ISOLAR® Compass 1/2022

SOUND INSULATING GLASS

FOR INNER PEACE

ISOLAR® GLAS

MEHR AUS GLAS

INTRODUCTION

Sound is an important and essential part of our lives. Our bodies can generate and process sound, like when we hear and speak. Here, sound frequencies (measured in Hertz) indicate the pitch, and the intensity of sound fluctuations (measured in decibels) indicates the loudness. How loud or soft, high or low a sound is perceived is determined by our subjective perception. Hence, sound can also quickly turn into unpleasant noise. For one thing, short-duration or long-duration spikes or levels of sound can damage our hearing. The consequences of this can be hearing loss or permanent ringing noise in the ears (tinnitus).

But apart from these aural effects, noise can also disturb the whole organism. Even low levels of sound that are not harmful to hearing – like traffic noise – can trigger physical stress reactions. This not only affects our well-being and quality of life, but also activates the autonomic nervous system and the hormonal system. This can have far-reaching consequences: the increased release of stress hormones can affect blood pressure, heart rate and other circulatory system factors and interferes with the body's metabolic processes. The risk of sleep disorders, high blood pressure and even heart attacks increases. Noise can therefore cause irreparable damage to humans, something that should not be underestimated. Speaking of which, it is not possible to get used to noise, since the regulation of the circulatory system and metabolism occurs unconsciously via the autonomic nervous system, and therefore reactions to noise can also occur during sleep.

According to the German Environment Agency (Umweltbundesamt, UBA) and the World Health Organization, the following values should therefore not be exceeded:

- To avoid health risks, noise levels should not exceed 65 dB during the day and 55 dB at night.
- To avoid significant nuisance, noise levels should be reduced to 55 dB during the day and 45 dB at night.
- In the long term, values of 50 dB during the day and 40 dB at night should be aimed for.

Traffic jams and traffic noise are part of our everyday lives in busy inner-city areas.

The recommendations of the Federal Environment Agency (UBA) are quickly exceeded, especially in inner-city areas and on very busy roads. According to the UBA, around 75% of people living in Germany feel disturbed or bothered by road traffic noise. It is difficult to concentrate on work in office or residential buildings under these conditions. The following table shows the reference values for sound levels from various noise sources. An increase in sound level by 10 dB is already perceived by humans as a doubling of the volume.

dB	Characteristic sound levels of noise sources
0-6	Hearing threshold
20	Clock ticking
40	Speaking softly, quiet street
50	Normal conversation
60	Speaking loudly, vacuum cleaner
70	Noisy street
80	Heavy traffic noise
90	Circular saw, motorcycle
120	Powered aircraft at 3 m distance
130	Siren at 2 m distance

Characteristic sound levels of noise sources based on the VFF Fact Sheet "Sound Insulation for Windows, Doors and Façades".

HERTZ, DECIBLE AND CO.

Sound is vibrations and waves in the frequency range between 16 and 20,000 Hertz (Hz). These vibrations can propagate in air as well as in solids. At frequencies below 16 Hz, one is in the infrasound spectrum, and at frequencies above 20,000 Hz, one is in the ultrasound spectrum—neither of which can be perceived by the human ear.

Here, **frequency** indicates the number of vibrations per second and is measured in hertz. High frequencies (= many vibrations) produce high pitches, low frequencies (= few vibrations) produce low pitches. In the construction industry, the frequency range from 100 Hz to 3150 Hz, or in the measuring range of 50 Hz - 5000 Hz is considered.

The energy contained in airborne sound – the **sound (pressure) level** – is measured in decibels (dB). Different pitches of a sound pressure cause the sounds to be perceived as being of different loudness. Accordingly, loudness is the result of sound pressure level and frequency.

To protect against noise, active and passive **sound insulation** is possible. Active noise control involves measures to reduce noise at the source itself; for example, in the case of aircraft noise, a ban on night flights. Passive noise control, in turn, includes all measures at the immission point, i.e., where the noise arrives. Soundproof windows are a classic example of passive noise control.

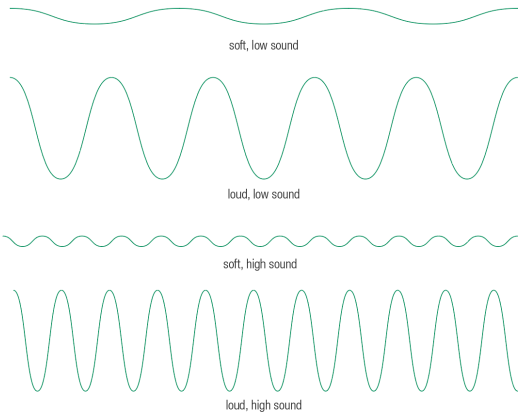


Illustration of frequencies of high, low, loud and soft sounds.

THE SOLUTION

Sound insulating glazing helps in reducing a noise pollution when you are inside the building. In order to achieve optimum sound insulation, this factor must be included in the overall planning of the building. Depending on the type and source of noise, the right combination of glass assemblies – using different construction methods – can achieve a significant improvement in sound insulation as compared to conventional insulation glazing.

AKUSTEX® sound insulating glass in the MoRo Opera Quarter Frankfurt/Main.

Different requirements call for different principles in glass construction. Accordingly, the following factors can positively influence sound insulation:

- Increased glass thickness (high mass)
- Asymmetrical assembly (glass of various thicknesses)
- Increased spacing between panes
- Acoustic laminated safety glass with acoustic films

With the right glass construction, sound insulation values of up to 54 dB can be achieved. For instance, if a chainsaw is being used outside the building, this noise will be perceived inside the building only as a low-level street noise.

By the way: The sound insulation classes of windows in the VDI- guideline 2719 have been replaced by the introduction of DIN 4109 and no longer provide any normative basis.

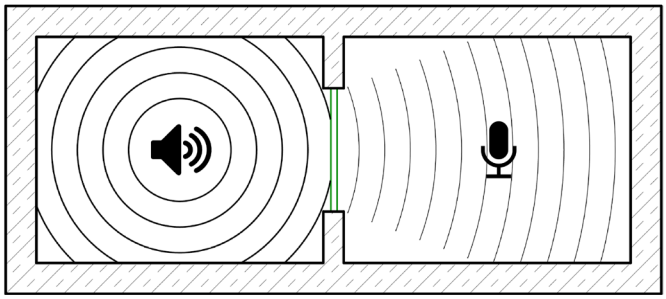
TESTING STANDARDS AND METHODS

In Germany, the sound insulation of glazing is currently tested in the laboratory according to DIN EN ISO 10140-2. The test bench consists of two adjoining rooms with a partition wall in which the glazing to be tested is installed. In one of the rooms, sound is generated at a frequency range of 100 to 5000 Hz. With the help of the measured sound pressure levels in the transmitting room and the receiving room, the frequency-dependent sound reduction index is determined. After determining the sound reduction index R for the defined frequencies, the weighted sound reduction index Rw is calculated according to DIN EN ISO 717-1 and expressed in decibels (dB).

In accordance with DIN ISO 717-1, the so-called spectrum adaptation terms C and Ctr were also introduced to take into consideration the different frequency spectra of residential and traffic noises—they reflect the subjective perception of the user. They are used to adapt the weighted sound reduction index in a frequency range of 100 - 5000 Hz. These adaptation terms are derived from the measured sound insulation of the glass products, taking into account the relevant noise source.

Noise source	Corresponding spectrum adaptation term
■ Residential activities (talking, TV, radio) ■ Children playing ■ Medium and high-speed rail transport ■ Autobahn/Highway traffic > 80 km/h ■ Factories that predominantly emit medium and high-frequency noise	C (Spectrum No. 1)
■ Urban road traffic ■ Rail traffic with low ■ speed ■ Disco music ■ Factories that predominantly emit low and medium-frequency noise	C_{tr} (Spectrum No. 2)

Spectrum adaptation terms C and Ctr based on the BF Bulletin “Sound Insulating Glass”.



Schematic representation of the transmitting room (left) and receiving room (right) of sound insulation tests in the laboratory. The partition wall contains the glazing to be tested (shown in green colour).

As a rule, sound insulation test values always refer to a glass pane size of 1.23 x 1.48 m in accordance with the authoritative test standard DIN EN ISO 10140-2. An orientation of possible changes in Rw as a function of the format can be found in the following table. They apply to the window as a complete element.

Pane format S	Correction summand ΔR_w
$0{,}6\ m^2 < S \leq 1{,}5\ m^2$	-2 dB bis 0 dB
$1{,}5\ m^2 < S \leq 2{,}7\ m^2$	0 dB
$2{,}7\ m^2 < S \leq 3{,}6\ m^2$	-1 dB
$3{,}6\ m^2 < S \leq 4{,}6\ m^2$	-2 dB
$> 4{,}6\ m^2$	-3 dB

Correction values for the R-value of windows from the BF Bulletin “Sound Insulating Glass”.

Sound insulation values of glazing are measured in the laboratory and not on the building itself.

EXTENDED REPLACEMENT RULES

In order to determine sound reduction index for a glass product, apart from a test in the laboratory, it is also permissible to apply replacement rules according to DIN EN 12758. If the following rules are followed in the construction of the glass itself, the sound insulation values will not be negatively influenced:

a) Rules for basic glass products

- The sound-insulating properties are independent of the glass composition, the glass colour (clear or body-tinted glass) or any further processing, inter alia, thermal processing, e.g. into tempered safety glass (TSG) or heat-strengthened glass (HSG).
- In terms of acoustics, ornamental glass behaves like glass with the next smaller thickness of float glass. Example: Ornamental glass with a thickness of 6 mm is described, in terms of acoustics, by values for monolithic float glass with a thickness of 5 mm.
- The wire mesh in the wired glass has no effect on sound insulation.

b) Rules for surface treatment and coatings

Sandblasting, etching, enamelling and coating have no effect on sound insulation, provided the glass thickness remains within the permissible tolerance for the respective product.

c) Rules of laminated glass/laminated safety glass

- Laminated glass can be described, in terms of acoustics, by the values for single-pane safety glass with the same or the next smaller total thickness (i.e. sum of the thicknesses of the glass components).
- The values for a laminated glass may be adopted with a higher thickness of the same intermediate layer.
- For laminated glass with tempered safety glass of different thicknesses, there is no preferred type of installation direction.
- For the replaceability of laminated glass, rules are stated by means of a measurand that is characteristic for the respective type of film, according to ISO 16940.

d) Rules for multi-pane insulating glass (MIG)

- No distinction is made between air or argon filling. If gas type Krypton is mentioned in the test report, then this gas type shall be used.
- The sound insulation does not depend on the installation direction of the MIG, regardless of the glass types of MIG (with or without laminated glass).
- Any installation in the inter-pane space that does not touch the glass panes (blinds, glazing bars, etc.) has a negligible effect on the sound-insulating properties.
- The sealants used in the edge seal and the spacer may be replaced.
- The values for an MIG filled with air or argon can be used for an MIG filled with krypton or a mixture of krypton, argon and air.
- The values for MIG with a spacer > 12 mm can be adopted for a wider spacer.
- The values for MIG with a spacer = 12 mm can be adopted for a narrower spacer.
- Sound insulation does not deteriorate if tempered glass is replaced by laminated glass/laminated safety glass of at least the same thickness.

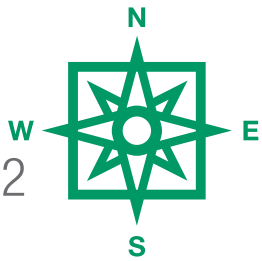
e) Rules for mirrors as well as lacquered, enamelled and foil-coated glass

The sound insulation of the glass substrate remains unaffected by coating with silver, lacquer, enamel or a thin film.

f) Replacement of PVB films

DIN EN 12758, Appendix A, refers to ISO 16940, wherein a method is described for comparing the acoustic properties of laminated glass intermediate layers based on the stiffness and loss factor of the intermediate layer. According to the Bundesverband Flachglas (German Flat Glass Association), relevant data for this can be provided by film manufacturers by means of certificate of compliance. Alternatively, comparative sound tests can also provide results for this purpose.

Extended replacement rules from the BF Bulletin “Replacement rules and standardized sound insulation values according to DIN EN 12758 2019-1”.



STANDARDIZED SOUND INSULATION VALUES

In addition to the laboratory-tested glass assemblies and the application of extensible replacement rules, standardized sound insulation values can also be included as yet another option. These standardized, conservatively rated sound insulation values may be used if no test report is available. The following table contains a number of these standardized sound insulating assemblies as single-pane glazing, laminated safety glass as well as double-pane and triple-pane insulating glass with air or argon filling.

Glass type and thickness in mm	Sound insulation in dB R_w / C / C_{tr}
Single glazing	
3	28 / -1 / -4
4	29 / -2 / -3
5	30 / -1 / -2
6	31 / -2 / -3
8	32 / -2 / -3
10	33 / -2 / -3
12	34 / -1 / -2
15	36 / -1 / -2
19	38 / -2 / -4
Laminated glass/Laminated safety glass*	
33.2	32 / -1 / -3
44.2	33 / -1 / -3
55.2	34 / -1 / -3
66.2	36 / -1 / -2
88.2***	36 / -1 / -3
1010.2***	37 / -1 / -3
1212.2***	38 / -1 / -3

* Laminated glass without acoustic intermediate layer
** 6 < Cavity < 16
*** Values from DIN EN 12758:201 1

Glass type and thickness in mm	Sound insulation in dB R_w / C / C_{tr}
Double-IGU	
4 / SZR / 4	29 / -1 / -4
6 / SZR / 4	32 / -2 / -4
6 / SZR / 6	31 / -1 / -4
8 / SZR / 4	34 / -2 / -4
8 / SZR / 6	35 / -3 / -6
8 / SZR / 8	32 / -2 / -5
10 / SZR / 4	35 / -2 / -5
10 / SZR / 6	36 / -2 / -4
4 / SZR / 33.2	33 / -1 / -5
6 / SZR / 33.2	33 / -2 / -5
6 / SZR / 44.2	36 / -2 / -5
6 / SZR / 55.2	38 / -1 / -5
Triple-IGU	
4 / SZR / 4 / SZR / 4	30 / -1 / -5
6 / SZR / 4 / SZR / 4	34 / -2 / -5
8 / SZR / 4 / SZR / 6	37 / -3 / -7
8 / SZR / 6 / SZR / 6	35 / -2 / -5
10 / SZR / 6 / SZR / 8	40 / -2 / -5
4 / SZR / 4 / SZR / 33.2	34 / -2 / -6
4 / SZR / 4 / SZR / 44.2	36 / -2 / -6
6 / SZR / 4 / SZR / 44.2	38 / -2 / -8
6 / SZR / 6 / SZR / 44.2	38 / -2 / -6
6 / SZR / 6 / SZR / 55.2	40 / -2 / -5
6 / SZR / 6 / SZR / 66.2	40 / -2 / -4
33.2 / SZR / 4 / SZR / 33.2	36 / -3 / -7
44.2 / SZR / 4 / SZR / 33.2	40 / -3 / -7
44.2 / SZR / 4 / SZR / 44.2	37 / -2 / -5
44.2 / SZR / 6 / SZR / 44.2	39 / -2 / -6
66.2 / SZR / 4 / SZR / 44.2	42 / -2 / -4

* Laminated glass without acoustic intermediate layer
** 6 < Cavity < 16
*** Values from DIN EN 12758:201 1

Standardized sound insulation values from the BF Bulletin “Replacement rules and standardized sound insulation values according to DIN EN 12758 2019-1”.

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SOUND INSULATING GLASS – THE MOST IMPORTANT ADVANTAGES

- Less noise pollution inside the building
- Improved well-being
- Increased living comfort
- Increased concentration

LEGAL NOTICE

Version: 1/2022
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Publisher: ISOLAR GLAS Beratung GmbH
Otto-Hahn-Straße 1, 55481 Kirchberg, Germany, Tel.: +49 6763 521, www.isolar.de/en
Managing Director: Hannes Spiß
Chairman of the Supervisory Board: Hans-Joachim Arnold

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