

SOUND ABSORBING

To sum up all the arguments, what makes ONDULINE® sheets sound absorbing?

- Bitumen is a viscoelastic material, which means that it has the capacity to absorb sound by transforming vibration into heat.

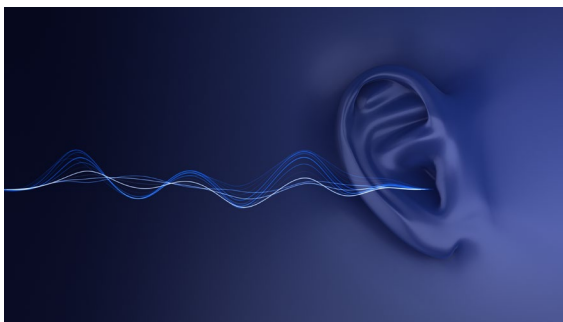
- Quantity of bitumen and homogeneous impregnation ensuring a more effective absorption of the vibrations and noise absorption: ONDULINE® CLASSIC sheets contribute to a **4 times quieter** atmosphere inside homes than metal sheets (difference of 23 dB in favour of ONDULINE®) - ISO 140-18:2006.

Noise generation is an environmental problem that affects human beings and animals. The noise generation may be mitigated by using ONDULINE® bitumen sheets. In order to understand how ONDULINE® sheets can contribute to absorb external sounds, first we need to describe sound.

What is a sound?

In physics, a sound is a form of energy that travels through matter in the form of waves. It is a mechanical wave that consists of variations in pressure, density, and particle displacement within a medium, typically air, water, ... Sound can travel through all medium, except a vacuum, (in which there are no molecules). That's why as the old tagline says "In space, no one can hear you scream!".

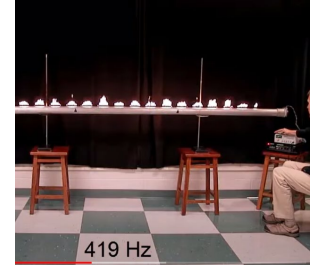
In short, sound is nothing more than the compression and expansion (rarefaction) of a medium (material) molecules causing acoustic waves (Moreau René, "The emission, propagation and perception of sound", 2019).



Imagine guitar strings excited by the musician's fingers, huge drops of rain or big gusts of wind on an ONDULINE® sheet! This would result in vibrations that cause particles to move back and forth, creating a chain reaction of neighbouring particles. The vibrating source transfer its energy to the medium and the energy travel through the medium in the shape of waves from one point to another, so, the wave also can be thought as a travelling energy (Abokhalil Ahmed, "On the nature of sound", 2020). When nylon is used for guitar strings, we use bitumen for our roofing sheets.

→ Ruben's Flame Tube Experience is a classic physics experiment that demonstrates in a fun and impressive way many characteristics of sound waves.

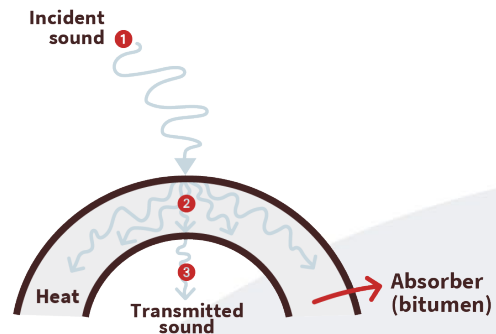
"In our environment, everything is constantly moving and therefore emitting sounds"



René Moreau

How to explain the capacity of ONDULINE® sheets to absorb sound?

Best known for its waterproofing capabilities, Bitumen has also proven to be particularly effective for sound absorption, as Bitumen is a viscoelastic material, which means that it has the capacity to absorb sound by transforming vibration into heat.



- 1 Incident sound
- 2 Vibration converted into heat (internal friction)
- 3 Sound energy is dissipated

Bitumen reduces the transmission of vibrations caused by external sources. That's why bitumen is also used as a heavy mass around car engines and in washing machines, among other, as a soundproof material.

To sum up the advantages of using bitumen for sound absorption:

- **A unique combination of properties:** bitumen exhibits viscoelastic behaviour due to its ability to combine both viscous (dissipative) and elastic (restorative) properties when subjected to mechanical stress. This characteristic enables bitumen to absorb and dissipate mechanical energy, including vibrations, which contributes to its damping capacity (Marco Amabili, *Viscoelasticity and damping*, Cambridge University Press, 2018, Bhatia, S., « Damping properties of bitumen and polymer modified bitumen ». *Procedia Engineering*, p361-369, 2018).



Watertight



Wind Resistant



Sound absorbing



Lightweight



Fast to install



Easy to install



Aesthetic



Eco-responsible



MORE FAQ ABOUT SOUND ABSORBING

- **Damping of vibrations:** viscoelastic materials are excellent at damping vibrations and converting mechanical energy into heat. When sound waves propagate through these materials, the vibrations are quickly dissipated, reducing the amplitude of the waves and preventing them from reflecting back into the environment (To learn more, read Jean-Louis Guyader, *Vibrations in continuous media*, 2013).

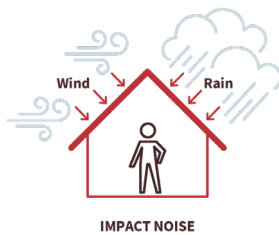
In conclusion, bitumen, as a viscoelastic material, exhibits good damping vibrations capacity due to its combined viscosity and elasticity. The material's ability to dissipate mechanical energy through internal friction makes it effective at attenuating vibrations and absorbing sound energy. This property has practical implications in various fields, contributing to sound absorption, noise reduction, and improved acoustic environments.

About the importance of the mass.

The mass of the bitumen can help absorb and attenuate the vibrations. ONDULINE® sheets monolayer technology ensures a homogeneous impregnation of the bitumen sheet.

What kind of sounds are we talking about?

ONDULINE® sheets are particularly effective to absorb **impact noises such as rain, wind, fallen debris (leaves, branches)...**



This argument is particularly important for countries where there is no insulation, with roofing material visible from the inside. It is **very appreciated by people living, working or learning under.**



What is the sound attenuation coefficient of ONDULINE® sheets?

For impact noise, the measurement parameter used is the **impact sound pressure level reduction index**, which is indicated as ΔL_w (dB) and represents the improvement introduced by an ONDULINE® sheet. The **decibel (dB) curve** is based on a **logarithmic scale** which means that the consequences of increasing decibels become stronger and stronger.



For comparison purpose, a metal roofing sheet (thickness of 3 mm – ribbed profile) has been compared to an ONDULINE® CLASSIC sheet on simulated roof settings and rainfall conditions (**Test Report BBT3.TR.20.00023.R**, available in [SharePoint](#).)

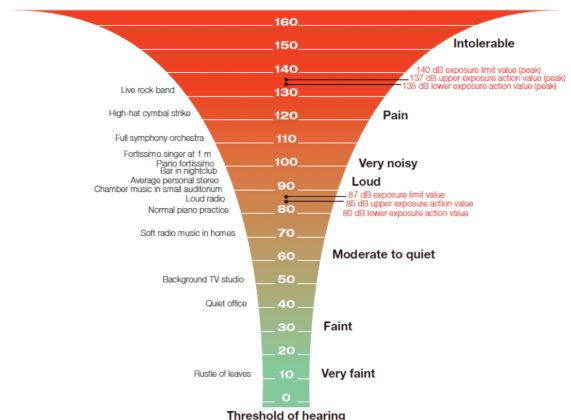
Rainfall Noise measurement on roof specimens:

The **metal sheet** generates **83,09 dB(A)** where the **ONDULINE® sheet** generates **59,88 dB(A)**: a **major difference of 23 dB(A)** and a very good performance for a roofing material of only 3 mm!

Noise measurement was performed, **at constant rainfall**, using five microphones inside the rooms.

As we can see from the scale, the switch from 60 to 83 is a major difference. Below 60 dB(A), we can have a normal conversation, whereas it becomes really disturbing to overpass 80 dB (A).

For example, 80 dB(A) is the level of a high traffic street or klaxons, a garbage disposal or a piano practice.



We can clearly hear the difference between the metal sheet and the ONDULINE® sheet!



MORE FAQ ABOUT SOUND ABSORBING

Reducing from 83 dB(A) to less than 60 dB(A) is life changing. It means that **with ONDULINE®, the indoor environment is 4 times quieter than with a metal roof.** Thanks to its unique composite material, ONDULINE® roofing generates less noise under rainfall.

➔ This reduction of noise has been officially tested by an **independent third-party laboratory**, the BPPT (Indonesian National Laboratory for Aerodynamics, Aeroplastics and Aeroacoustics technology) and measured according to ISO 140-18:2006.

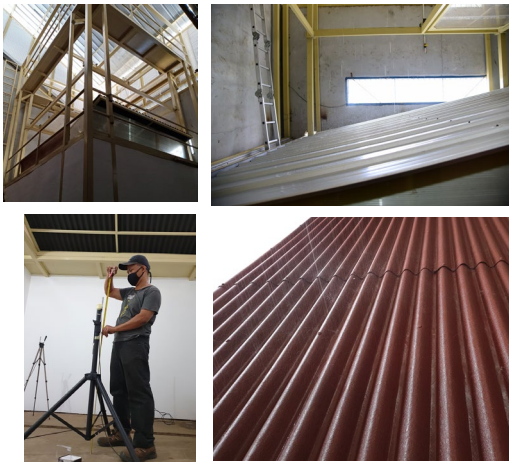
Test Report BBT3.TR.20.00023.R

No.	Type of specimen	Global LIA (dB-A)	Uncertainty ¹⁾ (dB-A)
1	ST-1	59.88	±1.34
2	ST-2	83.09	±1.35

¹⁾ Confident level 95%.

ST-1= sample ONDULINE® sheet & ST-2 = sample metal sheet.

We can clearly hear the difference between the metal sheet and the ONDULINE® sheet!



Specimens installed

ONDULINE® also efficient at reducing rainfall noise when used as under-roofing.

A second test was done in 2021 (**Test Report BBT3.TR.21.003**) by the same laboratory and also according to ISO 140-18:2006. This test compared a metal sheet (thickness of 3 mm – ribbed profile) with an ONDULINE® CLASSIC sheet of 3 mm thick too, in **both under-sheeting and over-sheeting conditions.**

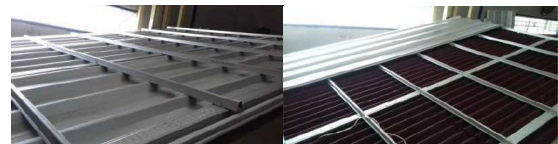
➔ The global sound intensity levels are **76.64 dB-A for Metal-sheet**, **52.90 dB-A for Onduline over-sheeting**, and **68.54 dB-A for Onduline under-sheeting**: a major difference for Onduline which provides better noise insulation.

Table 3.2-1 Global A-weighted sound intensity level (LIA)

No	Type of Specimen	Global A-Weighted Sound Intensity Level (LIA) [dB-A]	Uncertainty ¹⁾ [dB-A]
1.	ST-1	76.64	±1.01
2.	ST-2	52.90	±1.02
3.	ST-3	68.54	±1.09

¹⁾ Confident level 95%

ST-1= sample metal sheet, ST-2 = sample metal sheet + ONDULINE® over-sheeting & ST 3 = sample metal sheet ONDULINE® under-sheeting



Specimens installed

ONDULINE is the preferred roofing systems for stables.

Horses feel safer during storms thanks to Onduline®!



Like many animals, **horses are easily afraid when environment is noisy.** During storms, they may feel particularly unsafe because of the **rain noise.**



While other roofing materials let sounds go through, particularly metal, ONDULINE® sheets absorb part of it. As **horses feel safer**, lots of UK owners choose, repurchase and **recommend ONDULINE® sheets for stables.**