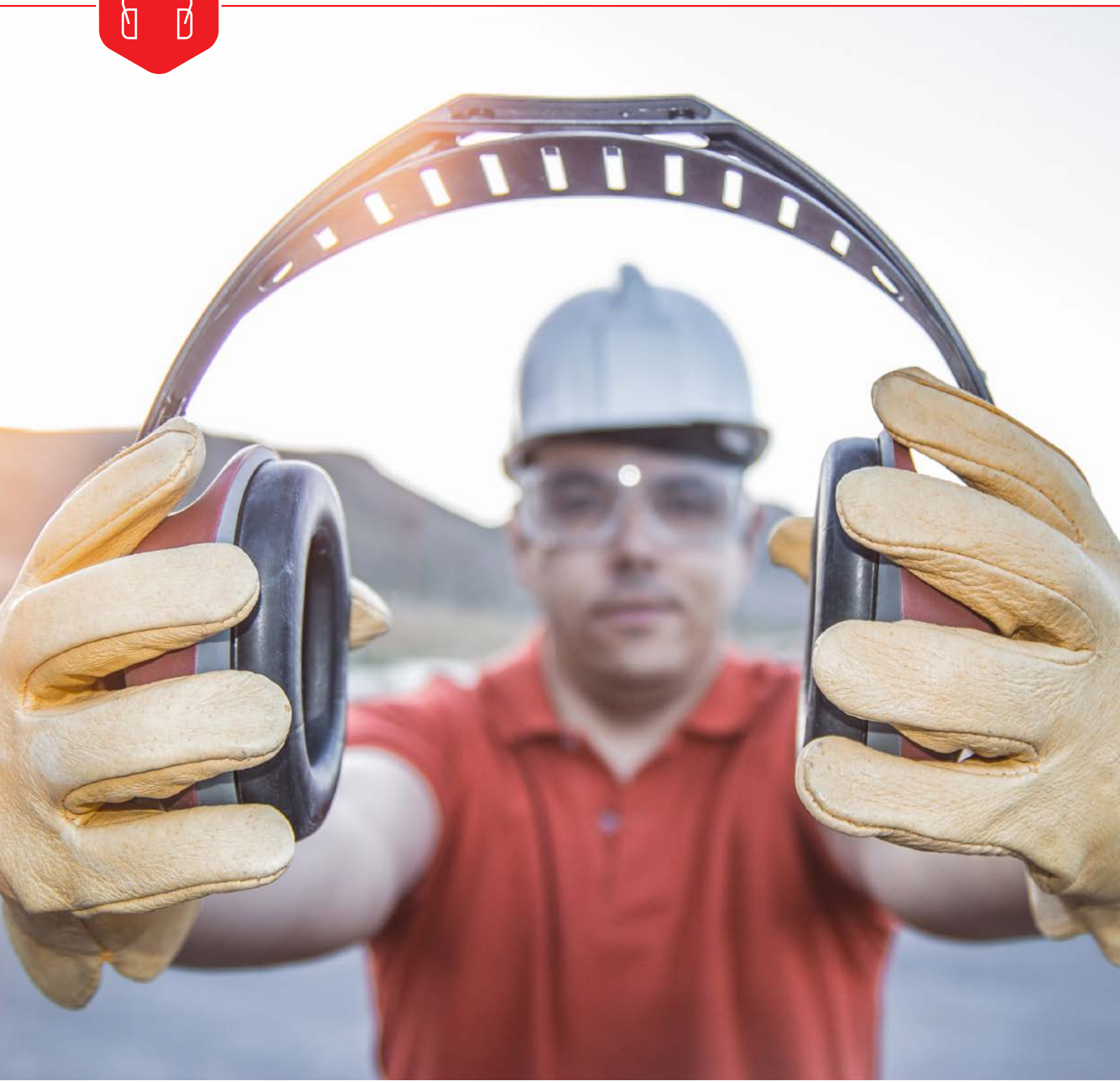
Keller Lärmschutz AG



A Solution Made to Measure – for Every Noise Protection Problem

Swiss Noise Protection Pros

A Solution Made to Measure

For Every Noise Protection Problem

The breadth and depth of our assortment of products made of tailor-made materials gives us the leeway to provide you with individually tailored advice. Our many years of market and application experience, combined with competent, rapid action, adherence to delivery dates and fairness have all combined to make us a reliable partner. Our combination of technology, material and competence is simply incomparable.

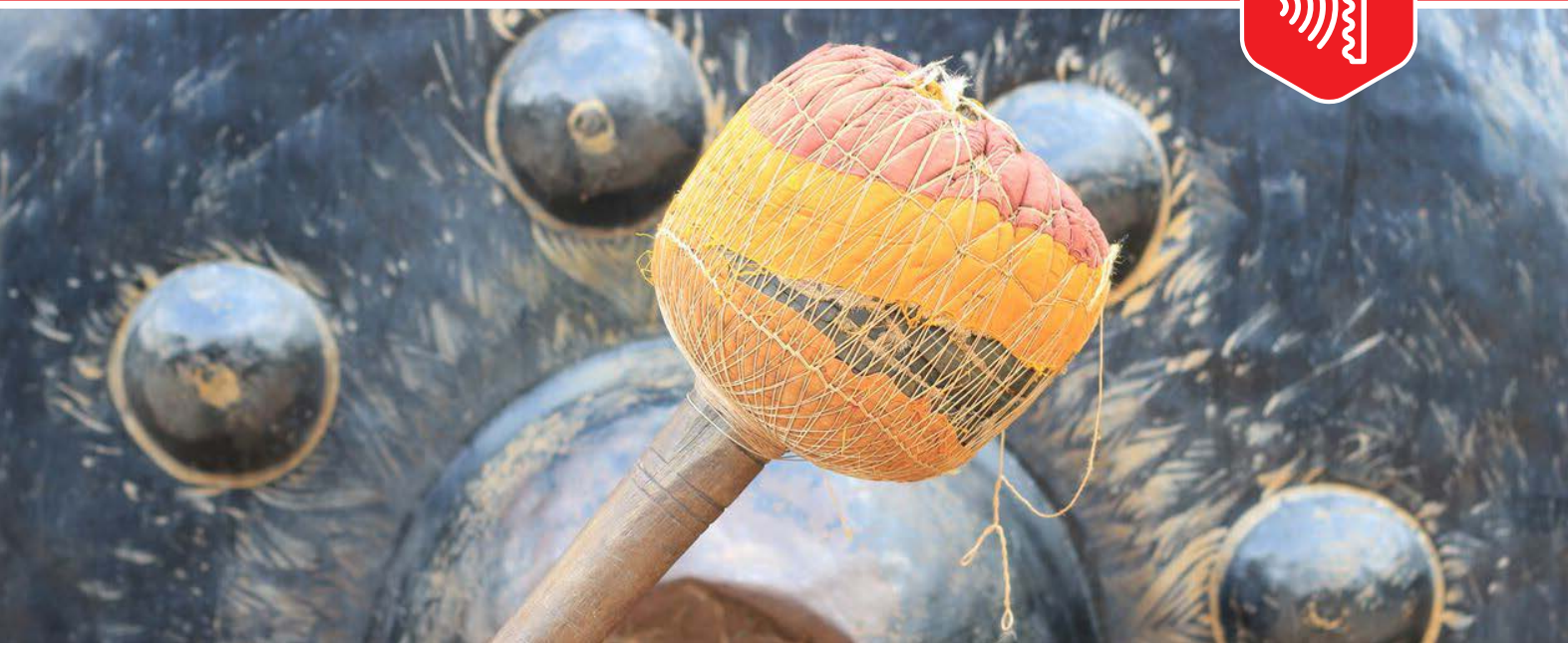
Allow us to advise you directly where you are and conduct indicative noise measurements

Working with us will bring you the following benefits...

- A personal contact who will competently advise you on all matters and who will plan and coordinate the implementation with specialists – "Keller Lärmschutz Full Service"
- Years of well-founded application experience
- An extensive assortment of products
- Materials only as needed
- Customer-specific product development
- Special parts also available in the smallest of quantities
- Fire protection approvals for the railway and machinery industry
- Provision of hand samples
- Indicative measurements performed directly at your location
- Personal contact and short response time

The most important methods for combatting noise:

Sound-Deadening / Damping



Sound-deadening, also called “structure-borne sound” or “vibration damping”, primarily involves the reduction or damping of “emitted” airborne sound at the source of emissions.

For example, when a hammer causes a gong to vibrate, the sound that we perceive is the emitted airborne sound. However, the surface vibration of a material emits more than just airborne sound. The sound spreads through the material / structure itself as well.

Sound-deadening is used for the following cases:

- Profile sheet metal structures (interior and exterior)
- Plastic housings
- Machine casings
- Ventilation systems
- Vehicle chassis (floor structures)

Loss Factor

The loss factor is a dimensionless value and specifies how fast the material caused to vibrate (excited) by mechanical means comes “to rest” again.

The higher this factor is, the less the sound will spread and the better the damping will be.

The Loss Factor

Material	Loss Factor
Steel	0.0001
Glass	0.001
Lead	0.02 – 0.03
Mineral fibreboard, pressed	0.1
Idikell® M4021/05 heavy foil	0.3
Afraplast® A94 drone-deadening compound	0.11
Dinaphon® A330 drone-deadening compound	0.12

Please note:

- Thin-walled structures require a drone-deadening covering.
- The damping material is normally applied with a thickness of two sheets.

Reverberation and Sound Absorption

The goal of sound absorption is to reduce sound reflection.

Room acoustics are poor, for instance, when you are sitting in a restaurant full of people and can no longer understand your own words, let alone those of the person next to you.

Sound waves that spread out in a room and hit a surface will be reflected (in part), thereby causing the direct and reflecting sound to overlap.

The ability of a material to "swallow" – or absorb – sound waves that hit it is illustrated by its **absorption coefficient**. It is clear that reverberant surfaces such as laminate, tiles or concrete, glass and wooden walls are less able to absorb the sound than sound-absorbent surfaces such as a carpet.

The **reverberation time** is the oldest and often also the most significant parameter for assessing the absorption capacity of an entire room. It can be calculated somewhat arduously using a formula, or measured with comparative ease. The reverberation time is the time needed for the sound pressure level to drop to 60 dB after the sonification ends. The shorter the reverberation time, the better the absorption.

The reverberation time largely depends on the size and shape of the room, the quality of the surfaces, the furnishings and the number of people. A well-harmonised room climate is important for well-being and prevents tiring.

Some Practical Tips for Minimising Sound

- Determine the reverberation time.
- Mix materials to prevent local phenomena, using architectonic tricks as needed (pictures, for example).
- Avoid the presence of parallel reflecting surfaces (flutter echo).
- Sensibly position absorbing elements around the room. Use multiple small surfaces instead of a large surface.

Room Type	Reverberation Time in Seconds
Open-plan office	0.4–0.6
Classroom	0.5–0.7
Office	0.6–1.0
Restaurant, lounge	0.6–1.0
Auditorium	0.9–1.2
Church nave	1.5–3.0

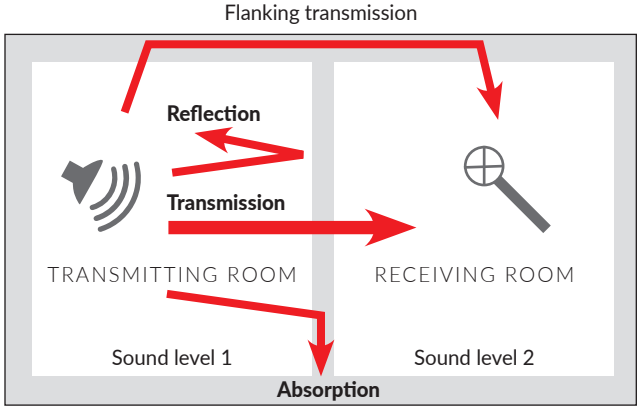
Airborne Sound

Airborne sound is sound that spreads via the air. It is transmitted both from the outside into a room as well as from one room to another.

There is airborne sound when you hear the TV or a lively conversation between your neighbours or co-workers in the next room.

The term airborne sound insulation involves decreasing the sound that penetrates a partition element such as a wall or the ceiling. A first portion of the incoming sound energy is reflected back at the surface of the partition wall, the second portion is absorbed by the partition element itself and the third portion enters into the adjoining room.

Understanding what makes good sound protection requires an understanding of a few basic operating principles:



Sound level difference = sound level 1 – sound level 2

Mass (weight) of the component: The heavier the component, the better the sound insulation. To increase the sound insulation, it is necessary for the increase in weight to be significant compared to the original weight. In order to improve a concrete wall with a density of 200 kg/m^2, it is necessary to increase the mass by at least 100 kg/m2; increasing it by 10 kg/m^2 will have no effect.

Rigidity of the component: More rigid components exhibit poorer sound insulation properties than components that are more pliable, whereby it is not the rigidity of the material that is decisive as such but the combination of the material's rigidity and thickness. While a piece of steel sheet 1 mm thick is pliable, a piece 10 mm thick is rigid. If the sound insulation of a component is to be increased, then only the mass should be significantly increased and not its rigidity. Additional masses are most effective when they are pliable.

The acoustic insulation properties of a component are indicated by the sound insulation mass R. R is a differential value; in other words, the higher the R value, the better the sound insulation. This value holds for the component but not for its effect in a room. Airborne sound is not only transmitted directly through a partition element but also via secondary routes, referred to as flanking transmission. The effective insulating effect of a component can be measured by the sound level difference between the sending room (sound level 1) and the receiving room (sound level 2).

Insulating and Protecting

Insulation of Machine Enclosures

In order to use a machine sensibly, its sound and heat emissions must be reduced to a minimum so that the machine can be optimally integrated into the production environment.

The solutions we develop and produce for optimising the acoustic and thermal properties of machines are as unique as the machines themselves, covering a vast range of very different machines and devices. Our products are exceptionally suited to achieving maximum sound insulation within a very small space.
It has been proven* that this can increase the productivity of both production workers as well as office staff.

Enclosures with sound insulation are suitable for all kinds of noise-producing units, machines, compressors, pumps, heaters, blowers, air conditioners, air outlets, etc. They are very efficient at eliminating the noise emitted by these elements.

** We are referring here to the publication issued by the Swiss accident prevention institution Suva (Schweizerische Unfallversicherungsanstalt): "Noise at the Workplace That Can Cause Hearing Loss".*

Protecting

Using our products, we are able to protect against the following influences:

Condensation: With moisture absorption of up to 100 percent by volume, condensation problems in railway carriages, carports, warehouses, etc. will become a thing of the past.

Falling rock: Our products have been proving their worth for years in the railway industry and in vehicle construction thanks to their excellent adhesion and tough-elastic properties.

Why Noise Protection

Noise is dangerous, undesired sound and more than just a bothersome by-product. Traffic, modern technology, neighbouring flats, industry, businesses, recreational facilities and institutions are all sources of noise. This development is diametrically opposed to people's need for more quiet. According to the World Health Organisation (WHO), the absence of noise is actually a basic human right!

Bothersome noises reduce the quality of life and decrease the value of a building, a workplace or an employer. However, the negative effects of noise and noise pollution are much more diverse than this.

- Noise impairs the body and mind in a way that can lead to serious health damage.
- Sound – and thus noise – is perceived very differently from one person to another.
- Noise today is the most frequent environmental stress factor and may, for example, cause damage to the heart and circulation as a result.

No-One Gets Used to Noise!

The graph on the last page shows after which time and noise volume permanent damage can be expected. For example, an MP3 player, which can easily produce up to 100 dB, will already lead to long-term hearing loss with a listening level of 1.0 h / week.

Hearing loss is usually incurable (irreversible)!

Limit Values for Noise Pollution

In order to assess and limit noise pollution, noise protection legislation lays down the planning values, immission limit values and alarm values with corresponding acoustic measures for various types of noise. They are harmonised with the noise sensitivity of the area affected and are each lower at night. The limit values for noise pollution are incorporated in the noise abatement ordinance LSV (*Lärmschutz-Verordnung*) and are based on the Environmental Protection Act:

- **Planned values** apply for the erection of new facilities that produce noise and for the elimination and development of construction zones for noise-sensitive buildings (residences).
- **Immission limit values** set the threshold above which the noise will considerably impair people's well-being. They apply for existing noise-producing facilities and for building permits for noise-sensitive buildings (residences).
- **Alarm values** are a criterion for measuring the urgency of renovations and of installing soundproof windows.

The noise pollution limits are stricter for purely residential areas than for areas in which commercial activities are also allowed ("Sensitivity Level" in the table). The following limit values generally apply:

Sensitivity Value Level (ES)	Planning Value (PV) in dB(A)		Immission Limit Value (ILV) in dB(A)		Alarm (AV) in dB(A)	
	Day	Night	Day	Night	Day	Night
I Rest and Relaxation	50	40	55	45	65	60
II Residential	55	45	60	50	70	65
III Residential/Commercial	60	50	65	55	70	65
IV Industry	65	55	70	60	75	70

The best and most effective way to combat noise is by dealing with the source of emissions.

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What Sound Generates How Much Noise

Toy pistol fired right next to the ear	180
Slap on the ear, firecrackers near the ear	170
Airbag deployment at close proximity	160
	150
	140
Jet aircraft	130
Waterfall	120
Circular saw, discotheque	110
Pneumatic hammer from 10 m away	100
Passing train, thunderstorm, lawnmower	90
Motorcycle	80
Normal road traffic	70
Conversation, frogs	60
Refrigerator from 1 m away, light rain	50
Slight road traffic behind double-glazed windows	40
Whispering, breathing sounds	30
Ticking of a clock, rustling of leaves	20
Mosquito, computer	10
Falling of a feather	0

From 120 dB = pain threshold. Hearing loss is already possible after brief exposure.

From 85 dB = damaging range. There is a risk of hearing loss after a normal work day (8-hour day)

From 65 dB = day-to-day noise. 20% increased risk of cardiovascular disease with ongoing exposure

From 55 dB = night noise. 20% increased risk of cardiovascular disease with ongoing exposure

From 40 dB = may disturb learning and concentration.

0 db = hearing threshold

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