TECHNICAL FACT SHEET: ACOUSTICS AND WINDOWS

Version 1 Released June 2019

Congestion and noise pollution are increasing as development spreads further and densities become higher in urban areas. Add to these a general desire amongst homeowners to get away from it by blocking out the outside world as much as possible and you see consumers turning more to their windows for solutions.

Measurements of Sounds

The decibel (dB) is the unit used to measure the intensity of a sound. The decibel scale is logarithmic: each 10 dB increase in sound corresponds to a perceived doubling of the loudness.

Rw represents the Weighted Sound Reduction Index. This is a single number rating for the insulation property of a window for airborne sound. It is based on an average reduction across a range of frequencies in the audible range (between 100 Hz to 3.159 kHz).

In some cases, Rw+Ctr is specified. The Ctr factor adjusts for low frequency sounds, such as road traffic noise, that are transmitted through materials more readily than higher frequencies. The higher the Rw value, the better the sound insulation achieved. The Rw correlates in a general way to decibels of sound reduction.

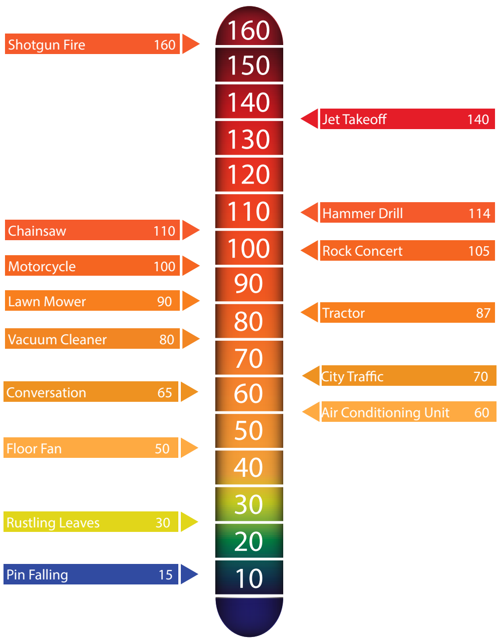

Figure 1 The Decibel Scale (logarithmic) Source: Australian Fenestration Training Institute

Regulatory Requirements

Volume One of the National Construction Code (NCC) covers the internal acoustic considerations for multiple dwellings Class 2, 3 and 9c buildings, but does not provide specific guidance for other building types. In some circumstances, such as near main roads and airports, additional requirements may be required. These are generally covered by Local Government authorities. AS/NZS 2107 contains recommendations for the internal sound levels that should be achieved for various rooms based on their intended use. While the standard is not called up in the NCC it does provide guidance for building designers and planning authorities.

Table 1 Acoustic Considerations for Dwellings Source: AS/NZS 2107

Environment	Satisfactory	Maximum
Classrooms	35 dB(A)	40 dB(A)
Conference Rooms	30 dB(A)	35 dB(A)
Hotel/Motel Sleeping Rooms	30 dB(A)	35 dB(A)
Residental	30 dB(A)	
- Recreation Areas	30 dB(A)	40 dB(A)
- Sleeping Areas	30 dB(A)	35 dB(A)
- Work Areas	35 dB(A)	40 dB(A)

QUICK FACT

- An increase of 10 Decibels is equivalent to a percieved doubling of sound.
- The human ear cannot detect a difference of two Decibels.
- RW+CTR is the Road Traffic Weighted Sound Reduction.

Australian Glass & Window Association (AGWA)
a: Pymble Corporate Centre, Suite 1, Level 1, Building 1, 20 Bridge Street, Pymble NSW 2073
t: +61 2 9498 2768 f: +61 2 9498 3816 e: info@awa.org.au w: www.awa.org.au

TECHNICAL FACT SHEET: **ACOUSTICS AND WINDOWS**

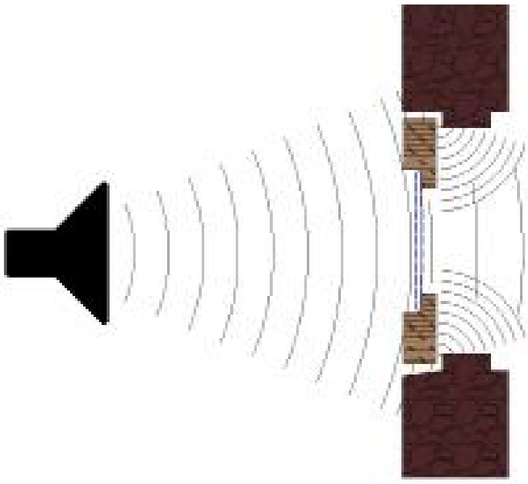

Figure 2 Sound Propagation Through a Window

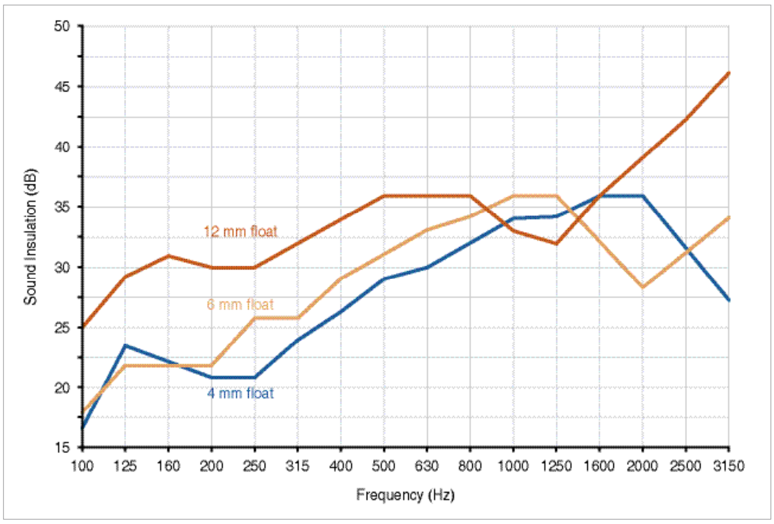

Figure 3 Acoustic Performance of Float Glass Source: Australian Fenestration Training Institute

Acoustic performance of windows and glazed doors

Windows and doors are often seen as a building's weakest element in the fight against unwanted noise, as ordinary glass and poorly sealed windows provide very little noise resistance.

Sound can enter through windows and doors via two means: penetration and propagation. Effective noise attenuation requires both of these mechanisms to be addressed.

Sound penetrates a window or door through gaps. Any gaps (even quite small ones) will allow large amounts of noise to enter. In order to provide maximum sound insulation, windows and doors should be tight fitting into their frames and effectively sealed. Some window types (such as sliding or double hung) often require some clearance between the frame and the operating parts like the sash and therefore are harder to seal. Hinged products, such as awning and casement windows tend to use compression seals which typically provide superior performance.

In all cases, good quality seals are important to minimising gaps around window sashes and door panels. Seals that cover the full perimeter of the opening and have a relatively high mass tend to work best, and special acoustic seals are designed to provide optimal performance.

Sound can also propagate through a window. As sound waves hit the outer surface of the glass, they cause the glass to vibrate in unison, creating sound waves on the inside.

Generally speaking, thicker glass performs better in attenuating noise. However, different glass thicknesses perform differently at different frequencies.

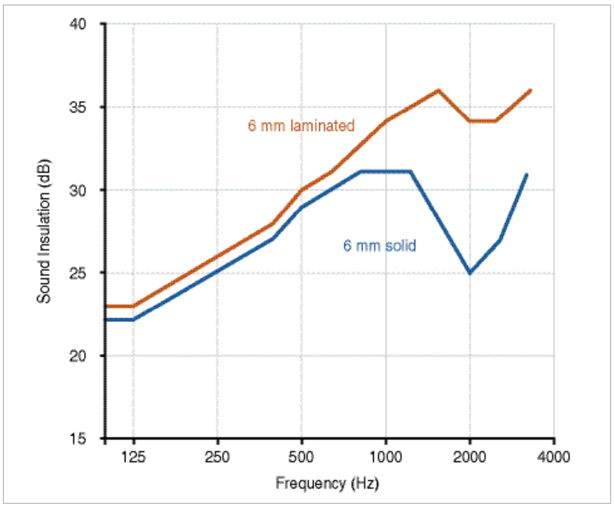

Figure 4 Acoustic Performance Comparison: Laminated Glass versus Float Glass. Source: Australian Fenestration Training Institute

At the lower frequencies, 12 mm glass is much more effective than 6 mm or 4 mm while there is little difference at the higher frequencies. Where the noise problem is traffic and other low frequency noises, a thicker glass will provide the most benefit.

In Figure 3, the graph lines rise and then suddenly dip. This happens when the glass vibrates in unison with the frequency of the sound. This is called the 'coincidence

Laminated glass performs slightly better than monolithic glass of the same thickness, especially at higher frequencies. In Figure 4, the graph compares 6 mm laminated glass with 6 mm float glass. Note the coincidence dip in the float glass at 2000 Hz compared with a smaller dip for the laminated glass.

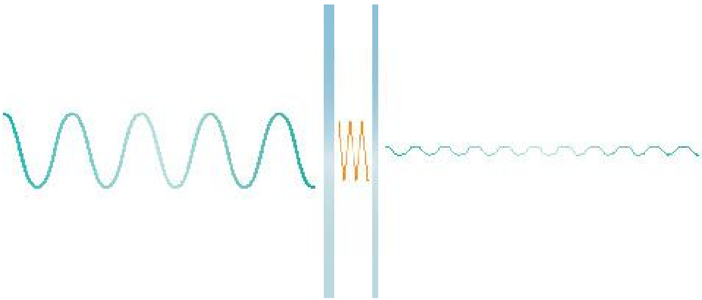

Figure 5 Sound waves as they propagate through laminated glass constructed with an acoustic interlayer. Source: Australian Fenestration Training Institute.

High Performance Solutions

A variety of high performance solutions are available that can be tailored to suit different applications. For specific or high level noise problems, an acoustics engineer can provide a solution. The acoustic engineer assesses the level and types of noise affecting the building and specifies the appropriate acoustic performance requirements.

A common misunderstanding is that all double glazing is effective at attenuating noise. However, studies have shown that ordinary double glazing with a standard gap of about 12 mm does not substantially improve the acoustic performance. This gap is too small to provide any real benefit. The most effective solution is to increase the gap between the two panes to at least 100 mm. This is referred to as secondary glazing and usually involves two separate window frames placed back-to-back.

Another solution is to use two pieces of glass, either in an Insulated Glass Unit (IGU) or Laminate, with each pane a different thickness. For instance, one pane might be 4 mm and the other 6 mm. Each pane in a dissimilar glass unit will block different sound frequencies. Figure 5 illustrates sound as it travels through the dissimilar glasses. The thicker pane targets lower frequency sounds like a neighbour's stereo or traffic noise. The thinner pane targets higher frequency sounds like screaming and jet aircraft. This leads to a reduction in amplitude (loudness) across a wider spectrum of frequencies and the result is a significantly higher acoustic rating than for a window with standard glazing. The thicker glass should be about 40 per cent thicker than the thinner glass to have the most benefit.

Recent technological advances in the manufacture of the interlayer of laminated glass have provided an improvement in acoustic performance. Acoustic laminates have a thicker, specialised interlayers, up to 1.52 mm thick, and provide some improvement over standard laminates

Figure 6 Acoustic Test Laboratory Source: CSIRO.

Figure 7 Preparing testing equipment at the CSIRO acoustic laboratory. Source: CSIRO

Verification of Performance

Windows are tested in a special laboratory, which basically entails two reverberation chambers separated by an opening. 'White' noise is broadcast from one chamber and received in the other to determine the base figures. A window is then installed into the opening and the sequence repeated. The difference in measurements between the first and second sequence represents the overall attenuation provided by the window specimen.

Whole of window performance values (expressed as an Rw rating) are important in determining the overall performance of the system. Whilst comparing glass performance values is helpful in comparing one glass type with another, these values do not account for the possible effects of gaps, seals, and other window elements which may enhance or degrade the overall performance of the window.

Acoustic testing should be conducted in laboratories, using methodologies, equipment and other requirements of Australian Standard (AS) 1191 Acoustics—Method for laboratory measurement of airborne sound insulation of building elements.

AUSTRALIAN GLASS & WINDOW ASSOCIATION

Figure 8 An internal gap between the architrave wall.

Figure 9 A gap on the external wall surface between frame and brickwork.

Figure 10 Applying sealant to the external frame of a glazed sliding door.

Window Installation

Just as important as the window or door itself, is its proper installation. Any gaps around the perimeter of the window or door will allow sound to enter the wall cavity and will reduce the overall performance achieved.

Gaps, no matter how small, should be sealed effectively, particularly on the outside of the wall cavity. Wherever possible, both exterior and interior faces should be sealed. There are a wide range of products available for this purpose. Some examples are given in Figures 10 through 12.

Figure 11 Applying high density acoustic foam

Figure 12 Applying high density acoustic foam to the exterior of the window frame.

NOTE: Windows should be considered as one component to an overall acoustic solution. Penetrations, such as down-lights, vents and exhaust fans can be a contributing factor leading to increased internal noise levels