smart
SYSTEMS

White Paper.
A guide to the acoustic performance of Smarts Systems Products.

Building Regulations **Document E**
Resistance to the passage of sound

Smart Systems Ltd.
January 2007

Contents

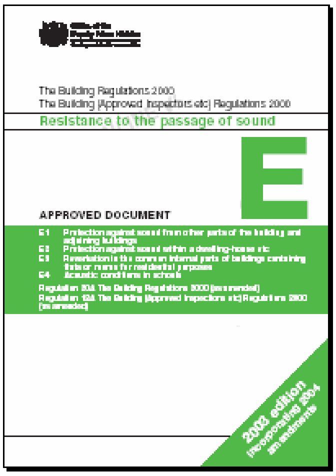
Building Regulations.. 4
Acoustic Performance - Overview.................... 5
Influencing Factors 5
Glass Values 6
Framing System.. 6
Testing Frame performance............................. 6
Standards: 8

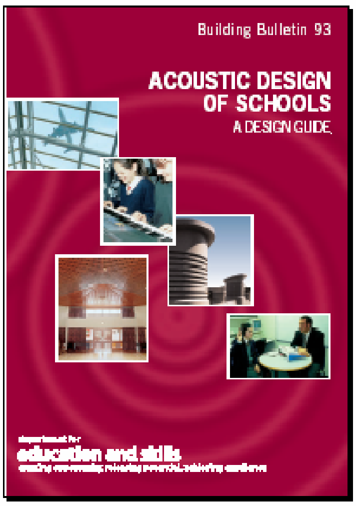
INTRODUCTION

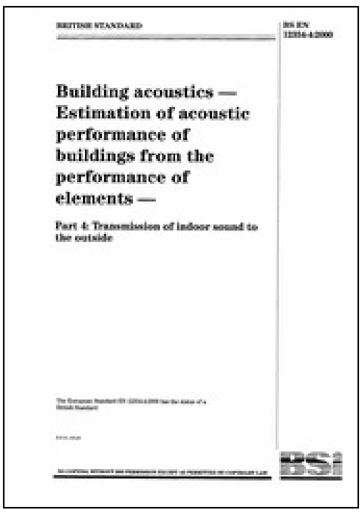
Building Regulations Document E covers the acoustic performance of buildings. This document summarises the areas of relevance to the fenestration industry, from the most recent publications of standards and acoustic performance of typical glass units.

Anthony Murray (MEng)
Smart Systems Ltd.

Building Regulations







As of the 1st July 2003 the revisions to Building Regulations Document E make reference to the acoustic performance of floors, walls, ceilings and doors and specify the performance that must be achieved in order to remain compliant with the building regulations.

For the first time in the regulations, doors are specifically mentioned and the acoustic performance is specified. The building regulations also refer to Bulletin 93 which examines the acoustic designs of schools and makes recommendations to the acoustic performance.

Doors	R_m
Residential [1]	29dB
Schools [2]	30dB
Schools (music rooms) [2]	35dB

Table 1 R_m Mean Noise Reductions

[1] Source Building Regulations
[2] Bulletin 93 Acoustic Designs of Schools

Whilst the acoustic performance for many different types of materials and building scenarios are not explicitly specified in the building regulations. The building regulations highlight a duty of care in the building contractor to consider the acoustic performance for the building, particularly in circumstances where external noises may be significant or may be a nuisance.

BS 8233 :1987 gives recommended maximum sound levels for many building scenarios, which are dependent on the environment and purpose of the building. The main contractor or architect would be able to establish the required thermal performance of the building envelope, given the environment and building use.

Acoustic Performance – Overview

When required sound reduction criteria are specified by a main contractor, the acoustic performance can be expressed by a number of different factors. Because these factors are designed to assess acoustic performance differently, it is important that it is clear which factor is being specified, such that comparative calculations meet the intended requirement.

Mean Sound Reduction, R_M

Because of the nature of acoustic sound reduction, certain materials will dampen certain frequencies to a greater extent than other frequencies, a range or spectrum of frequencies should always be considered. The range considered will result in a mean sound reduction (across a range of frequencies) $\mathbf{R_M}$ for a given product.

Weighted Noise reduction, R_W and Traffic Noise Reduction, R_{TRA}

To help in the interpretation of the acoustic performance in buildings, the mean value can be weighted giving greater emphasis to the frequencies which humans are most sensitive to. This value, the $\mathbf{R_w}$, greater reflects the perceived acoustic performance of a product. A third factor $\mathbf{R_{TRA}}$ gives emphasis to the lower frequencies, which are particularly prevalent in road noise, giving a closer indication to the perceived acoustic performance if the source of the noise is primarily from traffic noise.

Supplementary Adaptation Terms, (C_{TR} and C)

In to further address the potential attenuation of certain frequencies this has lead to some specifications requesting the supplementary Adaptation Terms, $\mathbf{C_{TR}}$ and **C** which, when used in conjunction with **Rw**, indicate probable attenuation to a variety of noise sources. In particular, the composite index, ($\mathbf{R_W}$ + $\mathbf{C_{TR}}$), is replacing the $\mathbf{R_{TRA}}$ index to indicate perceived acoustic performance of traffic noise (Refer to BS EN ISO 717-1:1997 and BS EN ISO 717-2:1997)

Influencing Factors

- Glass performance / spandrel panels
- Area of the product
- Frame Performance
- Air tightness of the opening frame
- Building Height

The Acoustic performance of a window or door is greatest influenced by the glass used in the systems to such an extent in all, but exceedingly high performance windows, the frame performance is sufficiently insignificant to neglect. See Table 2 for typical glass thermal performance. The frame performance is influenced by many factors including the size and air tightness of the product and the building height. Also further factors such as glass thickness will affect the suitability of certain framing systems.

Typical Glass Values

Double glazing was originally developed to reduce heat loss through windows. However, by judicious design, it is possible to achieve moderately high acoustic insulation. A double glazed window with 4/12/4 will typically achieve the minimum requirements of 29dB for residential doors.

	Acoustic Performance			
Typical Glass Unit	R_m[1] dBA	R_w[2] dBA	R_{TRA}[3] dBA	Frame Effect
4/12/4 (Normal)	29	31	25	Negligible
6/12/6	30	33	26	
10/12/4	34	36	29	
10/12/6	34	38	32	
10/12/6.4 pvb	36	40	34	Significant*
10/12/17 Audio Screen	41	45	37	

Table 2 Acoustic performance of glass units source Pilkington's, for actual performance of glass units consult your glazing supplier.

1 R_m (Mean Value) this is the simplest approach, involving an arithmetic mean of the sound reduction indices measured at the 16 1/3 octives.

2 R_w (Weighted) this is the most common way to classify sound insulation. It is biased towards the particular frequencies that humans are particularly sensitivity to, giving an indication to the perceived acoustic performance.

3 R_{tra} (Traffic noise reduction) is biased towards the lower frequencies and is used to compare products where the external noises arise from mainly lower frequency road traffic.

Framing System

The influence of frame materials on Sound Reduction is often negligible. In spite of hollow box sections being an integral feature of aluminium framing for thermal performance, laboratory and field measurements have shown that, up to a glazing R_m of about 35dB, the window frame is not often a serious leak path. (The sound insulation of the glazing can be adopted as being representative of the window as a whole). On high performance windows, beyond R_m of 35dB*, it is prudent to evaluate the acoustic performance of the proposed framing; more substantial sections may be necessary to be compactable with very high performance glazing.

*Evaluating Acoustic Performance

If it is determined that the frame performance is significant then a numerical approximation BS EN 12354-4:2000, may be sufficient to prove the acoustic performance, or a physical test of the particular design and sizes of the product may be necessary to be completed by an authorised test facility to BS EN ISO 140-3:1995.
The Cliff Inman Consultancy is an independent consultancy which can undertake a variety of acoustic calculations based on project specific cross sectional drawings.

Cliff Inman Consultancy
7 Lonsdale Close
Great Sankey
Warrington
Cheshire
WUA 3AU
Tel: 01925 714320
Fax: 01925 714320

Standards:

BS EN ISO 140-1:1998 Acoustics. Measurement of sound insulation in buildings and of building elements. Requirements for laboratory test facilities with suppressed flanking transmission
BS EN ISO 140-3:1995, BS 2750-3:1995 Acoustics. Measurement of sound insulation in buildings and of building elements. Laboratory measurement of airborne sound insulation of building elements
BS EN ISO 717-1:1997 Acoustics. Rating of sound insulation in buildings and of building elements. Airborne sound insulation
BS EN 12354-4:2000 Building acoustics. Estimation of acoustic performance in buildings from the performance of elements. Transmission of indoor sound to the outside.
BS 8233 : 1987