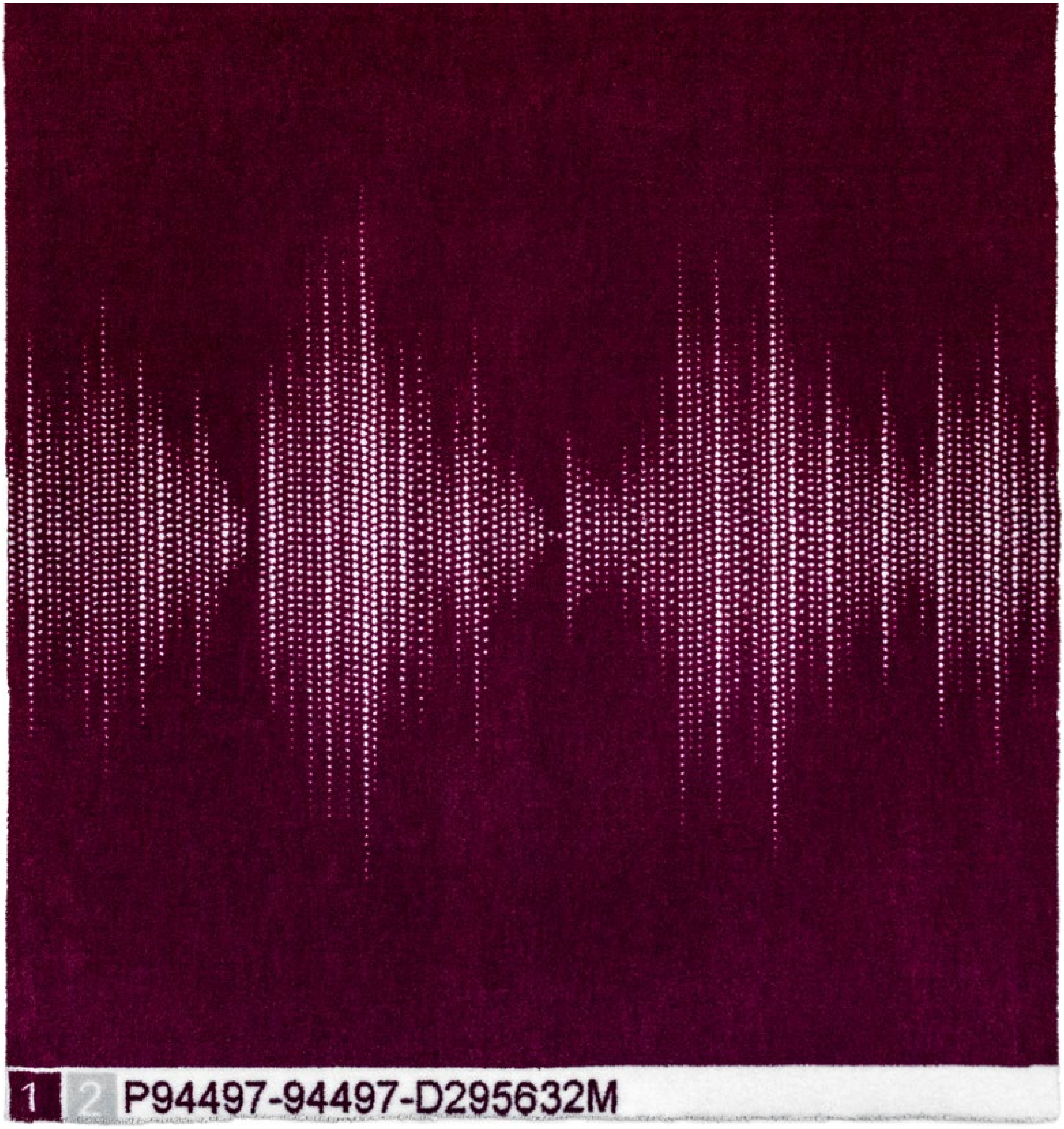
INFO GUIDE 01

HALBMOND TEPPICHWERKE

HTW DESIGN CARPET

ACOUSTICS



Acoustic quality*

* **Acoustics involve the theory of sound. Room acoustics cover the theory of sound in rooms.**

The acoustic quality of a room that is designed for people to listen to each other is described as its **acoustic quality.** The term can be traced back to the experiment by Leo Beranek in 1962 to determine the overall room acoustics from a weighted summary of 18 individual criteria. Later experiments showed, however, that no more than four assessment components, which relate to the temporal, spatial, spectral and dynamic structure of the sound field, are sufficient to characterise acoustic quality. The acoustic quality of a room or its audibility can be affected by the design of the ceiling, walls and particularly the floor.

PEOPLE LIVE THROUGH THEIR SENSES

We establish contact with our environment through our senses. We get our bearings, we communicate and we understand matters purely through our senses.

The *sense of hearing*

Our sense of hearing: our first point of contact with the world.

It has already developed by the 22nd week of pregnancy: the sense of hearing starts receiving messages in our mother's womb. The embryo develops a feeling for the world by distinguishing voices at an early stage. We can hear long before we can see: our mother's voice, noises from the surrounding area, music. No wonder therefore that hearing is second nature to us and we barely notice it in everyday life.

Hugo Fastl (2004) showed, for example, that people in red trains sense that sounds are approx. 15% louder than those in green trains.

We **touch.** We **see.** And: we hear.

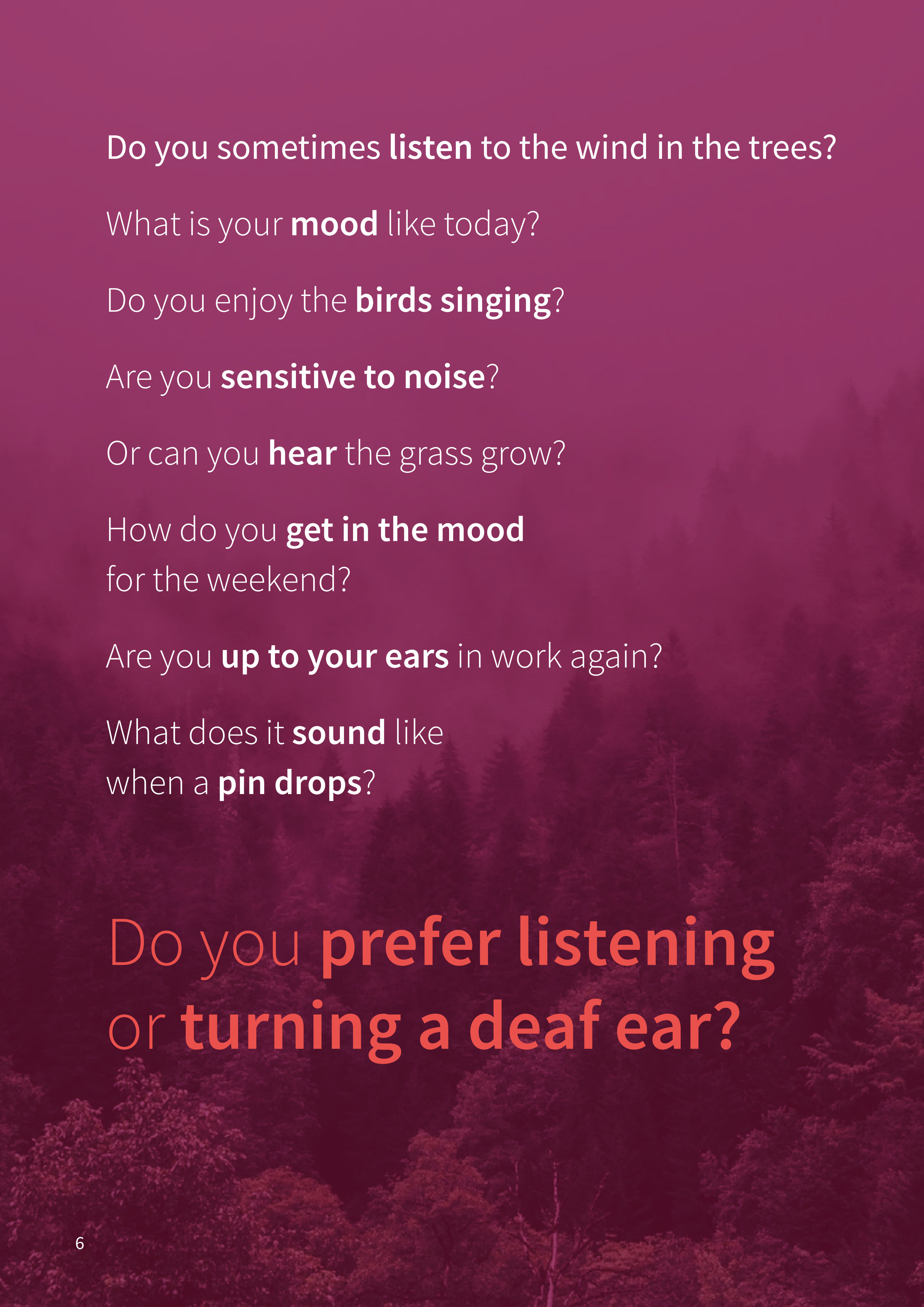
The matching vocabulary that both senses 'use', e.g. tone colour and shades of colour, demonstrate how closely seeing and hearing are to each other. We not only describe colours as loud and soft, but also as high and low, lively or calm or even atmospheric using major or minor keys. These are really all adjectives describing what we hear. The description often does not just relate to the colour as such, but also to the design interacting with it. Designs can also be viewed as calm or restless.

Can you see noise or hear colour? When do you feel in "tune" with your room environment?

The significance of colour and design in acoustics.

Acoustic stimuli seldom occur in isolation. The different sense impressions combine to form one impression on our brains and cannot be clearly separated.

Most of our brain capacity is used for colour vision. Colours determine our expectations in the environment and the characteristics of people, rooms and things. If observers feel good about what they see, they are more tolerant towards other stimuli, e.g. noises.



Do you sometimes **listen** to the wind in the trees?

What is your **mood** like today?

Do you enjoy the **birds singing**?

Are you **sensitive to noise**?

Or can you **hear** the grass grow?

How do you **get in the mood**
for the weekend?

Are you **up to your ears** in work again?

What does it **sound** like
when a **pin drops**?

Do you **prefer listening** or **turning a deaf ear?**

YOUR EYES LISTEN TOO

We always hear, but that is never the only factor.

If our ears are active, our eyes are usually involved too. It is hardly surprising that visual impressions intermingle with what we hear and affect it. **Colour, shape, structures** and **designs** therefore have an audiovisual component too.

When describing what we hear, we also register the **effect** that **colour and design** have on us. We therefore associate a loud or quiet atmosphere with particular designs. We usually do this quite unconsciously.

If a carpet with a “quiet” colour is laid in a hotel lobby, it often creates a calm atmosphere with subdued background noise. The design of a carpet helps provide suitable room acoustics in addition to its quality.

In contrast to sight, we can barely dog control what we hear. Or have you ever managed to close your ears?

Exactly: our ears are always open to hear things – and this is true long before we are born. The noises that we pick up, the music that we hear, the words that find their way into our ears – all these things can bother us, overwhelm us or even make us happy. After all, sound does not just touch us like a caress – it literally invades us, whether it is pleasant or not.

PLEASANT SOUNDS OR DISTURBING NOISE

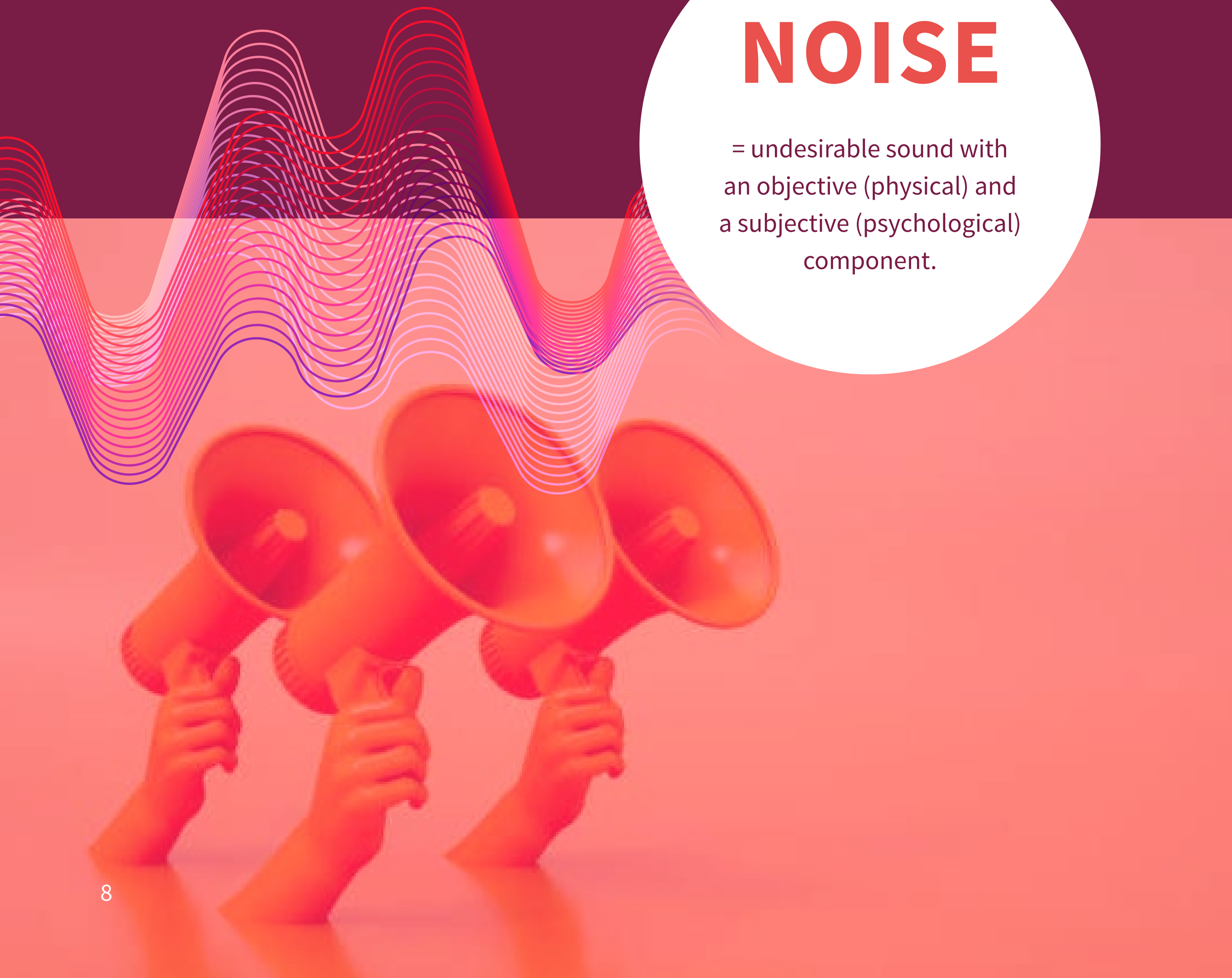
We are exposed to all kinds of sounds and noises in our everyday lives. Some of it is welcome (music), some of it disturbs us a great deal (building noise). We hear other things (most of them) unconsciously: footsteps, background noises in the office, audible signals.

It is true that we enjoy speech and music through our ears – but noise can have a threatening and painful effect and cause stress and serious health problems. Our ability to learn and our performance react to a disruptive or pleasant acoustic environment.

As we can normally look away, but cannot simply turn a deaf ear (or even turn our ears off), we should never underestimate consciously designed room acoustics and their ability to create a sense of well-being or promote health and concentration.

NOISE

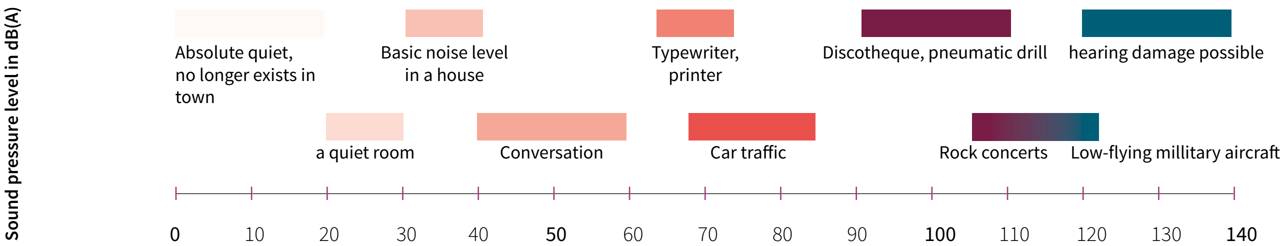
= undesirable sound with an objective (physical) and a subjective (psychological) component.



People find sound unpleasant if the noise level exceeds approx. 65 dB. This feeling is no accident. From this noise level upwards, sounds create stress in our bodies and aggravate our metabolism. There are some indications that circulation disorders, stomach ulcers or an increased risk of suffering a heart attack may result from this.

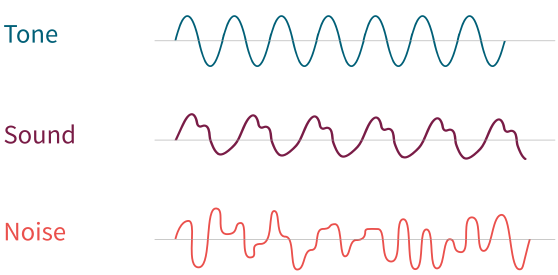
NOISE:

- Lawn mower
- Grinding machines
- Traffic and aircraft noise
- Loud music
- …



THE DIFFERENCE BETWEEN TONE, SOUND OR NOISE

Our sense of hearing deteriorates as we grow older. Children and young adults hear much more, while people's hearing becomes less acute, particularly in the high frequency range, as they grow older.



As consonants occur in a higher frequency range, for example, this has significant effects on our ability to understand others. This is the reason why it is important to adapt people's surroundings to their hearing capacity and ensure good language comprehension. Experts call this **acoustic quality.**

How does a cricket actually hear?

Crickets do not have any ears on their heads for hearing. However, they do have hearing membranes on their front legs.

source: planet-wissen.de

EACH ROOM IS DIFFERENT

Work room. Living room. Guest room. Dining room. Bedroom.

What should a room sound like? What is necessary to enable people to hear in it? The intended purpose and user groups, specific challenges and individual needs define the requirements for room acoustics. However, there are some objective parameters that are crucially important for room acoustics too.

The quietest place

According to the Guinness Book of Records, the quietest room in the world is a research room in the US State of Minnesota. The quiet room, which is protected by steel-reinforced doors and thick fibreglass, absorbs 99.99% of all noises. If you spend some time in this room, you can hear your own heart beating and your lungs working – nobody has so far managed to stay there for longer than 45 minutes!

What we mean about when we talk about hearing:

SOUND

What we hear is energy. This energy spreads in waves – also known as sound waves – from the source within the room. We receive oscillations, which our auditory sense translates into sound. Sound waves can be reflected or absorbed – with the relevant consequences for the room's acoustics.

TIME AND SPACE

One key parameter for room acoustics is the **reverberation time**: the time needed for the **sound level to fall by 60 dB** after the source of the sound has been turned off.

How long does it take for a sound to disappear? How quickly does silence set in – or the space for the answer to a question?

Offices or conference rooms benefit from a short reverberation time. The shorter the reverberation time is, the easier it is to understand what people say. Rooms where music is played are even more challenging, so that the sounds do not overlap.

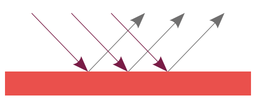
The reverberation time can be affected by the **shape or volume of the room** or the **design of the ceiling, walls and floor.**

A VICIOUS CIRCLE

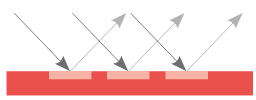
People talk more loudly in rooms with a lot of reverberation, allegedly to help others understand them better. The noise level surges and makes it difficult for people to understand each other. As a result, people try to speak even more loudly and increase the noise level even more. This is called the **Lombard effect.**

SOUND AND SPACE

If sound hits a surface (wall, floor, ceiling), it is reflected or "absorbed", depending on the quality of the surface. The degree of so-called sound absorption has direct effects on the reverberation time and is therefore an important factor in regulating a room's acoustics. The more sound that is absorbed, the shorter the reverberation.



Complete sound reflection without sound absorption



Partial sound absorption

Using carpets makes a significant contribution to sound absorption. Depending on the design of the carpet, the acoustic efficiency can target different frequency ranges. A high, thick level of pile therefore acts as a pore absorber for high frequencies (theatres, cinemas, concert halls) and a heavy, thick carpet backing acts as a resonance absorber (ships' cabins, call centres, offices).

Women hear better

Women are better at listening. The cliché seems to be true. Numerous experiments prove that women hear what is spoken within a frequency range of 1,000 hertz better than men. Their hearing capacity declines much less in old age too. Scientists suspect that female hormones such as oestrogen protect women's ears from rapidly losing their sense of hearing.

Sound can only be absorbed where it occurs. If people talk to each other, for example, the sound normally tends to migrate back and forth between the walls. However, the quality of the floor and particularly the carpet has an important influence on the room's acoustics.

WHY?

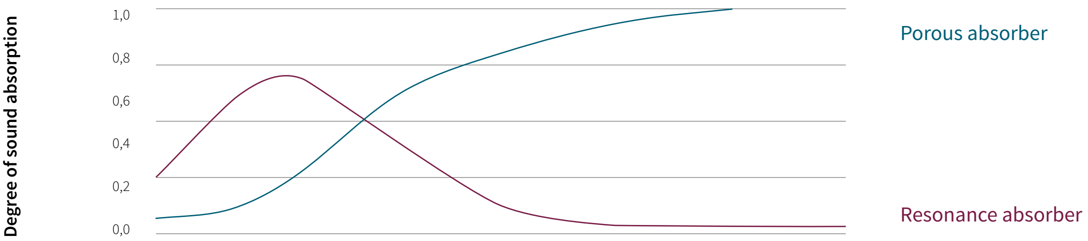
Because the reflection of the sound waves is repeatedly deflected and redirected and some of the sound waves therefore hit the floor too.

Because background noises particularly affect the acoustic quality of a room. The noise of footsteps, for example, is created directly on the floor – so why not absorb it directly at its source?

Our sense of hearing: efficient and at risk

Human beings can distinguish between 400,000 sounds. We can also locat the direction from which the sound is coming very accurately. However, our ears are also very sensitive. Any part of our ears can be damaged. Problems occur most frequently in our inner ear.

DEGREE OF SOUND ABSORPTION α



The **degree of sound absorption a** describes the property of a material to transform sound that occurs (motion energy) into other forms of energy (e.g. heat).

WHEN IS A CARPET A GOOD SOUND OR RESONANCE ABSORBER?

A tufted carpet is a very effective sound absorber, depending on its design and the materials used.

This is possible through the coordinated interaction of the different, more or less porous layers of the carpet: the **pile layer (1)** made of fibrous material and the **coating and secondary backing (2)**, when well-coordinated, create a sound-absorbing effect even for simple carpets, particularly in the low frequency range. However, carpets effectively help room acoustics with high frequencies too.

WALKING SOUND AND RADIATED SOUND

Right or left?

Which of your ears hears better? Scientists have discovered that we can hear better with our right ear than with our left one if too many sound impressions bombard us all at once. This is probably because everything that we hear with our right ear is directed to the left-hand side of our brain, which accommodates the centres for speech and our memory, among other things. It is therefore easier to process the stimuli from our right ear.

Walking sound (DIN EN 16205) and **radiated sound** (DIN EN ISO 10140) are special forms of mechanical vibration and have one thing in common: the source of the sound. While walking sound develops through a source of sound in a room, radiated sound initially causes the ceiling to vibrate (mechanical vibration), which then radiates the sound to horizontally and vertically adjacent rooms. Walking sound can occur through people moving in a room – but not just through this. Other noises that occur on the floor of a room, e.g. the scraping noise when moving chairs, are included in “walking sound”. Radiated sound can occur when somebody walks along the hall with stiletto heels – but not just through this. Radiated sound also includes the rolling sound caused by a trolley that somebody is pulling, if it is heard in an adjacent room. Radiated sound can therefore cover what happens when somebody causes walking sound by bouncing a ball on the floor in an adjacent room.

It is very simple. Does it all make sense?

How does a frog hear?

Frogs only hear what is important to them. Their brain responds to the sound of other frogs and their predators; the animals are simply deaf to all the other unimportant sounds.

source: planet-wissen.de

Reducing walking sound and radiated sound

Selecting and laying carpets can significantly affect **walking sound**. One benefit of a textile floor covering in comparison with hard coverings is that it is only possible to directly reduce noises at their source through carpets. Carpets can therefore almost completely muffle walking and rolling noises.

The floor design (floor screed) and the ceiling covering are crucial for determining the degree of **radiated sound**. Even with an ideal floor and ceiling design, carpets can significantly help reduce radiated sound.

Thanks to high levels of tread elasticity, the energy activated by walking is directly transformed into deformation energy. Radiated sound is therefore barely audible or measurable.

A high degree of tread elasticity not only has a positive effect on the room acoustics, but also on people’s muscles and joints.

Floor covering	Rated reduction in radiated sound in line with ISO 140-8
Parquet without underlay	0 dB
Parquet with underlay	approx. 14 dB
Cork	approx. 16 dB
Vinyl	approx. 17 dB
*AP 016 SM F120	approx. 20 dB
*SD 800 M F550	approx. 38 dB
*Arcade F550	approx. 34 dB
*Art 1050 WB	approx. 28 dB
*Art 1050 F550	approx. 40 dB
*Art 1050 EL F120	approx. 27 dB
*Art 1050 TF1000	approx. 32 dB
*Art 1250 F550	approx. 40 dB
*Art 1400 F550	approx. 39 dB
*Artemis 1850 F550	approx. 42 dB

* = Halbmond qualities

A reduction in radiated sound of 20 dB means reducing footstep noise a hundred times and no other sound absorbers, which are hard to install, are necessary.

WORK WITH GREATER CONCENTRATION

Footsteps, voices, keyboards, printers, phones… hustle and bustle dominate offices and rooms used by the public – and the noise level rises.

SLEEP RESTFULLY

Hear? But sensitively please!

Our sense of hearing is closely associated with our emotions. Adverts and product design capitalise on this: shavers are made so that they sound particularly powerful and efficient. Substances creating a crispy effect in your mouth are added to crisps or cornflakes. Your ear is involved in eating too.

source: planet-wissen.de

IT IS TIME TO SET ABOUT IMPROVING ROOM ACOUSTICS.

Irritating background noise affects our concentration, our efficiency and our health. Noise absorbers, which are very effective in a spectrum ranging between **250 and 2,000 Hz**, are necessary to guarantee that people can **easily understand each other** and enjoy **an atmosphere where concentration is possible.**

HOW CAN THE PROPERTIES OF A CARPET BE IMPROVED AS NOISE ABSORBERS?

Classic carpets are made on a lattice-like, secondary backing made of fabric and it is normally laid on a hard subsurface. As a result, it is not possible to transform the noise that occurs into motion or heat energy – which are crucial for absorbing sound.

By individually coordinating the separate components, it is possible to markedly improve the noise absorption effect. Connecting the **primary and adhesive layers** with a thicker and heavier textile secondary backing, such as **felt 550**, is the key here: the **acoustic effectiveness increases rapidly, even starting at 375 Hz.**

This works because the porous textile top layer can absorb the sound thanks to the other porous layers below it. This creates a crucial effect for room acoustics, particularly in the frequency range of speech.

The design of the secondary backing in particular affects the noise absorption.

Perfect pitch

If you have perfect pitch, you can exactly determine the pitch of a note, just like Beethoven or Mozart. What is only reserved for a few exceptionally talented persons here is very common among people who speak Chinese Mandarin. A word in Mandarin can have completely different meanings, depending on its pitch. The precision required here when speaking seems to train perfect pitch.

source: planet-wissen.de

FUNDAMENTAL FOR GOOD ROOM ACOUSTICS: **THE CARPET**

The **floor** is as crucial for room acoustics as the **wall or the ceiling**. As numerous studies prove and our own experience shows, **carpets** used as the **floor covering** have the best properties to provide ideal **room acoustics**.

- **Improved reduction in radiated sound**
- **Improved noise absorption**
- **Positively affects reverberation**
- **Positive effect on walking sound** (noises are reduced directly at their source)
- **Unlimited design options** (“soft” designs and colours)

Our carpets are also:

- **suitable for those who suffer from allergies** (by reliably binding particulate matter)
- **tread-elastic** (shock-absorbing and noise-reducing)
- **dust-binding**
- **heat-insulating**
- **anti-slip**

HALBMOND TEPPICHWERKE

GLOSSARY

Activity Based Acoustic Design
All-round treatment of room acoustics, taking into consideration various activities for acoustic planning.

ASR A3.7 (technical regulations for workplaces)
Mandatory stipulations since May 2018 about which room acoustic requirements (esp. reverberation times) must be met for different workplaces.

Decibels
Measure for specifying volume. A logarithmic measure, as when doubling the amplitude of the sound pressure, the perception of volume is not doubled, but increases by approx. 10 dB.

DIN 18041
The standard for acoustic quality in rooms. Different reverberation times are described as target values for different groups of rooms. An acoustically effective minimum space is defined, depending on the room's use and volume.

DGUV
The German Statutory Accident Insurance scheme (DGUV) specifies a threshold of 55 dB for work that requires a high level of concentration or verbal comprehension – a benchmark for offices and other workplaces, for example. A printer and a typewriter often exceed this threshold.

Reverberation time
The time required for a source of sound to fall by 60 dB in a room after the source of the sound has been turned off.

Walking sound
Footstep noise, which can be heard in the same room, is described as walking sound. The noise caused by footsteps depends on the muffling effect of the materials and the floor surface as well as the properties of the items creating the noise.

Radiated sound
Describes the noise that is created when you move on a floor. This noise can spread to adjacent rooms, both under and next to the floor, and be heard there. The intensity of the radiated sound depends on the design of the floor.

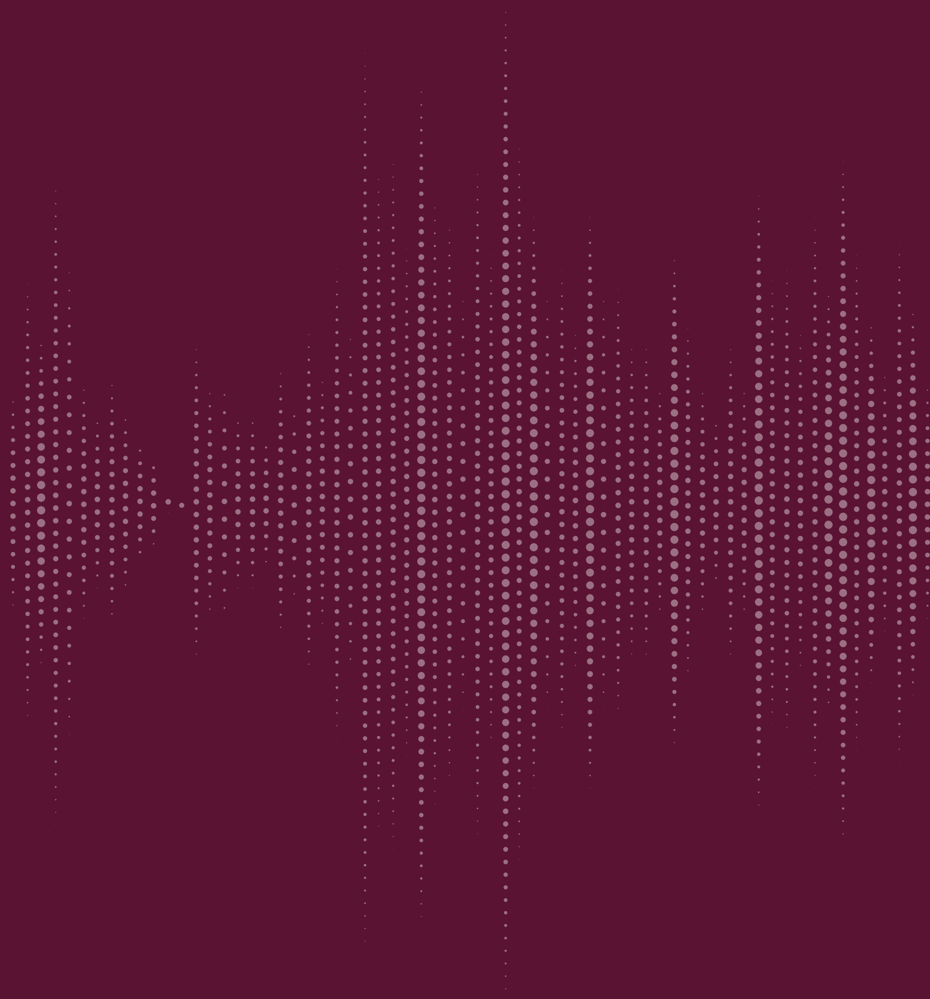
Hearing threshold
The level of sound pressure where human beings can just hear tones, sounds and noises. Shifted to higher sound pressure levels, depending on the frequency and with very low or very high frequencies. Very low or very high tones are therefore only heard if the volume is much higher.

Lombard effect
The noise level increases if the room acoustics are not ideal, as people try to improve comprehension by speaking louder in response to the poor acoustics – which makes the acoustic quality even worse!

Sound
Describes mechanical oscillations in an elastic medium (gas, liquid, solid body), which reproduce themselves in the form of sound waves. In lay terms, sound normally refers to noise and tones that people and animals can hear.

Sound absorption
A parameter regarding the acoustic properties of surfaces. It describes how strongly different surfaces reflect or absorb sound, depending on their material and structure.

Sound absorption level a
Describes the property of a material to transform the source of the sound (motion energy) into other types of energy (e.g. heat). A test is performed in an echo chamber according to ISO 354 to determine the sound absorption properties of a material.



Beyond sound

Acoustics deal with audible sound – fluctuations in air pressure in the frequency range of 16 Hz to approximately 16 kHz. Beyond this frequency range, experts speak about infrasound (> 0 - 16 Hz), ultrasound (20 kHz - 100 MHz) and hypersound (109 - 1012 Hz).

INFO GUIDE

HALBMOND TEPPICHWERKE

Halbmond Teppichwerke GmbH
Brückenstraße 1
08606 Oelsnitz/Vogtl, Germany
Phone: +49 37421 420
Fax: +49 37421 42571
info@halbmond.de
www.halbmond.de

HTW DESIGN CARPET

HTW DESIGN CARPET
Mindener Straße 6
32049 Herford, Germany
Phone: +49 5221 1779 0
Fax: +49 5221 1779 79
info@htw-designcarpet.de
www.htw-carpet.de