



Changes to Approved Document E

Introduction

Changes to Approved Document E, introduced in July 2003, have created a new responsibility for the specifier. In particular, the acoustic performance requirements for door assemblies in certain situations are now detailed, so specifiers need to understand the implications and what needs to be done in order to satisfy them. For an architectural door assembly, it is actually harder to achieve adequate acoustic performance than it is to meet the fire or smoke requirements and this puts a big demand on the sealing system.

Furthermore, while guidelines for acoustic performance are provided in Approved Document E, these are clearly stated to be minimum requirements. They are widely interpreted, however, as being absolute requirements and, in fact, we need to be aiming for higher levels than those recommended. Additional recognition has also to be given to Building Bulletin 93, with specific reference to schools, and where somewhat higher levels of performance are required than in dwellings.

References and Definitions

Building Regulation E1 - "Protection against sound from other parts of the building and from adjoining buildings"

Approved Document E - "Approved Document E to the Building Regulations [England and Wales] - Resistance to the passage of sound"

Building Bulletin 93 - "Acoustic design of schools" - An approved document to demonstrate compliance with the Building Regulations [England and Wales] with particular reference to schools

BS EN ISO 140-3 - "Measurement of sound insulation in buildings and of building elements - Part 3 - Laboratory measurement of airborne sound insulation of building elements" [Formerly BS 2750 Pt 3]

BS EN ISO 717-1 - "Rating of sound insulation in buildings and of building elements - Part 1 - Airborne sound

insulation" [Formerly BS 5821 Pt 1]

Decibel - dB - Unit of sound pressure measurement, generally relating to a reduction in value from one location to another

R - Sound reduction index at a particular frequency, expressed in dB

Rw - The "weighted average sound reduction index" - a single figure, expressed in dB and derived from values of R at different frequencies and weighted according to BS EN ISO 717-1

The Rw figure enables quick performance comparisons in relation to a benchmark or from one construction to another. It will always be expressed in terms of a number of dB - followed by the suffix "Rw"

Discussion

Building Regulation E1 is entitled "Protection against sound from other parts of the building and from adjoining buildings".

The Regulation itself states that "Dwelling-houses, flats and rooms for residential purposes shall be designed and constructed in such a way that they provide reasonable resistance to sound from other parts of the same building and from adjoining buildings".

That is the "Commandment" but, of course, it doesn't tell

us how to achieve this "reasonable resistance to sound", so we turn to Approved Document E to find out what the recommended practice is, in order to demonstrate compliance with the Regulation.

Most of the content of AD-E is devoted to wall and floor construction and methods of achieving the performance requirement for structure borne sound transmission. Relevant guidance with respect to door assemblies is, however, given in several places, under the heading of "Corridor walls and doors".

There are three main clauses to consider and these are repeated in three separate sections of Document E.

These sections refer in turn to [1] "new buildings" [2] "dwelling houses & flats" where there is a material change of use and [3] "rooms for residential purposes".

On pages 18, 54 & 63 we have identical guidance for separating walls in clauses 2.25 / 4.19 / 6.5.

"The separating walls described in this section should be used between corridors and rooms in flats, in order to control flanking transmission and to provide the required sound insulation. However, it is likely that the sound insulation will be reduced by the presence of a door."

This statement sets the scene and draws attention to the important influence of the door assembly. Then, on the same pages, clauses 2.26 / 4.20 / 6.6 state – "Ensure that any door has good perimeter sealing (including the threshold where practical) and a minimum mass per unit area of 25kg/m² or a minimum sound reduction index of 29 dB Rw (measured according to BS EN ISO 140-3:1995 and rated according to BS EN ISO 717-1 : 1997) The door should also satisfy the requirements of Building Regulation Part B - Fire Safety."

The critical statement

Firstly, we need to look at the recommendations for

"good perimeter sealing (including the threshold where practical) and a minimum mass per unit area of 25kg/m²"
- - -
OR

"a minimum sound reduction index of 29dB Rw"

These two statements are not equivalents, as implied and, in practice, this is not an "either-one-or-the-other" situation.

The recommendation neglects to enlighten us on what is a "good sealing system" and the only valid way to tell a good one from an indifferent one or a bad one is to verify performance under the relevant test regimes.

The recommendation also neglects to inform us that it is technically impossible to get any credible acoustic performance without sealing the threshold. Sealing the threshold "where practical" is, in fact, a necessity and not something we can overlook if inconvenient. This anomaly is recognized in Building Bulletin 93, with particular reference to schools.

The use of a door leaf of "minimum mass per unit area of 25kg/m²" is also no guarantee of acceptable acoustic performance, especially if the threshold is not sealed. It would also be very expensive.

So this advice, while well intentioned, falls short of being sufficiently specific for performance-related considerations. There are many other factors to consider and we need a benchmark.

A benchmark is provided in the later statement - "29dB Rw"

A typical architectural door leaf has a mass per unit area of only 18-22 kg/m² but, with a decent sealing system we can easily get 29 dB Rw.

Notice also the later reference to "doors meeting the requirements of Regulation B - fire safety".

Certainly in residential situations where we have corridors - such as apartments, hotels, care homes, etc, - we will inevitably have fire doors to consider, and those fire doors will invariably be required to be smoke doors as well.

A conventional FD30 or FD30S door leaf will also have a mass per unit area in the region of 18-22 kg/m² and, again, there is no problem to meet an additional acoustic performance requirement of 29 dB Rw - with an appropriate sealing system.

Specifiers, however, should not just rely on a verified fire

door assembly but with unverified seals.

While average smoke seals will make some contribution, their performance on a typical ½-hour fire door will fall well short of the 29 dB Rw requirement, (particularly the popular brush-pile types of smoke seal) especially when interrupted at the hinge points and, more especially, without a threshold seal incorporated.

An appropriate, professional, sealing system would be expected to provide full acoustic, smoke and fire performance. The credentials of the sealing system, however, need to be established and documented.

In practice, this means with three test reports - valid fire test evidence, smoke test evidence, and acoustic test evidence.

Door-related considerations

We know that sound pressure fluctuations impacting on one side of a door assembly will lead to the door leaf tending to vibrate in sympathy and this will lead to the generation of the sound pressure fluctuations to the other side of the door leaf. In this way sound waves are transferred through the door leaf itself.

A very dense or relatively flexible door leaf is harder to set into vibration and will therefore become a good acoustic barrier. Conversely, a less dense or excessively stiff door leaf will be easier to vibrate and obviously less effective as a barrier. Around the perimeter of the door leaf, however, there will be gaps and these gaps act as straight-through paths for sound waves, offering practically no resistance at all, even with quite deep stops or rebated edges.

For any given door assembly, an acoustic sealing system will be necessary to optimize the performance by effectively containing that serious sound leakage around the edges.

The sealing system, of course, may also control the transfer of other "unwants" at the same time - for example - draughts, dust, smoke & fire.

These last two items are particularly important, bearing in mind that the positioning of acoustic doors in a building, will very probably require them to be fire doors as well, and approved Document B tells us that practically all fire doors are additionally required to be smoke control doors.

With careful selection, just one sealing system can be relied upon to perform all of these tasks.

Interpretation of acoustic test reports -

What should we look for?

All information should obviously be derived from full size, fully operational door assemblies.

Importantly, they should also be acoustically tested in their everyday operational condition and not in an artificially con-



Combined Acoustic, Smoke and Fire



Typical range of Architectural S



Fire Seals



Seals

trived situation - for example - over-compression of seals to get enhanced performance.

Operational forces will not always be detailed, but it is important to know what kind of force was necessary to get the door to latch in the test condition, and what kind of force was necessary to open it as well.

We need to know that the test was conducted on a relevant door assembly.

Things like thickness; weight; whether single leaf or pairs; whether glazed or not; and the ratio of door area to wall area; can all affect the performance and it is important to know the details.

A test report on an acoustic door assembly should, furthermore, always indicate the method of sealing the perimeter for the results achieved - especially the threshold. We need to also remember there will inevitably be a difference between performance under laboratory conditions and under installed conditions on site. Certainly a laboratory will be a more clinical environment in which to carry out an evaluation, and attention to detail will be better in the laboratory than on site installation. Additionally, the ratio of the door area to wall area will be different, on site, as will the mass of the wall structure. It is just possible that results may be better than the laboratory; not necessarily worse, but practical experience suggests that this is extremely rare and a shortfall in the region of 2dB Rw is typical.

So, in aiming for a practical 29 dBRw, we really need to be looking at a test report that verifies a laboratory performance of at least 31dB Rw

What makes a good acoustic door assembly?

Two things go into the make-up of a good acoustic door assembly - the leaf construction and the sealing system.

For a general purpose door, ie the 29dB Rw that we are aiming for, the leaf will invariably be a solid core construction; minimum 44mm thick.

By solid core we mean chipboard, flaxboard, laminated timber or possibly mineral composite between the outer skins.

Within the confines of a 44mm, standard, architectural flush door, research work carried out shows that there is very little difference in performance between the typical constructions that are used in practice. The overall density and stiffness of the finished door leaf will not vary enough to significantly affect the acoustic performance.

Using any of those typical cores; if the door is well built enough to achieve an FD30 fire performance, a "good", pro-

fessional sealing system will additionally enable it to achieve at least 29 dB Rw - more in the region of 31-33 dB Rw.

Anything higher than this level of acoustic performance will need a specialist door leaf and this will have some technical features built in - lead sheets, perhaps - designed to damp-out the vibration which would otherwise be induced by incident sound waves on its surface.

For the typical architectural door assembly, the sealing system tends to be more critical than the leaf construction.

There are many different seals capable of delivering good acoustic performance and they can be broadly broken down into some basic design types.

Perimeter seals are probably fairly well understood and these may be either the compression type, probably fitted on the door stop and relying on some sort of a bulb profile to deter sound waves from getting through, or the wiping type, fitted in the rebate and relying on one or more fins to do a similar job. These are very often combined with an intumescent element to control fire spread as well.

In either case, it is important for the seal to remain continuous in the area of hinges or other ironmongery to maintain optimum acoustic performance.

Although it might be expected that the knuckle of a standard hinge would provide a significant barrier to the passage of sound, experience on the acoustic test chamber reveals that this is not the case. The hinges, in fact, behave as a straight-through gap and, similarly, the latch. Even quite small interruptions to the sealing system in the area of ironmongery items will lead to substantial transmission of sound waves, especially at medium to high frequencies.

The popular brush-pile type smoke seals are unsuitable as acoustic seals, although they will make a contribution. They are perfectly adequate for containing smoke - which is basically air particles contaminated with poisonous combustion products. In the case of airborne sound, however, these air particles are vibrating at high frequencies and the brush is not able to resist this vibration as well as a solid fin, or preferably two fins. They are also difficult to use in the ironmongery positions.

For comparison, where a dual fin seal is capable of 31-33 dB Rw, a brush-pile type would be more in the region of only 23-25 dB Rw.

Threshold seals are less well understood, but as already indicated, they are absolutely essential for effective acoustic door performance and, without one, the required 29 dB Rw is nowhere near achievable.

In practice, the automatic threshold seals are preferred, being very simple, easily concealed and requiring no raised threshold plate or any electrical connections. They consist of a mechanism inside a compact housing with a spring assisted seal element designed to retract into the housing as soon as the door is opened by a few millimetres.

Generally, it is advisable to have the threshold seal on the same plane as the perimeter seal, to avoid any stray sound leakage at the corners. Even a small gap can result in a loss of performance of 1 or 2 dB Rw. This can be quite critical, bearing in mind that the decibel scale is not a straight-line arithmetic relationship but a logarithmic one.

Design Conflicts

There is always a conflict between operational opening and closing forces and acoustic barrier performance.

Experience on actual acoustic tests shows that a balance has to be maintained between effective acoustic performance and ease of operation of the door assembly in everyday service.

Some interference by the sealing system is unavoidable but this needs to be held to the lowest possible level.

Serviceability

It is very simple to wedge a door leaf tightly in the closed position with a crude seal and obtain a deceptively impressive acoustic performance. Such a seal would quickly break down in everyday service, however, and there would be numerous complaints of difficult-to-operate doors from the building occupants.

On the other hand, of course, seals which do not provide some degree of interference, will be poor performers as acoustic barriers but will yield a door assembly that is easy to operate.

Even if we manage to get the balance right, we still have to provide a seal which will withstand many years of continual chafing, abrasion and flexion, without significant loss of performance and certainly without physical breakdown.

Even though a particular sealing system may have performed well on the relevant acoustic door test, will it still perform well after several years of service? We need some form of assurance on this point.

Independent quality and performance accreditation

The acoustic sealing system is particularly important because, while the door leaf construction itself can be assumed to be inherently stable, the sealing system is subject to an immense amount of everyday challenge, through wear and tear induced by the continual opening and shutting of the door.

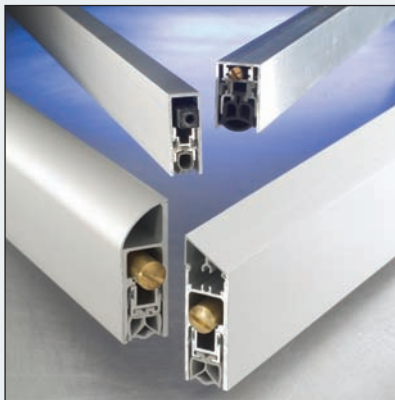
Unless it is well-designed and well manufactured, the acoustic performance of the sealing system will deteriorate over an unacceptably short period of time and it will require continual replacement. This should not be necessary.

Unfortunately, there is no specific independent performance accreditation scheme for an acoustic door assembly nor, indeed, for the associated sealing systems.

We can, however, draw from experience in other sections of the industry and it is particularly useful to note the strong affinity between the serviceability of smoke seals and the similar attributes required of acoustic seals. Two independent accreditation schemes are available for smoke seals - Certifire and British Board of Agrément [BBA].

The relevant parts of the Certifire scheme requires -

- That an approved seal should be capable of sustaining 100,000



Typical Automatic Threshold Seals



Typical Acoustic/Smoke Seal bypassing hinge

opening and shutting cycles on a full sized door assembly without deterioration of its sealing performance, within specified limits.

- That the sealing system should not add significantly to the opening and closing forces of the door assembly, again within specified limits.

- That the specification of the tested product, remains consistent with the specification of the manufactured product on a day-to-day basis, and is subject to random audit.

the manufactured product on a day-to-day basis, and is subject to random audit.

BBA follows similar lines to the Certifire scheme but with the emphasis on fitness-for-purpose as a building product as well as isolated performance in a test environment.

In the context of acoustic seals, the main difference would lie in the insistence of BBA in monitoring the serviceability of seals on actual building installations.

BBA also require that products are periodically submitted for complete re-assessment

Conclusion

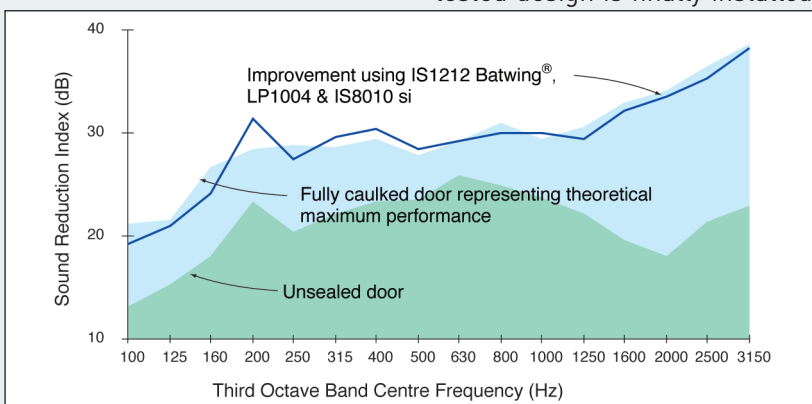
While it is harder to achieve adequate acoustic performance than it is to meet the fire or smoke requirements and putting a big demand on the sealing system, there are already existing products and proven solutions that can comfortably meet the new requirements of Approved Document E.

Many existing smoke seal profiles have excellent acoustic performance - the technology for containing airborne sound is very similar to that of containing smoke - however - the very popular brush-pile smoke seal just doesn't have the extra performance required.

A professional sealing system can be expected to deliver optimum acoustic performance on standard FD30 fire door assemblies while simultaneously complying with FD30S smoke protection requirements also. It should achieve at least 31 dB Rw under laboratory test, bearing in mind that there will inevitably be some loss of performance when the tested design is finally installed in a building project.

This will give a comfort factor with respect to the 29 dB Rw that is called for and common sense tells us we should be aiming much higher than the minimum of 29!

Not only should the sealing system have established technical performance attributes for fire, smoke and sound reduction, it should also have everyday operational characteristics of extremely low friction coupled with exceptional durability.



Typical graph showing acoustic performance of seals



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