to Type B elements when the junction has a small influence



ISO 10848-2 is the standard that explains how to measure flanking (indirect) **sound transmission between adjacent rooms for 'Type B' building elements.**

In summary:

- The ISO 10848 series generally defines measurement methods used to characterise flanking transmission through one or more building elements.
- 10848-2 specifically applies to Type B elements defined in ISO 10848-1:
  - **Suspended ceilings**
  - **Raised access floors**
  - **Lightweight continuous façade systems**
  - **Floating floors etc.**
- This applies to situations where the junction effect with the partition element is small in these Type B elements; that is, performance is primarily determined by the behaviour of the flanking element and, if present, the plenum.
- In practice, the standard describes how flanking quantities such as Dn,f, Ln,f and L_{ne0,f} are measured and reported in a laboratory setting.
- These obtained quantities are designed to:
  - **compare products with each other,**
  - **write performance requirements into specifications,**
  - **or serve as input data for estimation methods such as ISO 12354-1 and** 12354-2.

Note: Although the title mentions 'laboratory and field,' the scope section of the 2017 edition states that this section only addresses laboratory measurements.

Where do we use it?

In short, when we want to see numerically how much sound is transmitted through flanking in elements such as suspended ceilings, raised floors, lightweight facades, etc.

- Room-to-room airborne flanking transmission in lightweight facade buildings
- Sound travelling through the ceiling plenum in suspended ceiling offices
- Transmission of impact or installation noise to adjacent spaces through floating/raised floors

Building acoustics calculations requiring input data for laboratory product tests and these elements

ISO 10848-3

Acoustics — Laboratory and field measurement of flanking transmission for airborne, impact and building service equipment sound between adjoining rooms — Part 3: Application to Type B elements when the junction has a substantial influence

Flanking transmission measurement in Type B elements (suspended ceilings, raised floors, lightweight facades, etc.).

In summary, the scope of the standard:

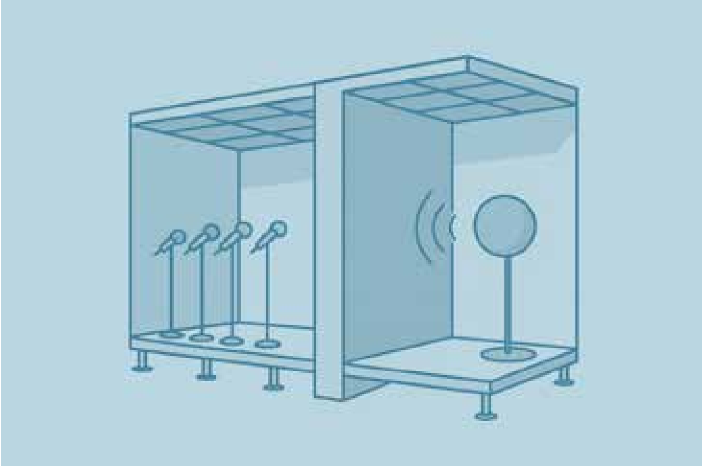
- **The ISO 10848 series** generally defines measurement methods used to characterise flanking (indirect) sound transmission between adjacent rooms.
- **10848-3** applies to Type B elements defined in ISO 10848-1 (suspended ceilings, raised floors, lightweight façade systems, etc.), but focuses on situations where the joint detail of these elements (wall-ceiling/floor connection, etc.) has a significant effect on flanking.
- Both **laboratory and field** measurements are described:
- **Laboratory:** Suppressing the test chamber's own flanking paths as much as possible and measuring the performance of the element + junction combination.
- **Field:** Observing the behaviour of a specific junction detail in situ in an existing building; since it is generally not possible to completely suppress other flanking paths here, the result is considered representative for that junction in that building.

As output, for the element + junction combination:

- **Dn,f,ij** – flanking airborne sound level difference
- **Ln,f,ij** – flanking impact sound level
- **L_{ne0,f,ij}** – technical installations (building services) flanking level or junction-specific normalised direction-averaged velocity level difference **D_{V},ij,n.**

These are used to:

- Compare different product/junction solutions,
- Express performance requirements for the project,
- And, in particular, to provide input for estimation methods such as ISO 12354-1 & 12354-2.



Where do you use it?

In short, in Type B systems, which are 'junction details that really make their mark on flanking':

- To measure the effect of room-to-room airborne flanking on suspended ceiling + partition wall junction details
- To see the junction effect on the transmission of impact and installation noise to adjacent spaces in systems such as raised flooring and floating flooring
- To numerically verify flanking control of façade–flooring–partition junctions in lightweight façade office/hotel buildings
- To produce product performance data for Type B products (e.g. different suspended ceiling systems + edge details) in the laboratory and prepare input for calculations

IEC 60268-16 defines the STI method used to objectively score speech intelligibility.

In summary:

- It describes the STI (Speech Transmission Index) model, test signals, and measurement/estimation methods. It expresses how much a transmission channel (room + sound system + noise, etc.) distorts speech using a single-digit indicator between 0 and 1; 0 means 'very poor' intelligibility, while 1 means 'perfect' intelligibility.
- STI is calculated by examining how much the amplitude modulations of the speech signal are distorted as they pass through the channel (direct measurement of modulated noise or derivation from the impulse response).
- Abbreviated versions such as STIPA, RASTI, STITEL, defined in previous editions, are part of the historical context of this standard.

The IEC also defines quality bands for STI; for example, approximately:

0–0.3 poor, 0.3–0.45 weak, 0.45–0.6 fair, 0.6–0.75 good, 0.75–1 very good/intelligible.

Where do we use it?

In short, wherever the question 'How intelligible is speech in this environment/sound system?' arises:

- Public address and emergency announcement (voice alarm) systems
- Conference halls, amphitheatres, classrooms, meeting rooms
- Speaker systems in large public spaces such as stations, terminals, airports, stadiums, shopping centres
- Walkie-talkies, intercoms, telephones, communication lines
- Design verification and acceptance measurements in room acoustics and sound system projects

The 2020 edition of the standard provides detailed information on the STI model, test signals, verification of measurement devices, and guidance on making application-oriented interpretations from measurement results.

IEC 60268-16

Sound system equipment - Part 16: Objective rating of speech intelligibility by speech transmission index

ISO 7240-19

Fire detection and alarm systems — Part 19: Design, installation, commissioning and service of sound systems for emergency purposes

ISO 7240-19 defines the design, installation, commissioning and servicing principles for sound systems for emergency purposes (SSEP).

- Scope: Emergency announcement/emergency public address systems used as part of a fire detection and alarm system (or in conjunction with other emergency detection systems).
- Purpose: To provide information and guidance for life safety in specific indoor or outdoor areas during an emergency;
- To produce emergency speech announcements via loudspeakers,
- warning signals in accordance with ISO 7731,
- evacuation signals in accordance with ISO 8201.
- The SSEP should be designed to initiate the rapid and orderly evacuation of people and should be part of a comprehensive emergency management structure, together with operating procedures and training programmes.
- It can also be used for normal (everyday) public address; however, emergency zoning may differ from normal usage zoning.
- It does not cover bell or siren-based systems; it refers to systems that transmit sound via loudspeakers.

The standard provides detailed criteria for:

- Design objectives (coverage area, sound level, intelligibility, etc.)
- Emergency announcement zoning by building area
- Equipment selection (control units, power amplifiers, loudspeakers, line monitoring, etc.)
- Redundancy, fault monitoring and line supervision
- Installation details, cabling, fire resistance
- Commissioning tests and periodic maintenance/service requirements

Where do you use it?

- Emergency announcement systems in complex buildings such as shopping centres, airports, hospitals, hotels, high-rise buildings
- Voice evacuation system required in projects (e.g. fire scenarios requiring voice alarm)
- Along with the fire detection standard ISO 7240-14, to form the backbone of the entire fire detection + emergency voice system design.

ASTM C423, the fundamental American standard used for **'sound absorption measurement in a reverberation chamber';** it is the ASTM version of ISO 354.

In summary:

- In a large reverberation chamber:
  - 1_The reverberation time (T_1) is measured when the chamber is empty.
  - 2_In the same room, with the test specimen (panel, ceiling, baffle, carpet, etc.) present, (T_2 is measured.
- Using Sabine/NR formulas, in frequency bands:
  - Equivalent sound absorption area (A) [m^2]
  - Normalised by area, the sound absorption coefficient (\alpha) and
  - Sometimes single-number indicators such as NRC, SAA are calculated.
- Sample placement (on the floor, wall, ceiling; flat, inclined, spaced mounting), room size, source/microphone placement, noise and uncertainty calculations are described in detail.

In short: The method that answers the question, 'How much sound does this acoustic material absorb on average in a reverberation chamber?' according to ASTM.

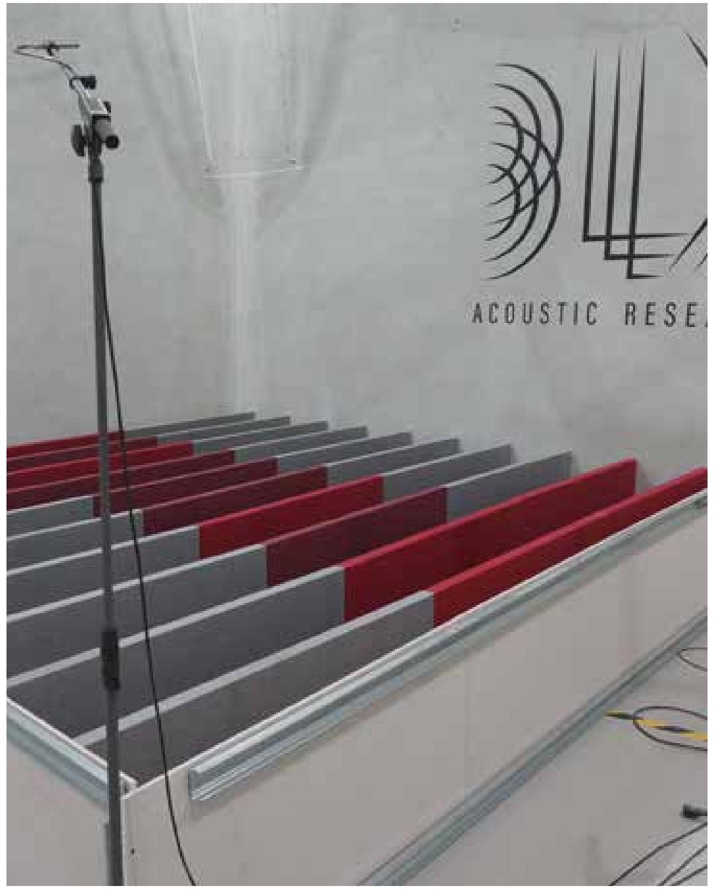
Where is it used?

- **Acoustic wall and ceiling panels**
- **Suspended ceiling systems**
- **Freely suspended baffles/bulkheads**
- For **carpeted floors**, perforated panels, decorative absorbers, etc.:
  - To obtain the **(\alpha), NRC, SAA** values to be given in the catalogue,
  - To compare different products,
  - To provide input for room acoustics calculations and simulations (ODEON, EASE, etc.).

It is technically very similar to ISO 354; the difference lies more in the details and reporting format. ISO 354 is generally referenced in European projects, while ASTM C423 is referenced in the US-focused market.

ASTM C423

Standard test method for sound absorption ans absorption coefficients by the reverberation room method



ISO 3747:2010

Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Engineering/survey methods for use in situ in a reverberant environment

ISO 3747:2010 defines the engineering/survey method used to determine the sound power/sound energy levels of noise sources operating in a reverberant environment under actual installation conditions (in situ) by measuring sound pressure.
Instead of requiring a controlled free field or special test chamber, as in the classic ISO 3744/3746, it allows measurement to be carried out in the existing reverberant environment (e.g. a workshop, machine room, factory area). The Lw, LwA values of the tested machine are calculated by comparison with a reference source of known sound power in the same environment. It is particularly used for on-site sound power declaration of machines in facilities without special acoustic test rooms.

ISO 16032:2004

Acoustics — Measurement of sound pressure level from service equipment in buildings — Engineering method

ISO 16032:2004 describes the engineering method used to measure the sound pressure level L[dB] generated in rooms by service equipment such as HVAC, pumps, lifts, and plumbing pipes in buildings.
The equipment is operated under normal working conditions, measurements are taken at specified points in the relevant rooms, and thus whether the indoor installation noise meets the comfort/specification limits is checked using a standardised method.

ISO/IEC 60704-1 is the general test code that describes how to measure the airborne noise of household and similar electrical appliances.

In summary:

- **Scope:** Mains- or battery-powered household and similar electrical appliances (including accessories and components). The term 'similar' includes use in residential-like conditions, such as in hotels, hairdressing salons, laundries, and cafés.
- Purpose: To provide a common measurement method for determining the airborne sound power level (Lw) and, if necessary, the sound pressure level of these appliances in an engineering accuracy class.
- Defines:

Measurement environment (semi-anechoic, anechoic, etc.), climatic conditions, background noise limits

Measurement bands to be used (typically 125 Hz–8 kHz octave or 1/3 octave bands)

Operating conditions of the device, loading conditions

Reporting of results and correlation with declared values (also refers to 60704-3 for declaration control).

This Section 1 provides the 'umbrella' general rules for all product-specific 60704-2-xx sections in the series (there is a separate -2 part for each product type: dishwasher, washing machine, vacuum cleaner, etc.).

Where is it used?

- For white goods, small domestic appliances, fans, cooker hoods, hair dryers, etc.:

When setting up laboratory noise test rigs,

To measure the LwA / dB(A) values provided in product catalogues.

- For noise labelling and market/regulatory compliance requirements (e.g., EU energy/noise labels).
- As a fundamental reference method for comparing the acoustic performance of different brands/models of household appliances.

ISO/IEC 60704-1

Household And Similar Electrical Appliances - Test Code For The Determination Of Airborne Acoustical Noise - Part 1: General Requirements

ISO/IEC 60704-2-1

Household and similar electrical appliances - Test code for the determination of airborne acoustical noise - Part 2-1: Particular requirements for vacuum cleaners

ISO/IEC 60704-2-1 is the section that customises the general rules of 60704-1 for electric vacuum cleaners.

In summary:

- Scope:

Mains-powered and **cordless dry-type vacuum cleaners**

Vacuum cleaners used in residential or similar conditions (home, hotel room, office type, etc.)

Industrial/professional vacuum cleaners are excluded.

- What does it define?

Provides specific conditions for measuring the airborne sound power level (Lw, LwA) and, if necessary, the sound pressure level of an electric vacuum cleaner.

Amends/adds/details the general provisions in 60704-1:

- Equipping and conditioning the device prior to testing (bag/fullness, filter condition, etc.)
- Standard Wilton test carpet / rules regarding the test carpet and its ageing
- Measurement method on carpet and on hard floor (hard floor method added in the latest edition).
- Key changes in the 2020 edition:

Extension of product scope to include cordless and similar vacuum cleaners

Addition of definitions such as 'cleaning head' and 'active nozzle'

Updating the test carpet description and referencing IEC/TS 62885-1

Defining measurement uncertainty and standard deviation values for declaration/verification

This section is always used in conjunction with 60704-1; the relevant clauses in Part 1 are either directly applicable or revised here with 'modification/addition/replacement'.

Where/how do you use it?

- In white goods and small household appliance manufacturers:

When measuring LwA [dB(A)] catalogue values for electric vacuum cleaners

When creating input for the declaration value and verification procedure (in conjunction with 60704-3) for EU noise labels or declarations

When comparing the noise performance of different motors, fans, acoustic insulation, or body designs in R&D

When wanting to perform a comparative test of different brand/model vacuum cleaners according to a standard method

ISO/IEC 60704-2-9

Household and similar electrical appliances – Test code for the determination of airborne acoustical noise – Part 2-9: Particular requirements for electric hair care appliances."

Scope: Mains-powered hand-held hair dryers and fan-assisted hair styling appliances; excluding hood dryers and radiant heating appliances.
What does it do? It supplements the general noise measurement rules in 60704-1 with specific operating conditions, test arrangements and reporting rules for these devices; thus, the airborne sound power level LwA values of different hair dryers/hair styling devices are measured in a comparable manner.

ISO/IEC 60704-2-10

Household and similar electrical appliances – Test code for the determination of airborne acoustical noise – Part 2-10: Particular requirements for ranges, ovens, steam ovens, grills and microwave ovens

Scope: Electric cookers, ovens, steam ovens, grills and microwave ovens for domestic and similar use (excluding gas parts and hob surfaces/hobs).
What does it do? It supplements the general noise measurement rules in 60704-1 with specific operating conditions, settings and test arrangements for these appliances; thus, the airborne sound power level LwA values of these products are measured using the same method, in a comparable manner.

ISO/IEC 60704-2-10

Household and similar electrical appliances – Test code for the determination of airborne acoustical noise – Part 2-14: Particular requirements for refrigerators, frozen-food storage cabinets and food freezers

Scope: Domestic refrigerators, deep freezers and frozen food storage cabinets (including accessories) powered by mains or battery.
What does it do? It supplements the general noise measurement rules of 60704-1 with specific operating conditions, test arrangements and reporting requirements for these appliances; it ensures that airborne sound power level LwA results measured in different laboratories are comparable.

ISO 3746

Determination of sound power levels and sound energy levels of noise sources using sound pressure — Survey method using an enveloping measurement surface over a reflecting plane

ISO 3746 is the 'survey' class free-field method used to determine the sound power level of noise sources using sound pressure.

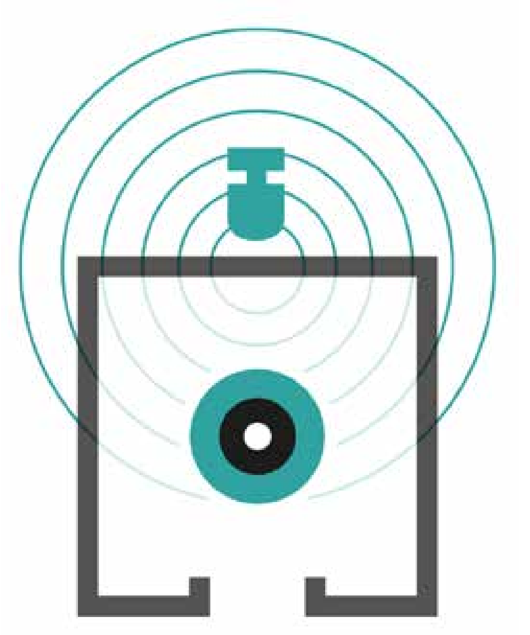
To elaborate:

- Its full name, in summary: **'Noise sources using sound pressure — Survey method using an enveloping measurement surface over a reflecting plane.'**
- An **enveloping measurement surface** (rectangular/cubic, cylindrical, etc.) is defined around a machine/device; the sound pressure level is measured at points on this surface.
- The environment should approximate a free field over a reflecting plane; that is, conditions similar to an open area or a semi-anechoic chamber.
- From these pressure values, the **sound power levels Lw, LwA** are calculated in frequency bands.
- As the accuracy class is survey (approximate / grade 3), it is more practical but has slightly higher uncertainty compared to the ISO 3744 (engineering) and ISO 3745 (precision) methods.

Summary: ISO 3746 is used when it is necessary to define a measurement surface around the machine and determine the sound power 'on-site but approximately' without setting up a special acoustic test chamber.

ISO 717-2

Acoustics — Rating of sound insulation in buildings and of building elements — Part 2: Impact sound insulation



ISO 717-2 is the standard that provides a single-number classification value (Ln,w, etc.) for impact sound; that is, it answers the question, 'How do you convert the measured impact sound spectrum into a performance class in dB?'

What does it do?

- **It uses impact sound data measured by other standards as input:**

Laboratory: ISO 10140-3 (L'n / L'n0 spectra)

Field: ISO 16283-2 (L'n,T or similar quantities)

- **It compares these frequency spectra with the reference curve provided in the standard and:**

Calculates the single-number value Ln,w (or L'n,w, L'nT,w, etc.),

Calculates additional values such as the spectral adaptation term CI,50-2500 if necessary.

In short: it converts frequency-based measurement results into the odd-numbered impact sound class mentioned in projects and regulations.

Where is it used?

- **To express inter-floor impact sound performance in buildings such as residential, hotel, dormitory, hospital, etc. (e.g., 'the flooring system will have Ln,w ≤ 58 dB').**
- **To make laboratory and field measurements suitable for comparing different flooring/carpet/floating screed systems.**

To define and control impact sound insulation classes in regulations and specifications.

Summary: ISO 16283-2 and ISO 10140-3 define 'how we measure',

while ISO 717-2 defines 'how we derive the single-number impact sound class from this measurement'.

ISO 10534-2

Acoustics — Determination of sound absorption coefficient and impedance in impedance tubes — Part 2: Transfer-function method

ISO 10534-2 describes the **determination of sound absorption coefficient and acoustic impedance using the transfer function method in an impedance tube.**

In short:

- Full name: "Acoustics — Determination of sound absorption coefficient and impedance in impedance tubes — Part 2: Transfer-function method."
- It is the straight tube (impedance tube / Kundt tube) method used for small samples (panels, foam, perforated panels, etc.).
- Inside the tube, the sound field is measured using two microphones placed in front of the sample; the complex transfer function is calculated from the signals at these two points.
- From this:
    - Reflection coefficient,
    - Normal incidence sound absorption coefficient α,
    - Surface impedance / acoustic impedance are derived.

Where is it used?

- Acoustic material development in R&D: thin panels, perforated plate + backing, fibrous/porous material, thin coatings, etc.
- For quick comparisons without needing to go to an ISO 354 / ASTM C423 reverberation chamber, as it requires a small sample.
- When manufacturers wish to publish the normal incidence α(f) curve and impedance data in their catalogues.
- To calibrate numerical modelling (FEM/BEM) or analytical models with measurements.

In summary: ISO 10534-2 is the standard answer to the question, 'How do we measure the flat sound absorption coefficient and impedance of a material using the two-microphone transfer function method in an impedance tube?'

ISO 717-1 is the standard that provides a single-number classification value for airborne sound insulation; that is, it answers the question, 'How do you convert the measured spectrum into a single number, such as Rw/DnT,w?'

What does it do?

It uses airborne sound insulation data measured by other standards as input, for example:

Laboratory measurements → ISO 10140-2 (R(f) spectrum)

Field measurements →ISO 16283-1 (R´(f), DnT(f) etc. spectra)

It compares these spectra with the reference curve given in ISO 717-1 and calculates:

Rw – laboratory airborne sound insulation class

Odd-numbered values of field quantities such as R´w, DnT,w, DnT,w + C, + Ctr

Spectral adaptation terms C and Ctr (for traffic, music, and general noise scenarios)

calculates.

In short: it takes the frequency-based measurement and converts it into the universally understood "Rw = … dB" format.

Where is it used?

- In residential, hotel, office, etc. buildings:

To define and control specification values such as 'Rw ≥ X dB', 'DnT,w ≥ Y dB' for inter-apartment walls/ceilings, hotel room dividers, office dividers.

- For doors, windows, facades, wall systems:

To provide Rw, Rw + C, Rw + Ctr in catalogues and technical documents.

- To define airborne sound insulation classes in national regulations and classification systems (residential classes, office classes, etc.).

Summary: While ISO 10140-2 / ISO 16283-1 addresses 'how do we measure?',

ISO 717-1 defines 'which single-number rating do we obtain from this measurement (Rw, DnT,w, C, Ctr)?'

ISO 717-1

Acoustics — Rating of sound insulation in buildings and of building elements — Part 1: Airborne sound insulation

ISO 11957 is a standard used to determine the sound insulation performance of cabins; it describes both laboratory conditions and in-situ measurement methods. Within this scope, the extent to which volumes such as machine operator cabins, control cabins, crane cabins, ship/construction machinery cabins block external noise from entering (and, if necessary, from inside to outside) is measured; the cabin's airborne sound insulation class is determined using level differences based on frequency and derived single-number quantities. This makes it possible to compare different cabin designs, write criteria such as 'the cabin shall provide at least … dB sound insulation' into the specification, and perform acceptance measurements.

ISO 20189 is a standard that rates the sound absorption and sound reduction performance of panels, partitions, acoustic furniture and individual objects used indoors, based on laboratory measurements.

This standard takes measurement results obtained using methods such as ISO 354, ISO 10140, and ISO 23351-1 for items such as an office partition, acoustic booth, free-standing panel, or furniture, and derives single-number indices and performance classes from them. Thus, the effectiveness of the product in terms of both sound absorption and sound reduction/separation is expressed in clear and comparable numbers.

Consequently, ISO 20189 enables architects and acousticians to objectively compare different interior acoustic elements in the same language based on questions such as 'which product calms the environment more, which one better cuts speech propagation?' and allows for the definition of minimum acoustic performance criteria for such elements in specifications.

ISO 11957

Acoustics — Determination of sound insulation performance of cabins — Laboratory and in situ measurements

ISO 20189

Acoustics — Screens, furniture and single objects intended for interior use — Rating of sound absorption and sound reduction of elements based on laboratory measurements

ISO 23591

Acoustic quality criteria for music rehearsal rooms and spaces

ISO 23591 is a comprehensive design and assessment standard that defines the room acoustic quality for music rehearsal rooms and spaces.

- Scope:
- Applicable to music rehearsal spaces of all sizes, from individual practice rooms to small ensemble rooms and choir/orchestra rehearsal halls.
- These spaces may be part of an independent music school, a school's sports hall or multi-purpose hall; there are no restrictions on building type.

The basic idea: 'For which type of music, what should the parameters such as volume, reverberation time, sound power level, sound intensity (G) of the room be in which ranges so thatthe musician feels comfortable,the ensemble balance is good,and the sound is neither muffled nor dry?'The standard's criteria are differentiated for three main music types:Amplified music – electric guitar, drum set, PA system, etc.Quiet acoustic music – chamber music, solo instruments, small acoustic ensemblesLoud acoustic music – large choirs, bands, large orchestras, and other high-volume acoustic ensembles

For each type:

- Target RT ranges,
- Recommended bands for net volume/net area/net height,
- Guidelines based on expected sound pressure levels for sound intensity (G) and forte are provided.

How is it used?

- New building design: When starting a project, the target RT, volume, G, etc. are selected from the standard tables according to the room type (individual room, small ensemble, choir/orchestra hall) and the type of music to be performed; the volume, surface materials, and variable acoustic solutions are designed accordingly.
- Improvement of existing spaces: In spaces not originally designed for music, such as sports halls, classrooms, and multipurpose halls; the measured RT and G values are compared with the targets in the standard to answer the question 'Is this room suitable/unsuitable for what type of music?' and, if necessary, measures such as panels, curtains, diffusers, and volume adjustments are planned.
- Who benefits?

Acousticians and architects (as a design criterion),

Municipalities, public institutions, school/dormitory/conservatory investors,

Music associations and user groups (to convert their own requests into numerical targets).

What does it not cover?

- Large, specialised concert halls, opera houses, and professional recording studios are excluded from the scope of this standard; separate, more detailed design guidelines and standards are envisaged for these.
- Sound insulation (R, DnT, etc.) criteria are not included in this document; it focuses on the room's internal acoustics and geometric/functional conditions.

In short: ISO 23591 provides a highly practical framework for design and evaluation, systematically addressing the question: "Is this rehearsal room suitable for this type of music in terms of volume, RT, and acoustic quality? If not, what should we aim for?"

ISO 11546-1

Acoustics — Determination of sound insulation performances of enclosures — Part 1: Measurements under laboratory conditions (for declaration purposes)

ISO 11546-2

Acoustics — Determination of sound insulation performances of enclosures — Part 2: Measurements in situ (for acceptance and verification purposes)

ISO 11546-1 and ISO 11546-2 are actually two sides of the same coin:

They explain how to measure the sound insulation performance of enclosures/cabinets; one in the laboratory, the other in the field.

Common topic: What are we measuring?

Both standards apply to 'enclosures/cabinets/covers':

- Sound insulation enclosures placed around machinery and equipment
- Small machine rooms, clad enclosures
- The aim: to quantify how much it reduces noise emitted to the outside (typically in terms of level reduction, additional loss, etc., in dB).

ISO 11546-1 — Laboratory measurements (for declaration)

Full focus:

Measurement under controlled laboratory conditions for 'Declarations' / catalogue value.

- The enclosure is tested in a laboratory environment (echo chamber, free field, etc.) in accordance with the standard.
- By comparing the reference condition (without the enclosure) and the condition with the enclosure:

Sound level reduction,

Magnitudes such as additional loss / sound reduction based on frequency are obtained.

- Results; for the manufacturer:

To state in the catalogue that 'the enclosure provides this much dB reduction',

To compare different enclosure types.

In short: A controlled and repeatable laboratory method designed for product development and official performance declaration.

ISO 11546-2 — In-situ measurements (for acceptance and verification)

Full focus:

To check how well the cabinet installed in the actual facility performs under real noise conditions in the field.

- Measurements are taken while the cabinet is installed on site on the machine/facility.
- Again, by comparing with/without the enclosure (or with/without the cover open/closed):

The effective level reduction in the field is determined.

Objective:

- To verify with an acceptance measurement the statement written in the specification that 'the enclosure shall provide at least ... dB reduction',
- To see how much of the performance declared in the laboratory is achieved in the actual installation.
- In short: ISO 11546-2 is used for acceptance and verification at the facility,

while ISO 11546-1 is used for product declaration in the laboratory; when considered together, they cover the entire chain from enclosure design to on-site performance control.

ISO 22955

Acoustics — Acoustic quality of open office spaces

ISO 22955 is a guideline standard that defines the acoustic quality of open-plan offices and provides target values for design.

The purpose of this standard is to relate issues such as noise disturbance, speech privacy and distraction in open-plan offices to measurable acoustic performance metrics. It recommends target ranges for indicators such as background noise, speech propagation, and sound level differences between desks for different types of open-plan office use (e.g., telephone-intensive work, intensive collaboration, mixed use, etc.).

It addresses open-plan office acoustic parameters defined by ISO 3382-3, such as D▯,S, Lp,A,S,4m, rD, and solutions such as surface finishes, furniture placement, acoustic panels/screens, and sound masking; it provides technical guidance for use in both new office design and the improvement of existing open-plan offices.

ISO 9613-1

Acoustics — Attenuation of sound during propagation outdoors — Part 1: Calculation of the absorption of sound by the atmosphere

ISO 9613-2

Acoustics — Attenuation of sound during propagation outdoors — Part 2: General method of calculation

ISO 9613-1 defines the standard formulas used to calculate the attenuation of sound by the atmosphere during propagation outdoors.

Full title:

"Acoustics — Attenuation of sound during propagation outdoors — Part 1: Calculation of the absorption of sound by the atmosphere."

In summary:

- It describes how to calculate the atmospheric absorption coefficient (α) in dB/km, depending on the given frequency, air temperature, relative humidity, and atmospheric pressure.
- These α values are then entered into outdoor sound propagation models used in standards such as ISO 9613-2; thus, when calculating the sound level at a distant receiver, we correctly account for the effect of 'attenuation in air'.
- Application areas: This is the standard atmospheric absorption calculation used in modelling external sources such as traffic noise, industrial facility noise, wind turbines, concert/event noise using software such as SoundPLAN and CadnaA.

ISO 9613-2 is the standard outdoor propagation model used to calculate all attenuation experienced by sound as it propagates from a source to a receiver in an outdoor environment.

This standard is used to calculate the sound pressure level L_p at a certain distance from open-field noise sources such as roads, industry, wind turbines, and entertainment facilities. The calculation includes:

- Geometric propagation (attenuation due to distance)
- Atmospheric attenuation (according to ISO 9613-1, dependent on temperature and humidity)
- Ground effect (hard/soft ground, source and receiver heights)
- Obstacle/barrier attenuation (earth embankment, wall, building, etc.) are taken into account together.

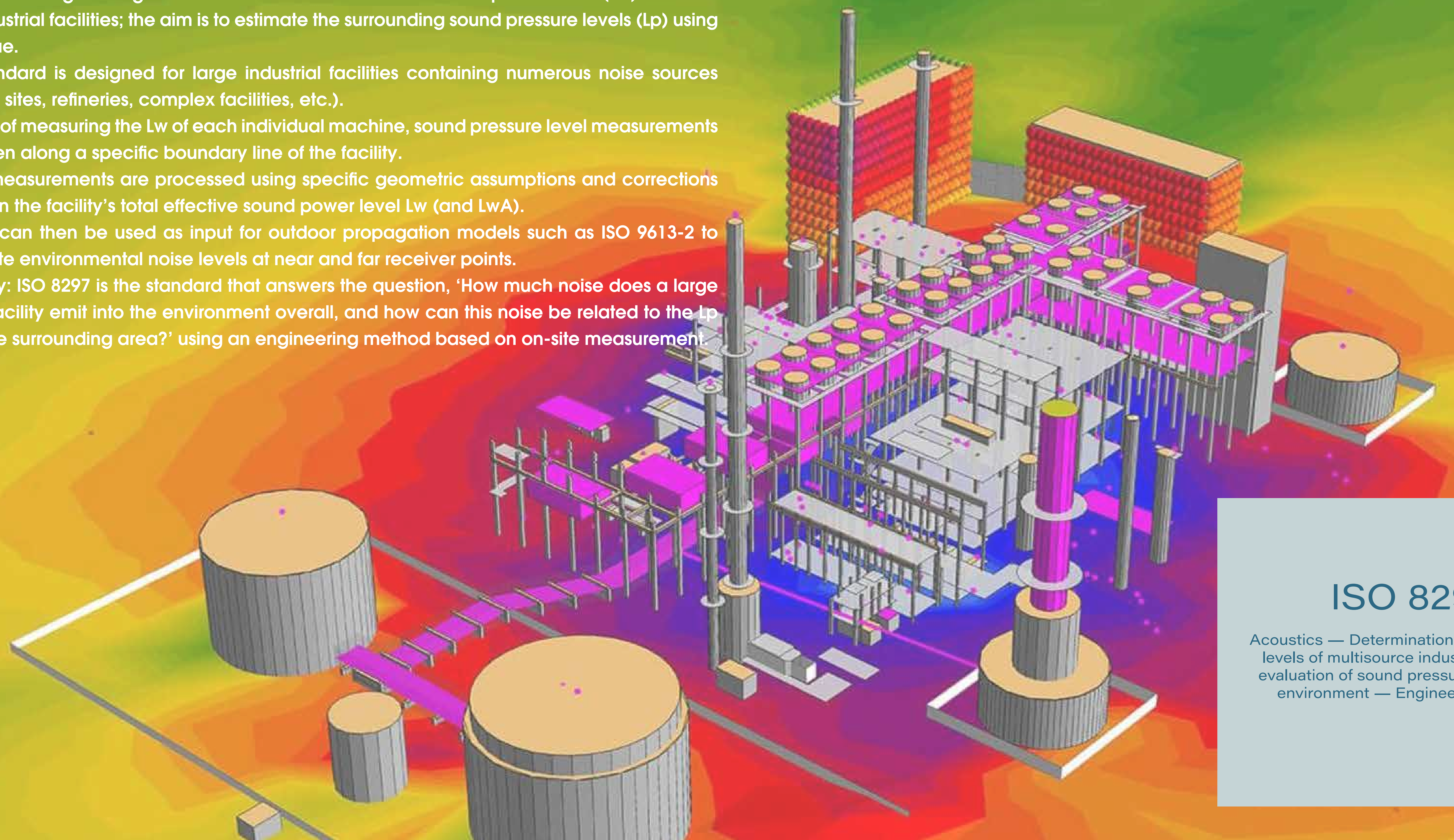
The model is often defined to represent **'favourable propagation conditions'** from the receiver's perspective (e.g., downwind, slight reverse temperature gradient), so it is often considered the 'worst-case scenario' in environmental noise studies.

Consequently, ISO 9613-2 is the fundamental reference method used in software such as SoundPLAN, CadnaA, etc., as the core calculation method for environmental noise calculations and noise maps, for comparing distance, barrier, elevation difference, and settlement scenarios.

ISO 8297 is an engineering method used to determine the sound power level (Lw) of multi-source industrial facilities; the aim is to estimate the surrounding sound pressure levels (Lp) using this Lw value.

- The standard is designed for large industrial facilities containing numerous noise sources (factory sites, refineries, complex facilities, etc.).
- Instead of measuring the Lw of each individual machine, sound pressure level measurements are taken along a specific boundary line of the facility.
- These measurements are processed using specific geometric assumptions and corrections to obtain the facility's total effective sound power level Lw (and LwA).
- This Lw can then be used as input for outdoor propagation models such as ISO 9613-2 to calculate environmental noise levels at near and far receiver points.

In summary: ISO 8297 is the standard that answers the question, 'How much noise does a large industrial facility emit into the environment overall, and how can this noise be related to the Lp levels in the surrounding area?' using an engineering method based on on-site measurement.



ISO 8297

Acoustics — Determination of sound power levels of multisource industrial plants for evaluation of sound pressure levels in the environment — Engineering method

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