COMFORT BEHIND GLASS

STADIP LAMINATED GLASS GUIDEBOOK

BUILDING GLASS POLAND

SAINT-GOBAIN

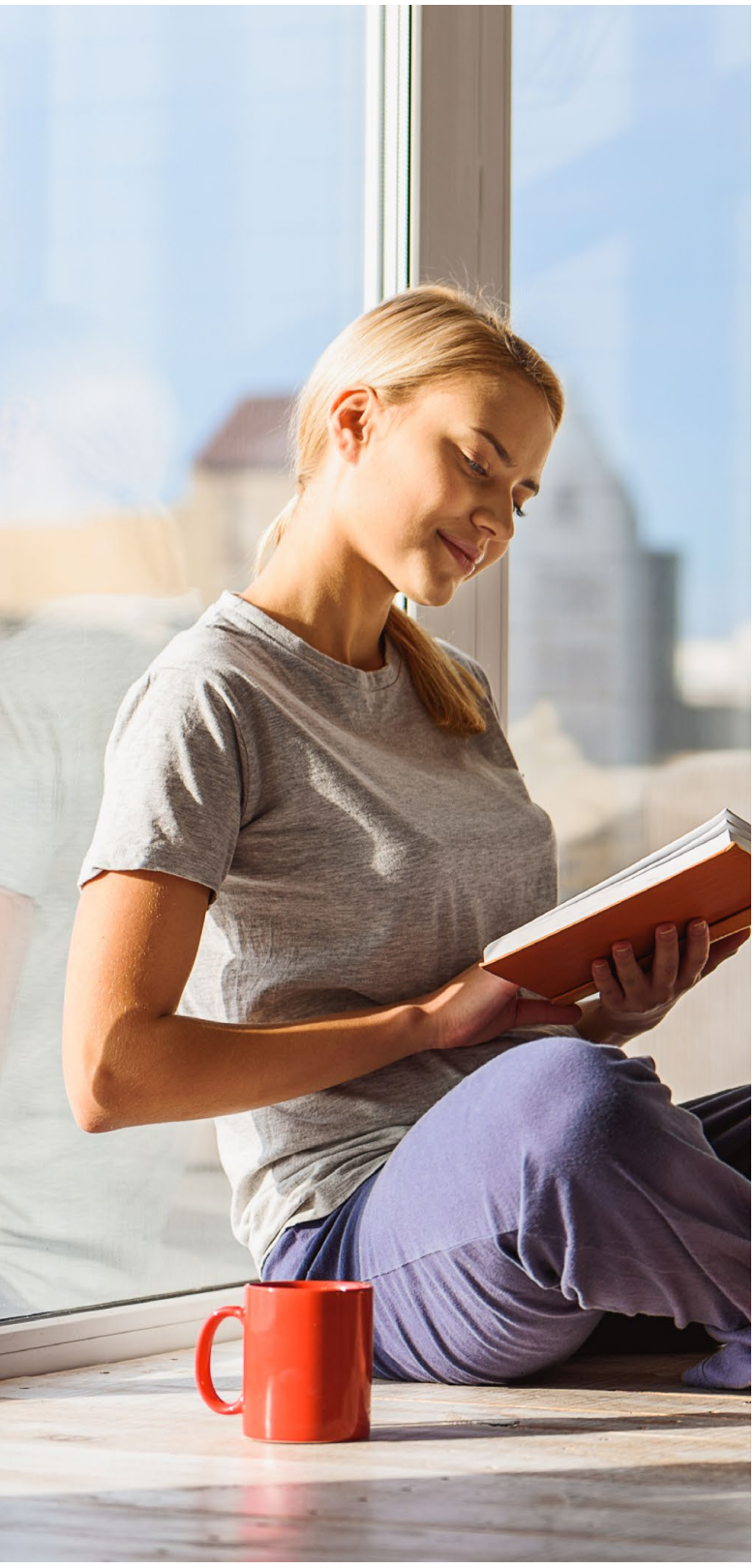
transparency

safety

protection

LAMINATED GLASS STADIP PROTECT AND STADIP PROTECT SILENCE ACOUSTIC

for your comfort



GLASS LAMINATION

Glass lamination is a conscious action to produce safety glass. It is made by sandwiching a PVB sheet (plastic interlayer) between two pieces of glass.

LAMINATED GLASS PRODUCTION PROCESS

Laminated glass production consists of main phases:

1. First, The glass panes are thoroughly cleaned. Then two perfectly clean sheets of glass are coupled, placing a sheet of PVB between them
2. Next, the air is removed, and the final effect of this process is a prelaminate.
3. The prelaminate goes through the autoclave process. In the autoclave the laminate is exposed to high pressures and high temperatures. The PVB foil combines with the glass, forming a laminate.

SAFETY GLASS
– discover the benefits of laminated glass

PROTECTION AGAINST INJURY

If the glass breaks, the fragments of glass remain bonded to the interlayer which reduces the risk of injuries. The standard glass pane breaks into small pieces, which can cause injuries very easily.

PROTECTION RISK OF FALLING

Laminated glass can protect a person who has broken the glass pane against falling out. As an obligatory to be in compliance with accuratelly sized and installation of glazing, in line with relevant regulations and requirements.

PROTECTION AGAINST VANDALISM AND BURGLARY

Laminated glass will make it harder for the attacker to get inside, so the property and occupants in the building are safe. Glass unit, installed in an appropriate frame, can be an important deterrent for burglars and delay their actions.

WHAT WILL YOU FIND IN OUR OFFER?

THE OFFER OF SAINT-GOBAIN BUILDING GLASS POLAND INCLUDES:

- STADIP glass incorporates a single PVB sheet with a nominal thickness of 0.38 mm
- STADIP PROTECT glass incorporates with two or more PVB sheets
- STADIP PROTECT SILENCE glass incorporates a special PVB sheet with particular acoustic properties; PVB SILENCE

IMPORTANT! Insulated Glass Unit (IGU) STADIP PROTECT SILENCE with PVB SILENCE has better acoustic insulation than the same glass thickness and number of foil sheets IGU STADIP and STADIP PROTECT but containing the PVB sheet.

COMPARISON OF STADIP PROTECT AND STADIP PROTECT SILENCE FOR THE SAME COMPOSITION OF INSTULATED GLASS UNIT

IGU STADIP composition	Rw*	C*	Ctr*
8/16AR/6/16AR/66.2 PROTECT	43	-2	-5
8/16AR/6/16AR/66.2 PROTECT SILENCE	46	-2	-6

Mechanical properties and safety parameters of STADIP, STADIP PROTECT, and STADIP PROTECT SILENCE are the same with the same composition (glass thickness, number of foil sheets).

Example: both STADIP PROTECT SILENCE 44.4 and STADIP PROTECT 44.4 are classified as P4A glass in accordance with the standard EN 356.

MULTIFUNCTIONALITY OF LAMINATED GLASS – HOW DOES IT WORK?

Depending on the functions, the laminated glass can be prepared on the basis of the following types of glass:

- PLANICLEAR float glass, DIAMANT extra clear glass with a low content of iron oxides, or PARSOL body-tinted glass
- COOL-LITE with a solar control glass
- ECLAZ or PLANITHERM low – emissivity glass
- ornamented glass
- VISION-LITE anti-reflective glass
- BIOCLEAN easy-to-clean glass

APPLICATION EXAMPLES

Application of DIAMANT extra clear glass, particularly in bigger thicknesses, guarantees high light transmittance and excellent colour rendition. VISION-LITE anti-reflective coating additionally allows to achieve perfect visibility of objects located behind the glass pane. Such a solution guarantees excellent colour rendition with no reflection.

Application of ECLAZ combines top energy efficiency with unparalleled access to natural daylight. Thanks to ECLAZ we have an opportunity to enjoy the advantages offered by thermal insulation of triple-glazing (excellent thermal insulation, high solar gain), with the simultaneous access to the same volume of natural daylight as provided by double-glazing.

Application of solar control glass from the COOL-LITE family protects building interiors against overheating, providing the optimum volume of natural daylight inside at the same time. The low value of the solar factor contributes to minimising discomfort associated with overheating in the summer season.

Villa Ola combines laminated ECLAZ x 2 laminated DIAMANT and middle pane VISION-LITE 44.2/16ar/4/16ar/44.8

LAMINATED GLASS – why is it worth?

INSULATED GLASS UNIT WITH LAMINATED GLASS – EXCELLENT PARAMETERS

Guarantee of safety, thermal, acoustic, and visual comfort (depending on the coating applied and the intended use).

Design your comfort behind glass.

GLASS BREAKAGE – SAFETY GUARANTEE

In the event of breakage of laminated glass, the foil keeps glass pieces in place. In a fully framed conventional installation, the glass fragments are held together and the glass retains a residual strength while awaiting replacement.

UV RADIATION – HIGH-LEVEL PROTECTION

Sunlight can cause discolouration of items inside a building that are exposed to direct sunlight. STADIP PROTECT range filters most UV rays and transmit only 0.4% of UV (compared to 44% for float glass). They provide maximum protection for items inside a building that are exposed to direct sunlight. (e.g. shop front displays, interior design elements).

PROTECTIVE FUNCTIONS OF LAMINATED GLASS

PROTECTION AGAINST FALLING OBJECTS (GLAZED ROOFS AND VERANDAS)

If an object falls onto the glazed roof, laminated glass will prevent the object from passing through the glass and also minimises the risk of fragments falling into the space below. The buildings` users are safe.

Depending on the composition, safety laminated glass STADIP meet requirements for overhead glazing.

STADIP PROTECT SILENCE considerably reduces the sound of rain and hail landing on to roof window.

INSULATION AGAINST THE SOUND OF RAIN FALLING ON THE ROOF WINDOW

PARTITION	COMPOSITION (mm)	LEVEL OF NOISE MEASURED INSIDE*
Polycarbonate	20	71 dB
STADIP PROTECT IGU	6 (12) 44.2	52 dB
STADIP PROTECT SILENCE IGU	6 (12) 44.2A	46 dB
STADIP PROTECT SILENCE IGU	44.2 A (12) 33.2A	39 dB

*Measurements taken in a glazed room exposed to rain, rain intensity: 50 litres/m²/h, height of the raindrop falling: 3m, roof slope: 10°.

PROTECTION AGAINST INJURY IN THE EVENT OF BREAKAGE

Glasses which have the protective function are called ‘safety’ in their official name. Hence, these will be all STADIP glasses range, compliant with the standard EN ISO 12543-2 – Glass in building – Laminated glass and laminated safety glass – Part 2: Laminated safety glass.

This type of protection – obligatory in motor vehicles (windscreens) and public buildings (schools, museums, etc.), is also fully justified in residential buildings, protecting inhabitants. If the glass breaks, the fragments of glass remain bonded to the interlayer which reduces the risk of injuries.

PROTECTION AGAINST NOISE

Thanks to the application of a special PVB interlayer PVB SILENCE, STADIP PROTECT SILENCE laminated glass allows to achieve optimal parameters wherever both acoustic insulation and impact resistance are essential – as a single panel (e.g. interpreting booths) and as an insulated glass unit (a reliable noise level outside should be determined on the basis of acoustic maps or acoustic noise conformity evaluations).

AWARDED

STADIP SILENCE is the awarded in the “Innovative Solutions for Windows” for “Acoustic and safety laminated glass STADIP SILENCE”.

PROTECTION AGAINST FALLING OUT

Thanks to accurate dimensioning, appropriate assembly, and supporting glass panels in compliance with the regulations and requirements in force, glass belonging to the STADIP PROTECT family can:

- secure residual stability of the glazing in the event of glass breakage
- prevent a fall of a person who has broken the glass pane

SAFETY LAMINATED GLASS – APPLICATIONS

- balustrades,
- glass partition walls,
- sloping glazing.

PROTECTION AGAINST ACTS OF VANDALISM AND BURGLARIES

STADIP safety laminated glasses are elements that considerably discourage burglars and improve the safety of property and people inside the building. Glass unit, installed in an appropriate frame, can be an important deterrent for burglars and delay their actions, giving you enough time to raise the alarm. Minor burglaries and acts of vandalism without use of tools are often associated with trial of breaking the glass.

Thrown objects and forces, which are described in EN 356, simulate acts of aggression to which glazed surfaces can be exposed. STADIP PROTECT to which this standard refers, provide different levels of protection against such acts of aggression.

THE LEVEL OF RISK AND THE REQUIREMENTS DETERMINE THE NECESSARY LEVEL OF PROTECTION AND THUS THE TYPE OF STADIP GLASS TO BE USED

The level of risk and the regulatory requirements determine the necessary level of protection, and thus the type of STADIP laminated security glass to use. This selection is determined by the type and value of the property to be protected, the type of building (for example: building which is easy to access, single or multi-family house, etc.) and its location (for example: stand-alone building, high risk area, etc.).

EXAMPLES OF STADIP PROTECT CLASS OF RESISTANCE ACCORDING TO EN 356

STADIP PROTECT	CLASS OF RESISTNANCE ACCORDING TO EN 356	THICKNESS (mm)	WEIGHT (kg/m^2)
33.2	P1A	7	16
44.2	P2A	9	21
44.3	P3A	9	21
44.4	P4A	10	22

	FACTOR TYPE	CLASS OF RESISTANCE	REACTION TYPE
1	Apartments, schools, offices, production plants: • internal doors • windows on upper floors • windows on ground floors	P1A	They protect against injury in the event of glass breakage and make it more difficult to break the glass when closing the window or door violently. They can protect against unprepared attempted thefts.
2	Newsstands, single family houses, windows on ground floors of blocks of flats, display windows of hotels and offices, commercial buildings with a low protected value, sports halls.	P2A	They protect against injury. They can constitute a temporary protection on tried of burglary without preparation.
3	Display windows of hotel and office lounges, commercial buildings with a considerable protected value, villas, pharmacies.	P3A, P4A	Glass panels that hinder break-ins, they can substitute for 10mm steel wire 150 mm mesh.
4	Museums, antique shops, art galleries, bank service lobbies, currency exchange offices, shops with a high protected value, luxury villas.	P5A, P6B	Glass panes with increased burglary resistance. They can substitute for bars made from 12 mm steel rods.
5	Jewellery stores, banks, special facilities, window displays of commercial facilities with a high protected value.	P7B, P8B	Glass panes with high burglary resistance. They can substitute for bars made from 16 mm steel rods.

GLASS AND ACOUSTIC INSULATION

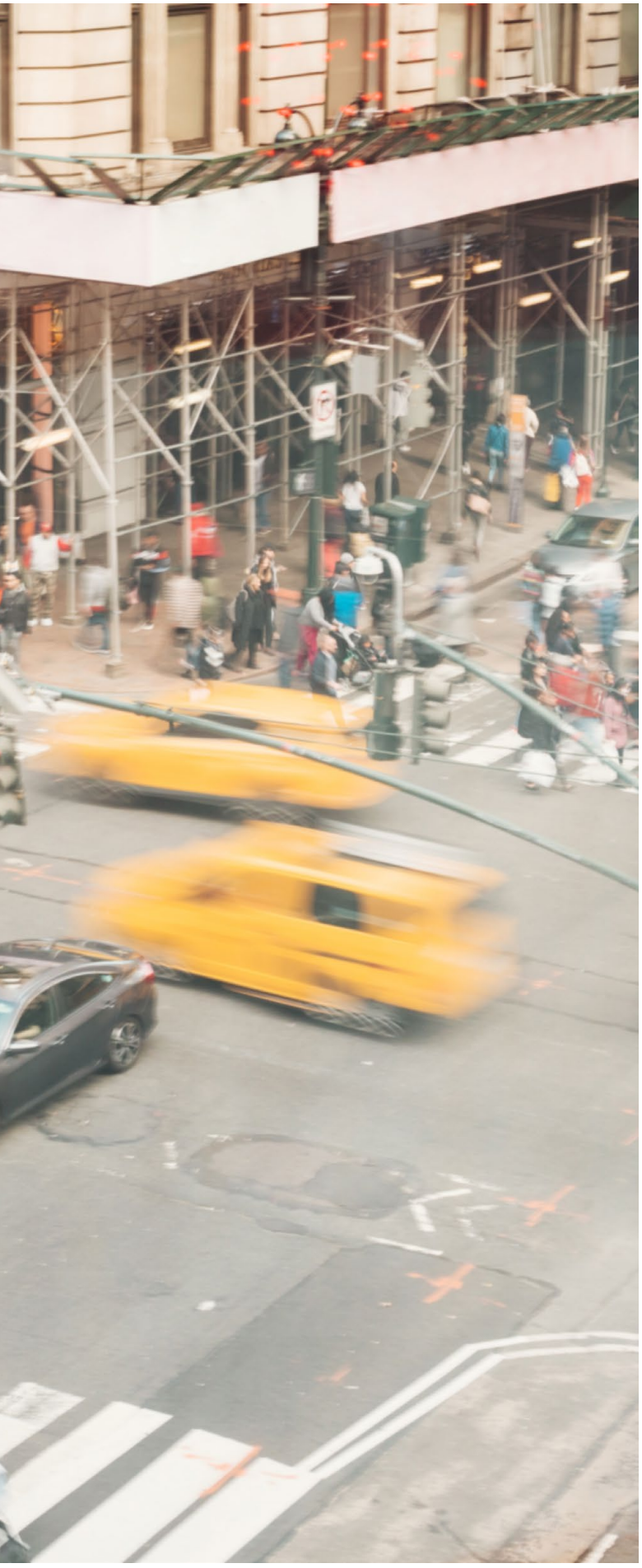
Sound is measured in decibel (dB) which determines the volume of the sound – 0 dB is a reference level, whereas 120 dB is the pain level.

IMPORTANT: Remember! When calculating decibels, 1+1 does not equal 2!

Two sources of noise with the level of sound of 50 dB generate the total noise of 53 dB. Double noise sources increase the sound intensity level by 3 dB. To obtain sound intensity by 10 dB, it is necessary to increase the number of noise sources ten times.

Frequency, expressed in hertz (Hz) describes the source of noice
Frequency is the number of sound waves in a one second cycle (frequency). The more numbers of sound waves the higher the sound (high tones). Low tones (low frequencies) are less audible by human ear: quiet – low amplitude, loud – high amplitude.

For acoustic in buildings the most important frequencies are between 100 and 4000 Hz. In this frequency range external and internal walls should provide effective acoustic insulation.



WHAT IS NOISE?

Noise can damage or can cause permanent hearing loss. It is nothing more than unpleasant sounds with excessive intensity, which are perceived as disturbing our hearing and in many cases as harmful. We have internal and external noise in buildings.

HUMAN HEARING – HOW DO WE PERCEIVE SOUNDS?

Sound perception is not linear, because because a drop in the sound intensity:

- by 1 dB is practically no noticeable for human
- by 3 dB is already noticeable
- by 5 dB is perceived as a noticeable improvement
- by 10 dB is perceived as reducing the noise by half

April 25 is the International Noise Awareness Day.

DIFFERENT SITUATIONS, DIFFERENT PERCEPTION OF SOUNDS

	dB
Plane taking off	140
Pain level	120
Concert, disco	105
Noise level that constitutes a risk	90
Risk level	85
Highway in the city	82
Crossroad in the city	78
Sounds through the window overlooking a busy street	70
Sounds through the window overlooking a quiet street	55
Surroundings of a house in the countryside	30
Light breeze	20
Rustle of leaves in the wind	10
Reference level	0

DAILY LIFE*

	dB
Passing bus with a window open, measurement taken 2 m away from the window	57,2
Passing bus with a window closed, measurement taken 2 m away from the window	34,7
Noise in an office with a window open, measurement taken 2 m away from the window	59,3
Noise in an office with a window closed, measurement taken 2 m away from the window	43,6
Car interior on a highway: 120 km/h 140 km/h 140 km/h (open window)	 70,4 72,1 82,1

*Based on the report „Poland in Decibels".

ACOUSTIC COMFORT AT ANY TIME – YOU WILL HEAR WHAT YOU WANT TO HEAR!

Glass protects against external noise and fulfils a crucial role in maintaining acoustic comfort.

A well-balanced environment on one hand blocks undesirable and harmful noise, and on the other enhances the sounds we want to hear. Apart from oppressive noise causing physical damage to our health, 'acoustic comfort' guarantees that we will hear neither of our closer or further neighbours, nor will they hear us. A crucial aspect and a real challenge is the fact that it is very expensive, and sometimes simply impossible, to improve acoustic comfort in an existing building where designing or construction errors have been made.

Glass protects against external noise and fulfils a crucial role in maintaining acoustic comfort.

In Poland new buildings have to meet six standards that describe evaluation criteria and requirements for full protection from noise and its effects. They are referred to in the regulations contained in Official Journal 2002 No. 75 item 690 as amended (consolidated text: Official Journal 2015 item 1422, appendix 1), which must be adhered to. They are applied when designing, constructing, rebuilding and usage single- and multi-family residential, commercial and public buildings.

IMPORTANT! It is crucial to take the requirements of all these standards into account. If the scope of one of them is omitted or left behind, it can cause a failure to satisfy the requirements of another.

EXCELLENT QUALITY THROUGH AND THROUGH

ACOUSTIC INSULATION – DEFINITION

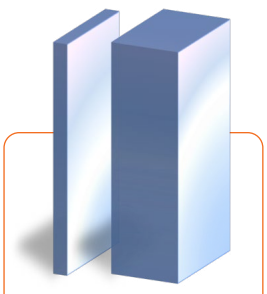
Acoustic insulation is the ability of elements of buildings to prevent undesirable penetration and transmission of sound.

THE FOLLOWNG ELEMENTS DO NOT HAVE ANY IMPACT ON ACOUSTIC INSULATION OF A GLAZING:

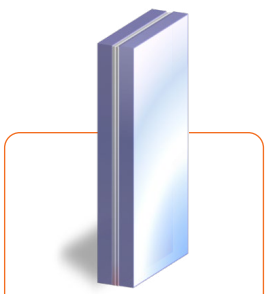
- application of a solar control or thermal insulation coating
- glass tempering
- different position within Insulated Glass Unit e.g. 8/16/6/16/66.2 and 66.2/16/6/16/8

Acoustic parameters of windows are connected not only with the type of glass, but also with the type of frame, the IGU assembled, with the installation of window shutters, and with the overall installed system. Therefore, an acoustic glass pane must be assembled in a frame demonstrating appropriate parameters and must be well installed. A window with STADIP PROTECT SILENCE has optimal acoustic parameters, providing people inside the building with comfort and excellent mood.

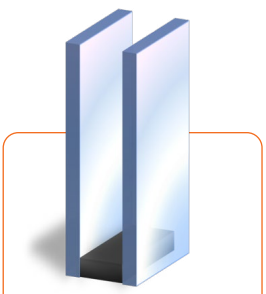
WHAT FACTORS INFLUENCE THE IMPROVEMENT OF ACOUSTIC INSULATION?



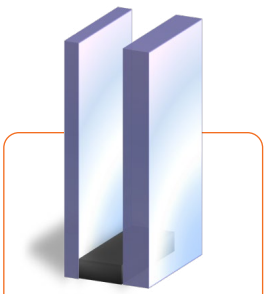
GLASS THICKNESS



LAMINATED GLASS type of foil used



INTERPANE SPACE width of the spacer



IGU COMPOSITION asymmetry

GLAZING RIGIDITY

MONOLITHIC GLASS AND ACOUSTIC INSULATION

Glass thickness – the mass law

The mass law applies to single partitions made of metal, concrete, brick. etc., as well as to glass panes. According to the assumptions of the mass law, the greater the weight of glass, the better the sound insulation provided. Noise transmitted through glass panes of the same thickness is lower the higher the frequency of the sounds is (from low to high tones), reaching a certain value referred to as critical sound frequency. At this frequency the glass has poor sound insulation properties, which results in the so-called unwanted acoustic peak.

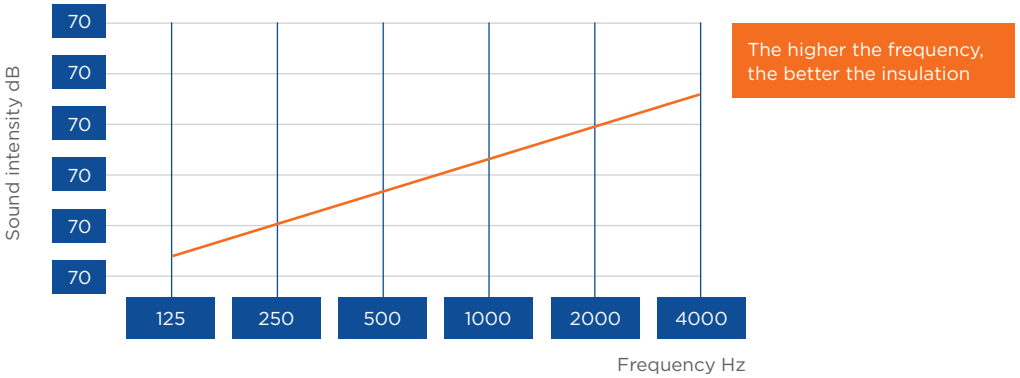
The application of laminated glass allows to reduce unwanted acoustic peak. How does it work? The PVB foil placed between two glass panes acts as an absorber, which muffles noise. In STADIP PROTECT SILENCE a special plastic foil is used, PVB SILENCE.

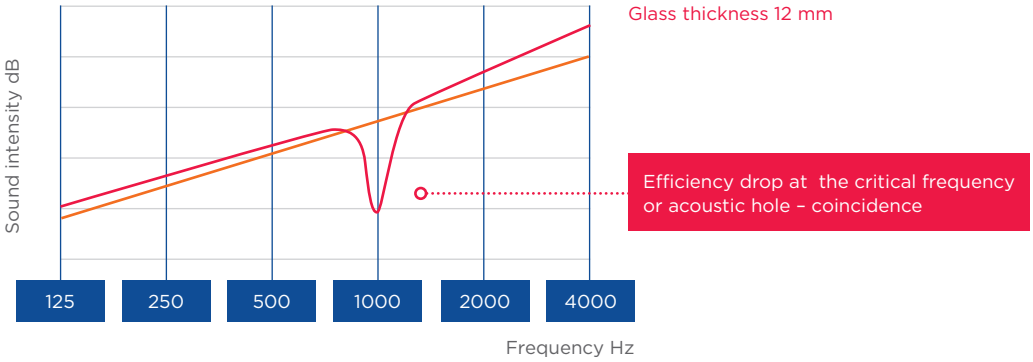
It allows to reduce the unwanted acoustic peak around the critical frequency almost completely, in comparison to the standard laminated glass, where the sound peak is still audible and oppressive.

TYPES OF GLASS PANES VS. ACOUSTIC INSULATION – select the right solution for your needs

MONOLITHIC GLASS

The the higher the sound pitch, the better the sound insulation. When the critical frequency is reached, noise becomes oppressive, because it is muffled in a less effective way.

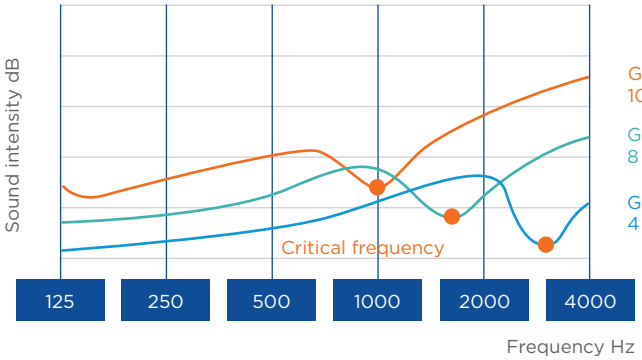




THICKER MONOLITHIC GLASS

The thicker the glass, the better the sound insulation. The acoustic peak just moves to lower frequencies which are less audible for the human ear.

THEORETICAL SOUND INSULATION CURVE



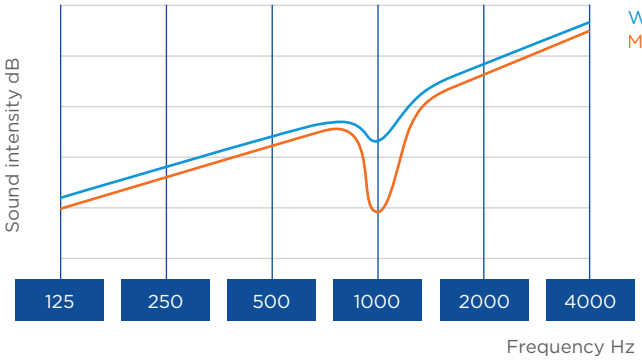
As the glass thickness **grows**, the critical frequency **drops**.

Thicker glass is appropriate for **high frequencies.**

LAMINATED MONOLITHIC GLASS

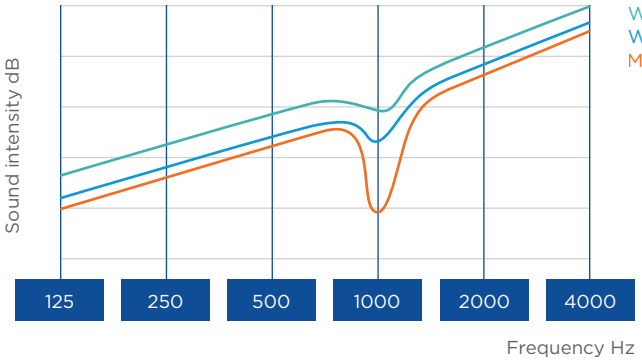
STADIP PROTECT

The unwanted acoustic peak at the level of the critical frequency is slightly reduced, but it still remains oppressive. The result is very similar to non-laminated glass of the similar thicknesses.



STADIP PROTECT SILENCE

Elimination of the unwanted acoustic peak, which makes the best solution.



ATTENTION! The flatter the graph, the better acoustic insulation of the glass pane.

INSULATED GLAZING UNIT VS. ACOUSTIC INSULATION

„MASS-SPRING-MASS" LAW

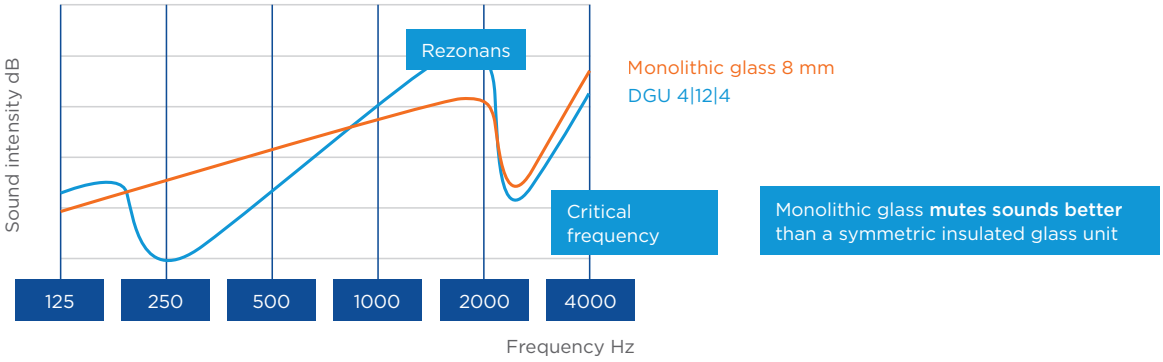
Two masses, i.e. two glass panels, are separated by a cavity with gas, which acts as a spring, dampens the vibrations. The Insulated Glass Unit is characterised by a specific resonance frequency, at which it begins to vibrate spontaneously, generating the unwanted acoustic peak in low frequencies. The lower the resonance frequency, the less sensitive to it the human ear is. Insulated glass unit has two critical frequencies, which characterise each of the two panels (see: monolithic glass).

If an insulated glass unit is symmetric, the unwanted acoustic peak is stronger for the whole than for each monolithic glass separately.

With asymmetric insulated glass unit (two glass of different thicknesses), we deal with two acoustic peaks, which are, however, weaker than for each monolithic glass separately.

SYMMETRIC INSULATED GLASS UNIT

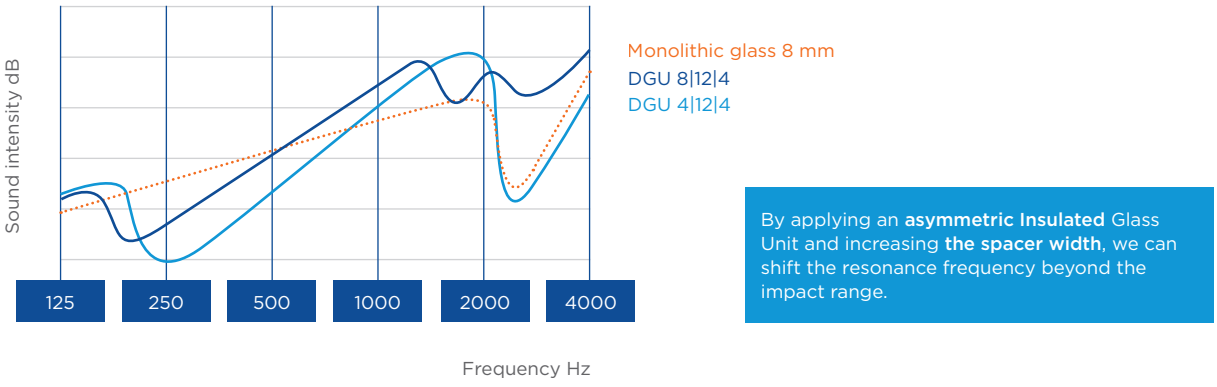
It reduces noise less than a monolithic glass of the thickness equal the sum of thickness insulated glass unit. It has the “mass-spring-mass” resonance within the range of low frequencies. It has a high unwanted acoustic peak within the range of high frequencies, because the critical frequency of both glass panes is identical.



Monolithic glass **mutes sounds better** than a symmetric insulated glass unit

ASYMMETRIC INSULATED GLASS UNIT

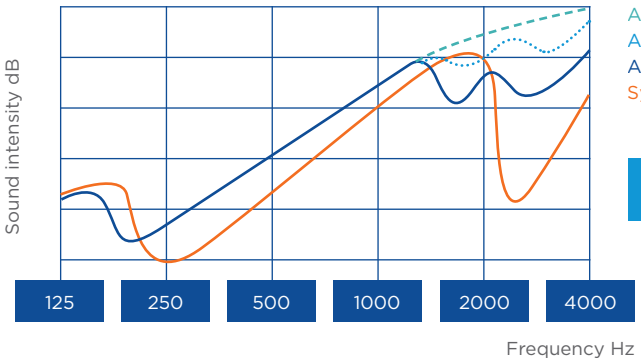
Better acoustic characteristics than for a symmetric Insulated Glass Unit. The „mass-spring-mass” resonance point within low frequencies is lower and moves towards the lower frequencies, which allows to achieve better acoustic insulation. An asymmetric insulated glass unit has two unwanted acoustic peaks at high frequencies, which are weaker, because critical frequency of glass panne of different thicknesses are not the same.



By applying an **asymmetric Insulated** Glass Unit and increasing **the spacer width**, we can shift the resonance frequency beyond the impact range.

ASYMMETRIC INSULATED GLASS UNIT

STADIP PROTECT: unwanted acoustic peaks at high frequencies are lower, but they still remain inconvenient.
STADIP PROTECT SILENCE: unwanted the acoustic peaks at high frequencies disappear, which makes it as a perfect solution.



Asymmetric laminated IGU with the PVB SILENCE foil
Asymmetric laminated IGU with the PVB foil
Asymmetric IGU
Symmetric IGU

Methods of increasing the acoustic insulation of an IGU

STADIP RANGE IN IGU – EXAMPLES OF THE ACOUSTIC TESTS RESULTS IN IFT ROSENHEIM IN 2020

COMPOSITION	THICKNESS (mm)	RW (dB)	RA1 (dB)	RA2 (dB)
STADIP PROTECT SILENCE 33.1	7	35	35	32
STADIP PROTECT SILENCE 44.1	9	37	36	34
STADIP PROTECT SILENCE 55.1	11	38	38	36
STADIP PROTECT SILENCE 66.1	13	39	39	37

STADIP range in IGU – examples of the acoustic tests results in IFT Rosenheim in 2020

COMPOSITION (glass / interpane space / glass / interpane space / glass)	THICKNESS (mm)	RW (dB)	RA1 (dB)	RA2 (dB)
33.1/16AR/4/16AR/33.1	49	39	37	32
6/16AR/6/16AR/55.2	55	43	41	38
10/16AR/44.1 SIL	35	43	42	38
10/16AR/44.2 SIL	35	44	42	38
44.1SIL/16AR/6/16AR/44.1SIL	55	46	45	39
44.1SIL/16AR/4/16AR/44.1SIL	53	47	45	40
8/16AR/6/16AR/66.2SIL	59	46	45	41
10/16Ar/8/16Ar/55.2 SIL	60	48	46	43
66.1SIL/12AR/5/12AR/44.2SIL	50	49	47	43
10/16AR/8/16AR/66.2 SIL	63	48	47	44

- SIL stands for PVB SILENCE
- RW (C; Ctr) expressed as DB, is the weighted sound reduction index of a partition, in compliance with EN 12354-3. The same index may refer to different acoustic insulation curves. C and Ctr are adjustment factors, nearly always are negative values.
- RA1=RW+C – this is applied to noise sources with high frequencies (household noise sources – conversation, music, TV, radio, children playing, jet aircraft in close proximity, highway > 80 km/h)
- RA2=RW+Ctr – this is applied to noise sources with low frequencies (traffic, disco music, jet aircraft in a long distance).

CLASSIFICATION STANDARDS

STANDARDS

- The standard EN 12600 (pendulum test) allows to classify glass depending on its resistance and mode of breakage. The standard defines 3 levels of impact, which in theory correspond to the kinetic energy associated with an accidental collision of a person with a single glass pane (for laminated glass – type B). In practice, STADIP, STADIP COLOR belong to class 2B2, STADIP PROTECT – to class 1B1.
- The standard EN 356 (resistance of glass to an impact of a steel ball and attempted break-ins by means of an axe) allows to classify anti-burglary glass.
- The standard EN 356 determines eight protection classes, in ascending order from P1A to P8B.

RANGE

STADIP, STADIP PROTECT, STADIP PROTECT SILENCE glasses manufactured by Saint-Gobain Building Glass Polska are available in maximum dimensions of 6000 x 3210 mm.

COMPLIANCE WITH REGULATIONS

The range of STADIP, STADIP PROTECT, STADIP PROTECT SILENCE comply with the standards EN 14449 and EN ISO 12543 and have the CE marking. For STADIP SILENCE – acoustic parameters according to the standard EN 12758.

Explanation of markings of laminated safety glasses

STADIP 44.1
4 = 1 glass pane of 4 mm
4 = 1 glass pane of 4 mm
1 = 1 PVB foil of 0,38 mm

STADIP PROTECT 66.2
6 = 1 glass pane of mm
6 = 1 glass pane of mm
2 = foil of 0,76 mm

STADIP PROTECT SILENCE 55.2
5 = 1 glass pane of mm
5 = 1 glass pane of mm
2 = 1 PVB SILENCE foil of 0,76 mm

STADIP PROTECT SP 722
SP = laminated glass with enhanced protection against burglaries and acts of vandalism
7 = class accordance with the standard EN 356: P7B
22 = total nominal thickness: 22 mm

Villa Metro
Architect: DA Dziuba Architects
Applied glass: COOL-LITE SKN 176 II STADIP PROTECT 55.2, and COOL-LITE SKN 176 II STADIP PROTECT SILENCE 55.2

SAINT-GOBAIN
BUILDING GLASS POLAND
Saint-Gobain
Innovative Materials Polska Sp. z o. o.
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