Technical Bulletin

1012 – Glass Acoustics

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Australian Glass Group®

TB 1012 – Glass Acoustics

Cited Documents

- NCC Volumes 1 & 2 2019
- W.H.O. Guidelines for Community Noise – 1999

Acoustic performance of glass components in any building has a direct impact on the comfort of the end user, whether a residential
home/apartment building or an office building. Sources of noise such as railroads, airports, highways, main arterial roads, suburban streets and human speech occur at slightly different frequencies, and the best performing glass option will vary depending on the noise source(s). This technical bulletin serves to assist the reader in understanding and then specifying the best glass solution for the particular situation.

Noise Levels

Noise levels are measured in decibels (dB), where more decibels equates to a louder noise. Decibels are also measured on the logarithmic scale which is not linear, so a noise of 100dB such as a nearby car horn is 8 times louder than a washing machine at 70dB. The World Health Organisation recommends a maximum of 30dB in a sleeping area during sleeping hours, and this is reflected in council development plans and/or building codes around the world. If an external noise of 60dB is expected, then all components of the façade would need to reduce the noise from 60dB down to acceptable levels. A double glazed unit with an Rw value of 30 would reduce the noise level inside to 30dB immediately behind the glass (excluding flanking sound from other entry points).

Typical Sound Sources	Average Noise Level (dB)
Normal breathing	10
Ticking watch	20
Soft whisper	30
Refrigerator hum	40
Normal conversation	60
Washing machine	70
City traffic (whilst inside car)	80-85
Petrol lawn mowers	80-85
Motor bikes	95
Approaching subway train, car horn at 5m	100
Very loud stereo, rock concert	105-110
Shouting/barking in ear	110
Standing next to sirens	120

Noise level data sourced from CDC https://www.cdc.gov/nceh/hearing_loss/what_noises_cause_hearing_loss.html

AGG NSW
140 Gilba Rd
Girraween, NSW
P: (02) 9896 0566
F: (02) 9896 0190

AGG VIC
81-83 Rushdale St
Knoxfield, VIC
P: (03) 9730 7400
F: (03) 9730 7488

AGG TAS
39 South Arm Rd
Rokeby, TAS
P: (03) 6247 1625
F: (03) 6247 6843

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agg.com.au | info.agg.com.au | 1300 768 024

Common Acoustic Criteria

Rw is the weighted sound index, and is the result of laboratory testing of components. It is averaged across several frequencies and is expressed in dB. Many building components have an Rw value, and glass is no exception. Commonly, building components have further reductions to their Rw value, as a representation of how each element performs against certain sound frequencies. These are normally C and Ctr. C represents human speech, music and some components of aircraft and highway traffic whereas Ctr represents urban traffic noise. Noise sources corresponding to Ctr values are of a lower frequency than C values.

Both C and Ctr are expressed as a negative value, so building specifications and or acoustic reports will often state a value of Rw + C or Rw + Ctr. A window with an Rw value of 30, -2 C and -4 Ctr would have the resulting sound reduction of 28 for Rw + C and 26 for urban traffic Rw + Ctr. Currently, the NCC specifies minimum Rw + Ctr values for internal floors and walls but not for the external envelope of the structure.

Damping

Any material will vibrate at a certain frequency when a sound wave comes into contact with it. The frequency will be determined much like any other deflection under load; by material properties, support conditions and cross sectional area. Damping occurs when two materials in close proximity are vibrating at different frequencies, in simple terms these two frequencies act to partially cancel each other out by filling in the troughs and lowering the peaks in the wave pattern. This results in a reduced amount of sound on the other side of the objects, as more of the soundwave's energy has been used up to overcome the damping effect.

Natural Frequency

As mentioned above, any material will vibrate when a sound wave hits it. For each combination of material, thickness & support condition, there exists what is called the natural frequency. When an object is vibrating at its natural frequency this is called resonance. When this occurs, the object is providing little to no sound resistance and is effectively transmitting maximum sound through itself.

AGG NSW

140 Gilba Rd
Girraween, NSW
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F: (02) 9896 0190

AGG VIC

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Monolithic or Laminated Glass?

Consider the table below, which displays the acoustic performance of 6mm monolithic toughened (6T) and 6.5mm acoustic laminate glass.

Glass	Rw	C	Ctr	Rw + C	Rw + Ctr
6	31	-2	-2	29	29
6.5	36	-1	-4	35	32

In both Rw + C & Rw + C_{tr} the laminate glass performs better, however this does not mean that laminate glass is always the best option. The Rw value is a weighted average, the purpose of this is to provide a single number and make it easier for all users to understand and compare against other glass types. The C and C_{tr} factors serve to skew the Rw value towards a certain frequency band, but are still a representation of a weighted average.

When considering what glass make up will be the best option for sound resistance, it is important to consider the frequency of the noise you wish to resist. If this sound frequency is closer to the natural frequency of a glass type, then this glass type will not perform as well as another. Consider the C_{tr} values of both glass types above, -2 for 6mm monolithic toughened and -3 for 6.5mm acoustic laminate.

This is due to the frequencies commonly found in urban traffic noise are closer to the natural frequency of the 3mm glass components that comprise the 6.5mm acoustic laminate than the natural frequency of 6mm monolithic glass. If we were to consider a lower frequency noise source such as a locomotive moving slowly nearby, its' likely that thick monolithic glass would perform similarly or even better than the acoustic laminate option for that specific noise offender.

Single or double glazed?

With a double glazed unit (DGU) comes more options for sound reduction. Not only will there be some damping between inner and outer panes, but there is also the option of including laminate in the unit composition. This in turn can be tailored to achieving sound reduction in both C and C_{tr} values, or skewed towards one or the other.

Incorporating a DGU into your specification will also increase the energy performance of the window, significantly so if a modern Softcoat LowE and a dense gas such as Argon are used. This in turn increases occupant's comfort and therefore useable space in any project.

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AGG's offering

AGG will provide acoustic calculation results on a project upon request. We can also provide options on glass make-ups to equal or better requirements in acoustic reports, specifications and council zoning plans. These results will be in Rw and can include both C and C_{tr} if required. This is a glass only calculation, and as such should not be taken as comparable to an in situ result, nor the acoustic performance of the window (including frames).

AGG offer speicaised acoutsic laminate, **Audioshield®**
Audioshield® is a high performance acoustic laminate that uses a special interlayer for superior sound reduction against a full range of noises. Audioshield® consists of 2 pieces of clear glass manufactured as one unit with a middle specialised interlayer that also acts as a strong adhesion against penetration, remaining in place and safe if the glass breaks. With a clear interlayer and using clear glass, high Clarity allows a clean view through the glass and high Visible Light Transmittance (VLT) that optimises natural light entering inside and filling your space.

We can also offer estimated full frame Rw based on the exact frame type.

Acoustic performance of common glass make ups

Glass Type	Thickness (mm)	Rw	Rw + C (dB)	Rw + Ctr (dB)
Monolithic	4	30	29	29
Monolithic	6	31	29	29
PVB laminate	6.38	32	32	31
Acoustic laminate	6.5	36	35	32
Monolithic	10	35	34	33
PVB laminate	10.38	36	35	34
IGU	4/12/4	32	31	29
IGU	6/12/6	34	33	30
IGU, differential thickness	4/12/6	33	32	30
IGU with laminate inner	6/12/6.38	39	38	34
IGU with acoustic laminate	6/12/6.5	41	40	36
IGU, differential thickness	6/12/10	37	36	33
IGU with laminate inner	10/12/10.38	43	32	39
IGU with acoustic laminate	10/12/10.5	46	45	42

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