Department for Education

Draft for consultation

Acoustic design of schools: performance standards

March 2014

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Summary

About this publication

This document supersedes Section 1 of the Second Edition of Building Bulletin 93 published in 2003. It sets out minimum performance standards for the acoustics of school buildings, and describes the normal means of demonstrating compliance with The Building Regulations. It also provides guidance in support of the School Premises Regulations (2012) and the Independent School Standards.

Acknowledgements

DfE would like to thank the Schools Committee of the Association of Noise Consultants and the Institute of Acoustics for their help in drafting this document.

Disclaimer

Expiry/review date

This advice will next be reviewed in 2024.

Who is this advice for?

This advice is for all those involved in the specification, design and construction of school buildings.

Key points

The overall objective of the performance standards is to ensure that the design and construction of school buildings provide acoustic conditions that enable effective teaching and learning.

1. Introduction and Scope

1.1 Background

This document should be read in conjunction with *Acoustic Design of Schools – A Design Guide* (expected to be available in 2014[1], to be published by the Association of Noise Consultants and the Institute of Acoustics), which will contain supporting information and additional design considerations. References to the guide are made throughout this document. On publication, this guidance document will supersede Sections 2 to 7 of Building Bulletin 93[2].

Section 2 sets out the acoustic performance standards. The normal way of satisfying Requirement E4 of the Building Regulations[3], the School Premises Regulations[4] and the Independent School Standards[5] is to demonstrate that the design meets the appropriate performance standards in Section 2.

Section 3 sets out the preferred means for demonstrating compliance of the design to the Education Funding Agency or other client body.

1.2 Regulatory Framework

The acoustic conditions in schools are controlled by Part E of the Building Regulations, School Premises Regulations and the Independent School Standards, which apply to new and existing schools. School premises are also subject to the Equality Act[6].

1.2.1 Building Regulations

Requirement E4 from Part E of Schedule 1 to the Building Regulations 2010 (as amended by SI 2002/2871) states:

> "*Each room or other space in a school building shall be designed and constructed in such a way that it has the acoustic conditions and the insulation against disturbance by noise appropriate to its intended use.*"

Approved Document E in support of the Building Regulations gives the following guidance:

> "*In the Secretary of State's view the normal way of satisfying Requirement E4 will be to meet the values for sound insulation, reverberation time and internal ambient noise which are given in Section 1 of Building Bulletin 93 'The Acoustic Design of Schools'*, produced by DfES." (Note DfES is now DfE).

1.2.2 School Premises Regulations & Independent School Standards

The School Premises Regulations and Independent School Standards contain a similar statement to that in Requirement E4 of the Building Regulations, which applies to both new and existing school buildings:

"The acoustic conditions and sound insulation of each room or other space must be suitable, having regard to the nature of the activities which normally take place therein."

In addition to the design and construction standards covered by the Building Regulations, the School Premises Regulations and Independent School Standards cover the performance in use of schools including speech intelligibility in the classrooms. This means that in order to comply with the School Premises Regulations and the Independent School Standards (but not the Building Regulations), operational noise levels (e.g. of equipment) in teaching and learning spaces will need to be suitable for the activities taking place and open plan teaching and learning spaces in new and refurbished schools will need to provide adequate speech intelligibility as measured by the Speech Transmission Index.

The School Premises Regulations and Independent School Standards do not apply retrospectively.

1.2.3 Equality Act 2010

The Equality Act 2010 replaces all previous equality legislation such as the Race Relations Act, Disability Discrimination Act and Sex Discrimination Act and provides a single, consolidated source of discrimination law, covering all the types of discrimination that are unlawful. It simplifies the law and extends the protection from discrimination in certain areas. The aspects that are relevant to acoustics in schools are principally those relating to disabilities, but can also include race, where English is not the first language and clarity of speech is particularly important to assist comprehension.

1.3 Areas covered by the regulations

1.3.1 Teaching and non-teaching spaces

Requirement E4 of the Building Regulations applies to teaching and learning spaces. The School Premises Regulations and the Independent School Standards apply to all areas of schools. The Regulations are not intended to cover the acoustic conditions in administration and ancillary spaces not used for teaching and learning except where they affect conditions in neighbouring teaching and learning spaces, but do require consideration to be given to adjoining areas, such as corridors, which might have doors, ventilators, or glazing separating them from a teaching or learning space.

1.3.2 Temporary buildings

Temporary buildings are exempt from Requirement E4 of the Building Regulations but not from the School Premises Regulations and the Independent School Standards. Temporary buildings are defined in Schedule 2 to the Building Regulations as those not intended to remain in place for longer than 28 days. What are commonly called temporary buildings in schools are classed as prefabricated buildings and are normally subject to the same Building Regulation requirements as other types of building. Many buildings in schools have only temporary planning permission, which usually lasts for two years. These buildings are subject to the Building Regulations.

Additional guidance on prefabricated buildings is given in Clause 0.6 of Approved Document E. These include, for example, a building created by dismantling, transporting and re-erecting sub-assemblies on the same premises or another premises. In these circumstances by virtue of the School Premises Regulations, the minimum standards for refurbishment and conversion of existing buildings apply.

1.3.3 New-build, conversion and refurbishment work

The School Premises Regulations and the Independent School Standards apply to refurbishment work, and the acoustic standards for refurbishment works given in this document apply. Where there is a need to upgrade the acoustic performance of an existing building or when refurbishment is undertaken for other reasons, then the building should meet, as far as reasonably practicable, the acoustic performance given in these guidelines to satisfy the School Premises Regulations, the Independent School Standards and the Equality Act.

Although Building Regulations do not apply to all alteration and refurbishment work, it is desirable that such work should consider acoustics and incorporate upgrading of the acoustics as appropriate. In the case of existing buildings, Part E of the Building Regulations applies to material changes of use as defined in Building Regulations. The Tables give values for both new buildings in the columns labelled “new build” and for new elements of a refurbishment in the columns labelled “refurbishment”.

Where there is a material change of use as defined in the Building Regulations, such work shall be carried out as is necessary to ensure that the building complies with the applicable requirements of Requirement E4 of the Building Regulations. In these cases, the ‘refurbishment’ criteria contained within this document apply. The School Premises Regulations and Independent School Standards apply whether or not there is a material change of use.

1.3.3.1 Material changes of use

The Building Regulations apply to certain changes of use of an existing building known as “material changes of use”.

The meaning of material change of use is given in Regulation 5 of the consolidated Building Regulations. For schools the most common material changes of use that are listed in Regulation 5 will be:

"5.(e) any building used as a public building, where previously it was not; and...

A "public building" is defined as a building consisting of or containing—

(b) a school or other educational establishment ..."

The Requirements of the Building Regulations relating to material change of use are given in Regulation 6.-(1):

"6.—(1) Where there is a material change of use of the whole of a building, such work, if any, shall be carried out as is necessary to ensure that the building complies with the applicable requirements of the following paragraphs of Schedule 1—"

1.3.4 Nursery and community education

Part E of the Building Regulations covers rooms used for nursery and adult/community education within school complexes but does not apply to nursery schools which are not part of a school.

The School Premises Regulations and Independent School Standards cover all types of schools, including nursery schools.

1.3.5 Sixth form colleges, Universities and Colleges of Further Education

Part E4 of Building Regulations and the School Premises Regulations do not cover sixth form colleges that have not been established as schools. Part E of the Building Regulations quotes the definition of school given in Section 4 of the 1996 Education Act. In the case of sixth form colleges Section 4 of the 1996 Act should be read in conjunction with Section 2 of the same Act, in particular subsections (2), (2A) and (4) which deal with the definition of secondary education.

If a sixth form college is established as a school under the 1998 School Standards and Framework Act then it will be classed as a school under Section 4 of the 1996 Education Act and Part E of the Building Regulations on acoustics will apply.

Most sixth form colleges are institutions in the Further Education sector and not schools, and Part E of the Building Regulations will not apply.

In the case of a new sixth form college it will be necessary to contact the Local Authority to enquire if the sixth form college has been established as a school or as an Institute of Further Education. However, in the case of Universities or Colleges of Further and Higher Education many of the acoustic specifications are desirable and can be used as a guide

to the design of these buildings. Part E4 does apply to sixth form units forming part of a school.

1.3.6 When do the Regulations apply?

<table>
<tr><th>Type of space</th><th>New Build
Including extensions, pre-fab. buildings</th><th>Material change of use
(from non-school building)</th><th>Refurbishment of existing school buildings
including Material Alterations</th><th>Temporary buildings*3</th></tr>
<tr><td>Schools*1</td><td colspan="2">E4: Applicable
SPR: Applicable</td><td colspan="2">E4: Exempt
SPR: Applicable</td></tr>
<tr><td>Admin and ancillary areas</td><td colspan="4" rowspan="2">E4: Exempt
SPR: Applicable</td></tr>
<tr><td>Nursery schools (not within school complexes)</td></tr>
<tr><td>Colleges/VI form colleges</td><td colspan="4" rowspan="5">E4: Exempt
SPR: Not applicable</td></tr>
<tr><td>Higher Education</td></tr>
<tr><td>Further Education</td></tr>
<tr><td>Universities</td></tr>
<tr><td>Community and adult education*2 (not within school complexes)</td></tr>
</table>

Notes

*1: “Schools” includes academies, free schools, university technical colleges, sixth form colleges attached to schools, and nursery/community & adult education spaces within school complexes

*2: SPRs apply to community special schools and pupil referral units, which are treated as “schools” in the table above.

*3: Temporary Buildings are those not intended to remain in place for longer than 28 days.

1.3.7 Planning issues

Whilst planning consents should not be subject to conditions that are covered by other legislation, such as the Building Regulations, local planning authorities may include conditions relating to noise and acoustics when granting consent. These could cover such aspects as noise from schools affecting nearby noise sensitive properties, or educational establishments where the acoustic conditions are not subject to Requirement

E4 of the Building Regulations. BREEAM Global currently refers to compliance with BB93 as a means of attaining specific BREEAM credits, verified by site testing in accordance with the Association of Noise Consultants *Good Practice Guide – Acoustic Testing of Schools*[7] and compliance with a specific BREEAM rating may be a requirement for planning approval.

1.3.8 Performance in use

To comply with the School Premises Regulations and the Independent School Standards the operational noise (and maintenance) of classroom equipment will need to be considered, e.g. computers, projectors, fume cupboards etc. Further information on typical noise levels and good practice for design and operational noise can be found in the Institute of Acoustics/Association of Noise Consultants' document *Acoustics of Schools – A Design Guide*.

1.4 Provision for children having special hearing or communication needs

For the purposes of this document, special hearing or communication needs include, but are not limited to, children with permanent hearing impairment; or with severe or complex needs including:

- speech, language and communication difficulties;
- visual impairments;
- fluctuating hearing impairments caused by conductive hearing loss;
- attention deficit hyperactivity disorders (ADHD);
- an auditory processing disorder or difficulty;
- being on the autistic spectrum.

The Equality Act 2010 places a duty on all schools and Local Authorities to prepare and implement accessibility strategies and plans to increase over time the accessibility of schools for disabled pupils and staff. Schools and Local Authorities are required to provide strategies for:

a) increasing the extent to which disabled pupils can participate in a school's curriculum.
b) improving the physical environment of schools for the purpose of increasing the extent to which disabled pupils are able to take advantage of education and the benefits, facilities and services provided.
c) improving the delivery to disabled pupils of information that is readily accessible to pupils who are not disabled.

This could mean provision of physical aids and acoustic improvements and aids. These will often benefit both hearing-impaired and other pupils.

When alterations affect the acoustics of a space then improvement of the acoustics to promote better access for children with special needs, including hearing impairments, must be considered. Approved Document M: 2004 – *Access to and use of buildings*, in support of the Building Regulations[8] includes requirements for access for children with special needs. Other guidance includes BS 8300:2009 Design of buildings and their approaches to meet the needs of disabled people. Code of practice[9] and Acoustics of Schools – A Design Guide*[1].*

1.4.1 Acoustic considerations

Pupils with special educational needs are generally even more reliant on good quality acoustic environments than others. Consequently, required reverberation times should be shorter, sound insulation between adjacent spaces higher and indoor ambient noise levels (and the capacity for distraction) lower than in environments for other pupils. This is reflected in the tables contained within this document.

Pupils with hearing impairment, autism and other special needs are often very sensitive to specific types of noise, particularly those with strong tonal, impulsive or intermittent characteristics. This should be taken into consideration in the design of areas which may be used by such children.

1.4.2 Visual considerations

Some pupils having special hearing and communication needs, such as autistic spectrum disorders, may require particular consideration in relation to the visual impact of acoustic treatment. For example, ceiling grids and other regular patterns may cause distraction to pupils.

1.4.3 Durability and robustness

Where the physical behaviour of pupils requires a high level of robustness and durability from room finishes then due consideration should be given to the appropriate selection of materials in the acoustic design.

1.5 Alternative Performance Standards

Alternative performance standards (APS) may be adopted for new buildings, where justified by specific educational, environmental, or health and safety requirements. An APS should not be of a lower standard than those shown for refurbishment in the tables given in Section 2 or those described in the exceptions in Section 2 and, where the

performance standard for refurbishment is proposed as an APS for a new school, a full and proper case must be made and documented to justify the decision.

Any APS must be justified on the grounds of educational, environmental or health and safety need and the Contractor, with the assistance of the project acoustician, should make the Building Control Body and the Client aware of the practical implications with respect to the operation of the space.

The procedure set out in this Section must be followed and fully documented in the project's design risk register, building manuals or other documentation and this documentation should be made available to the school governors, staff and parents of pupils at the school, to ensure that the client and users of the school have the opportunity to understand the effect of the reduction in standards.

2. Performance standards

In addition to the following minimum standards, the School Premises Regulations and the Independent School Standards require that consideration must be given to the 'performance in use' standards for speech intelligibility and operational noise that are given in Section 2.8.

The Building Regulations require that all spaces should meet the performance standards for indoor ambient noise level, airborne and impact sound insulation, and reverberation time as specified in Tables 1, 2, 3, 4, 5 and 6. These values are for rooms that are finished, furnished for normal use, but unoccupied. Where rooms are to be used without furnishings, the performance standards normally apply in the empty condition. Normal furnishing is not anticipated to have any significant effect on indoor ambient noise levels or sound insulation, but may reduce measured reverberation times by providing diffusion.

To comply with the School Premises Regulations and the Independent School Standards open plan spaces should additionally meet the performance standard for Speech Transmission Index in Table 7.

Section 3 describes acoustic tests that can be used to demonstrate compliance with the in-situ performance standards in this section. It is strongly recommended that the client requires acoustic testing to be carried out as part of the building contract, because testing of the completed construction is the best practical means of ensuring that it achieves the design intent.

Further guidance will be included in *Acoustics of Schools – A Design Guide,* available in 2014. This will provide additional information on the acoustic requirements and design of buildings for education purposes, on how to comply with these acoustic standards, and on testing / commissioning procedures.

2.1 Indoor ambient noise levels in unoccupied spaces

2.1.1 Objectives and definitions

The objective is to provide suitable Indoor Ambient Noise Levels (IANL) for

(a) clear communication of speech between teacher and student

(b) clear communication between students and

(c) learning and study activities.

The IANL includes noise contributions from:

- external sources outside the school premises (including, but not limited to, noise from road, rail and air traffic, industrial and commercial premises).

- building services (e.g. ventilation systems, plant, drainage, etc.). If a room is naturally ventilated, the IANL is calculated and measured with ventilators or windows open as required to provide ventilation as described in Section 2.1.3. If a room is mechanically ventilated or cooled, the plant should be assumed to be running at its normal operating duty.

The IANL excludes noise contributions from:

- teaching activities within the school premises, including noise from staff, students and equipment within the building or in the playground. Noise transmitted from adjacent spaces is addressed by the airborne and impact sound insulation requirements.
- equipment used in the space (e.g. machine tools, CNC machines, dust and fume extract equipment, compressors, computers, projectors, fume cupboards).
- rain noise. However, Building Regulation submissions should demonstrate that lightweight roofs and roof glazing have been designed to provide suitable control of rain noise reverberant sound pressure level in a space (calculated using laboratory test data with 'Heavy' rain noise excitation as defined in BS EN ISO 140-18[10]). Levels during heavy rain should not be more than 25 dB above the appropriate indoor ambient noise level given in Table 1. For refurbishments, this applies only to new roofs (including roof lights) and not to repairs to existing roofs.

2.1.2 Acoustic performance standards

Table 1 specifies upper limits for indoor ambient noise levels in terms of $L_{Aeq,30mins}$ during normal teaching hours. Values in the first column are for new buildings. Values in the second column are for conversions and refurbishments of existing buildings, and are also the minimum acceptable standards for Alternative Performance Standards in new buildings (see Section 1.5).

Where a type of room is not listed, the nearest approximation should be used. Where a room is used for more than one purpose, the most onerous condition should be used.

Noise from plant, machinery and equipment in teaching and learning rooms should not contain any significant tonal or intermittent characteristics.

Table 1: Upper limits for indoor ambient noise level, $L_{Aeq,30mins}$

Type of room	Room classification for the purpose of airborne sound insulation in Table 2		Upper limit for the indoor ambient noise level $L_{Aeq,30mins}$ dB	
	Activity noise (Source room)	Noise tolerance (Receiving room)	New build	Refurbishment
Nursery school rooms	Average	Medium	35	40
Primary school: classrooms, class bases, general teaching areas, small group rooms	Average	Medium	35	40
Secondary school: classrooms, general teaching areas, seminar rooms, tutorial rooms, language laboratories	Average	Medium	35	40
Open plan (See also Section 2.8)				
Teaching areas	Average	Medium	40	45
Resource/Breakout areas	Average	Medium	40	45
Music1				
Primary music room	High	Medium	35	40
Secondary music classroom	Very high	Low	35	40
Small and large practice/group room	Very high	Low	35	40
Ensemble room	Very high	Low	30	35
Performance/recital room	Very high	Low	35	40
Recording studio	Very high	Low	30	35
Control room - for recording	High	Low	35	40
Control room - not for recording	Average	Medium	35	40
Lecture rooms				
Small (fewer than 50 people)	Average	Medium	35	40
Large (more than 50 people)	Average	Medium	35	40
Teaching spaces specifically for students with special hearing and communication needs (See Section 1.5)	Average	Low	30	35
Study room (individual study, withdrawal, remedial work, teacher preparation)	Low	Medium	40	45

Type of room	Room classification for the purpose of airborne sound insulation in Table 2		Upper limit for the indoor ambient noise level $L_{Aeq,30mins}$ dB	
	Activity noise (Source room)	Noise tolerance (Receiving room)	New build	Refurbishment
Libraries				
Quiet study areas	Low	Medium	40	45
Resource areas	Average	Medium	40	45
Science laboratories	Average	Medium	40	45
Drama studios	High	Low	35	40
Design and Technology				
Resistant materials, CADCAM areas	High	High	40	45
Electronics/control, textiles, food, graphics, design/resource areas, ICT rooms, art	Average	Medium	40	45
Assembly halls, multi-purpose halls (drama, PE, audio/visual presentations, assembly, occasional music),	High	Low	35	40
Atria, circulation spaces used for circulation and socialising but not teaching and learning	Average	Medium	45	50
Sports hall	High	Medium	40	45
Dance studio	High	Medium	40	45
Gymnasium/Activity studio	High	Medium	40	45
Swimming pool	High	High	50	55
Meeting rooms, Interviewing/counselling rooms, video conference rooms	Low	Medium	40	45
Dining rooms	High	High	45	50
Administration and ancillary spaces				
Kitchens	High	High	50	55
Offices, medical rooms, staff rooms	Low	Medium	40	45
Corridors, stairwells, coats and locker areas	Average	High	45	50
Changing areas	High	High	50	55
Toilets	Average	High	50	55

[1] Music rooms – The levels of sound insulation between music rooms may not be sufficient for particularly noisy activities and timetabling/management will need to be

considered. Wherever possible music accommodation should make use of buffer spaces such as stores to increase the levels of sound insulation between rooms and to isolate rooms where very noisy activities such as drum practice will take place. If timetabling/management or isolation is not possible the levels of sound insulation should be increased. For further guidance on the design of music accommodation see *Acoustics of Schools – A Design Guide*.

2.1.3 Ventilation and Internal Ambient Noise Levels

Mechanical ventilation systems in all teaching spaces are required to meet the IANLs given in Table 1 when operating at their normal capacity. Mechanical ventilation systems must meet the indoor ambient noise levels given in Table 1 (when measured in conjunction with noise break-in from external sources). Mechanical ventilation refers to systems (or parts of systems) that use mechanical fans including those in hybrid or mixed mode systems. In hybrid or mixed mode systems, all mechanical parts or systems shall meet the IANLs given in Table 1.

It is recommended that, during unusually hot weather, a means is provided for the teacher to increase the air velocity in the room to improve comfort, for example, by opening windows, switching on local fans, or boosting the mechanical ventilation.

Under peak summertime conditions when the daily average outdoor temperature exceeds 23 ^{o}C, and thermal comfort is controlled by higher natural ventilation rates from opening windows, ventilators or ceiling fans, the users may determine their preferred balance between thermal comfort and higher IANL.

2.1.4 Exception for natural or mixed mode/hybrid systems

In rooms with standalone natural ventilation systems or natural ventilation systems as part of hybrid or mixed mode ventilation; where there is local control of the natural ventilation system or the natural ventilation part of a mixed mode system which enables the teacher to override any automatic operation and close the windows or vents, the following two criteria apply:

1. The IANLs given in Table 1 shall be met when the windows or natural vent paths are shut and any mechanical systems are operating to provide their normal duty.
2. When systems are operating in natural ventilation mode, with windows and vents set to provide a carbon dioxide concentration of 1500 ppm for the design mid-season weather condition, the IANL shall not exceed the IANLs given in Table 1 by more than 5 dB. The design mid-season weather condition is defined as an inside air temperature of 20 ^{o}C and an outside air temperature of 11 ^{o}C with an average external wind speed of 1.5 m/s.

For classrooms designed specifically for use by students who have special hearing and communication needs, this exception does not apply and the natural ventilation should

meet the performance standards in Table 1 at the design summertime condition, with an outside air temperature of 20 °C and an average external wind speed of 1.5 m/s.

2.2 Airborne sound insulation between spaces

2.2.1 Objectives and definitions

The objective is to attenuate airborne sound transmitted between spaces. The effect of internal glazing, doors, structure-borne and flanking transmission on sound transmission must be considered.

The sound insulation is to be assessed in terms of the standardised level difference D_{nT} in accordance with BS EN ISO 140-4 and the results are to be weighted and expressed as a single-number quantity, $D_{nT,w}$ in accordance with BS EN ISO 717-1. For the purposes of the assessment the reference reverberation time T is 0.5 seconds in all one-third octave bands from 100 Hz to 3.15 kHz

2.2.2 Acoustic performance standards

Table 2 shows the minimum standards for airborne sound insulation required between rooms. These values are defined by the activity noise in the source room and the noise tolerance in the receiving room as given in Table 1. Values in the first column are for new buildings. Values in the second column are for conversions and refurbishments of existing buildings, and are also the minimum acceptable standards for Alternative Performance Standards in new buildings.

The design assessment of $D_{nT,w}$ between two rooms must be carried out in both directions.

Table 2: Performance standards for airborne sound insulation between spaces

Minimum $D_{nT,w}$ (dB)		**Activity noise in source room (see Table 1)**							
		New build	**Refurbishment**	**New build**	**Refurbishment**	**New build**	**Refurbishment**	**New build**	**Refurbishment**
		Low		**Average**		**High**		**Very high**	
Noise tolerance in receiving room (see Table 1)	**High**	Not applicable		35	30	45	35	50	45
	Medium	40	30	45	40	50	45	55	45
	Low	45	35	50	40	55	50	55	50

2.2.3 Exceptions

- Serving hatches between kitchens and multipurpose halls used for dining should be avoided where practicable, and serveries placed between kitchens and dining areas wherever possible to avoid noise transfer during meal preparation. Where this is not possible, serving hatches should be designed to have as high a level of sound insulation as practicable (not less than 18 dB R_w) and, if necessary, use of the dining hall space timetabled so that noise sensitive activities, e.g., exams, do not take place in the hall when the kitchen is in use. Where the space is used solely for dining purposes, a sound insulated serving hatch between kitchen and dining space is not necessary.
- Where it is essential to link a teaching space with another occupied room via an interconnecting door for operational or safety purposes, a doorset should be used with a rating of at least 35 dB R_w. The surrounding wall containing the doorset should have a sound insulation rating of at least 45 dB R_w.
- Where there is an operable wall or folding partition between a teaching area and a hall, the minimum $D_{nT,w}$ between the spaces should be 45 dB. The end user should be made aware that the sound insulation performance of the operable wall may not facilitate simultaneous use of the spaces on either side.
- Vision panels between multi-purpose halls, music rooms and control rooms require careful consideration. If visual communication only is required then the vision panel should provide at least 45 dB R_w, set within a wall rated at 55 dB R_w. This degree of sound insulation from a vision panel will require specialist design input. Where visual and audio communication is required between the spaces then a sliding vision panel of only nominal acoustic performance may be appropriate, set in a wall rated at 45 dB R_w.

2.3 Airborne sound insulation between circulation spaces and other spaces used by students

2.3.1 Objectives and definitions

The objective is to attenuate airborne sound transmitted between circulation spaces (e.g. corridors, stairwells etc.) and other spaces used by students, for the purposes of minimising disturbance to teaching and learning spaces. This applies where the separating construction contains doors and/or glazed elements, but does not include flanking partitions of classrooms that do not give direct access to circulation spaces (in which case values from Table 2 should be used).

Values in the tables are the minimum weighted sound reduction index R_w of doorsets and the minimum composite weighted sound reduction index of wall and glazing (with and without ventilators). The weighted sound reduction index is measured in accordance with BS EN ISO 140-3 and rated in accordance with BS EN ISO 717-1.

The sound insulation of ventilators is specified in terms of the weighted element-normalised level difference, $D_{n,e,w}$ -10logN, where N is the number of ventilators with airborne sound insulation $D_{n,e,w}$. The weighted element-normalized level difference is measured in accordance with BS EN ISO 10140-10 and rated in accordance with BS EN ISO 717-1.

2.3.2 Acoustic performance standards

Table 3 shows the minimum permissible airborne sound insulation for the composite separating wall construction, for a separating wall that does not include ventilators in the wall. Values in the first column are for new buildings. Values in the second column are for conversions and refurbishments of existing buildings, and are also the minimum acceptable standards for Alternative Performance Standards in new buildings.

Table 3: Performance standards for airborne sound insulation between circulation spaces and other spaces used by students, with no ventilator in the wall

Type of space used by students	**Minimum R_w dB**		
	Composite R_w of wall and glazing with no ventilator.		**Doorset**
	New build	**Refurbishment**	
Music rooms Control rooms – for recording Drama rooms Multi-purpose halls Teaching spaces for use by students with special hearing or communication needs	45	40	35
All other rooms used for teaching or learning	40	35	30

Table 4 shows the minimum permissible airborne sound insulation, for a separating wall that does include ventilators in the wall.

Table 4: Performance standards for airborne sound insulation between circulation spaces and other spaces used by students, with ventilators in the wall

Type of space used by students	**Minimum R_w dB**			**Alternative to composite R_w of wall, glazing and ventilators dB, provided values in Table 3a are provided by partition and doors**
	Composite R_w of wall, glazing and ventilators dB			
	New build	**Refurbishment**	**Doorset**	**Minimum $D_{n,e,w}$ – 10logN dB for ventilators**
Music rooms Control rooms – for recording Drama rooms Multi-purpose halls Teaching spaces specifically designed for use by students with special hearing or communication needs	38	35	35	37
All other rooms used for teaching or learning	33	30	30	32

2.4 Impact sound insulation of floors

2.4.1 Objectives and definitions

The objective is to control impact sound (e.g. from footsteps and movement of furniture) transmitted into spaces via the floor above. It does not therefore address issues such as slamming doors (where care should be taken to ensure doors are fitted with soft closers, wherever possible) or significant impacts such as dancing (where specialist advice will be required from the acoustician and structural engineer).

Values in the tables are the maximum permissible weighted standardised impact sound pressure level $L'_{nT,w}$ (dB). This is measured in accordance with BS EN ISO 140-7 and rated in accordance with BS EN ISO 717-2. For the purposes of the assessment the reference reverberation time is 0.5 seconds in all one-third octave bands from 100 Hz to 3.15 kHz.

2.4.2 Acoustic Performance Standards

Table 5 shows the maximum weighted standardised impact sound pressure level, $L'_{nT,w}$ for receiving rooms of different types and uses. Values in the first column are for new buildings. Values in the second column are for conversions and refurbishments of existing buildings, and are also the minimum acceptable standards for Alternative Performance Standards in new buildings.

2.4.3 Exceptions

It is usual under Building Regulations for impact criteria to be achieved by the structural floor without finishes. However, as floor finishes in schools are usually fixed they may be taken into account in the design.

Table 5: Performance standards for impact sound insulation of floors

Type of room (receiving room)	**Maximum impact sound pressure level $L'_{nT,w}$ dB**	
	New build	**Refurbishment**
Nursery school rooms	60	65
Primary school: classrooms, class bases, general teaching areas, small group rooms	60	65
Secondary school: classrooms, general teaching areas, seminar rooms, tutorial rooms, language laboratories	60	65
Open plan Teaching and Resource areas	60	65
Music		
Primary music classroom	60	65
Secondary music rooms	55	65
Small and large practice/group room	55	65
Ensemble room	55	65
Performance/recital room	55	65
Recording studio	55	65
Control room - for recording	55	65
Control room – not for recording	55	65
Lecture rooms	60	65
Teaching spaces specifically for pupils having special hearing and communication needs (See Section 1.5)	55	60
Libraries	60	65
Science laboratories	60	65
Drama studios	60	65
Design and Technology - Resistant materials, CADCAM areas, Electronics/control, textiles, food, graphics, design/resource areas, ICT rooms, Art rooms	60	65
Assembly halls, multi-purpose halls (drama, PE, audio/visual presentations, assembly, occasional music)	60	65
Atria, circulation spaces used for circulation and socialising but not teaching and learning	65	65
Sports hall	60	65
Gymnasium/Activity studio	60	65
Dance studio	60	65
Swimming pool	65	65
Meeting rooms, interviewing/counselling rooms, video conference rooms	60	65
Dining rooms	65	65
Administration and ancillary spaces		
Kitchens	65	65
Offices, staff rooms, medical rooms	65	65
Corridors, stairwells	65	65
Coats and locker areas and changing areas	65	65
Toilets	65	65

2.5 Reverberation in teaching and study spaces

2.5.1 Objectives and definitions

The objective is to provide suitable reverberation times (RTs) for:

(a) clear communication of speech between teacher and student

(b) clear communication between students and

(c) music teaching and performance.

The reverberation time in Table 6 is quoted in terms of the mid-frequency reverberation time, T_{mf} which is the arithmetic average of the reverberation times in the 500 Hz, 1 kHz and 2 kHz octave bands, or the arithmetic average of the reverberation times in the one-third octave bands from 400 Hz to 2.5 kHz. (Although these are not mathematically equivalent, in practice the difference will be small and in the interests of simplicity and ease of measurement, either is acceptable.)

For teaching spaces for use by students with special hearing or communication needs, the required reverberation time is expressed as the arithmetic average of the reverberation times in the 125 Hz to the 4 kHz octave bands, or the arithmetic average of the reverberation times in the one-third octave bands from 100 Hz to 5 kHz.

These values are for rooms that are finished, furnished for normal use, but unoccupied.

2.5.2 Acoustic performance standards Objectives and definitions

Table 6 contains the maximum mid-frequency reverberation time requirements.

Values in the first column are for new buildings. Values in the second column are for conversions and refurbishments of existing buildings, and are also the minimum acceptable standards for Alternative Performance Standards in new buildings.

Table 6: Performance standards for reverberation time

Type of room	**T_{mf} seconds**	
	New build	**Refurbishment**
Nursery school rooms	≤ 0.6	≤ 0.8
Primary school: classrooms, class bases, general teaching areas, small group rooms	≤ 0.6	≤ 0.8
Secondary school: classrooms, general teaching areas, seminar rooms, tutorial rooms	≤ 0.8	≤1.0
Type of room	**T_{mf} seconds**	
	New build	**Refurbishment**
Secondary school language laboratories	≤ 0.8	≤ 1.0
Open plan Teaching areas Resource/Breakout areas	 ≤ 0.5 [see Section 2.8] ≤1.2 [see Section 2.8]	 ≤ 0.5 [see Section 2.8] ≤1.2 [see Section 2.8]
Music Primary music room Secondary music classroom Practice/group room, volume ≤ 30 m^3 Practice/group room, volume > 30 m^3 Ensemble room, Live room Performance/recital room Control room - for recording Control room - not for recording	 ≤1.0 ≤1.0 ≤ 0.6 ≤ 0.8 0.6 – 1.2 1.0 – 1.5 ≤ 0.5 ≤ 0.5	 ≤1.0 ≤1.0 ≤ 0.8 ≤1.0 0.6 – 1.2 1.0 – 1.5 ≤ 0.6 ≤ 0.6
Lecture rooms Small (fewer than 50 people) Large (more than 50 people)	 ≤ 0.8 ≤1.0	 ≤1.0 ≤1.0
Teaching spaces specifically for pupils having special hearing and communication needs (See Section 1.5)	T_{30} ≤ 0.4 averaged from 125 Hz to 4kHz octave band centre frequencies and T_{30} < 0.6 s in every octave band in this range	≤ 0.4
Study room (individual study, withdrawal, remedial work, teacher preparation)	≤ 0.8	≤ 1.0
Libraries	≤1.0	≤ 1.2
Science laboratories	≤ 0.8	≤ 1.0
Drama studios	≤1.0	≤ 1.0

Design and Technology Resistant materials, CADCAM areas, Electronics/control, textiles, food, graphics, design/resource areas, ICT rooms, art	≤ 0.8	≤ 1.0
Atria, foyers, entrance halls, spaces used for circulation and socialising but not teaching and learning	≤1.5	≤ 2.0
Type of room	**T_{mf} seconds**	
	New build	**Refurbishment**
Indoor sports hall	≤ 2.0	≤ 2.0
Gymnasium/activity studio	≤1.5	≤ 2.0
Dance studio	≤1.2	≤1.5
Swimming pool	≤ 2.0	≤ 2.0
Meeting rooms, Interviewing/counselling rooms, video conference rooms	≤ 0.8	≤ 0.8
Dining rooms	≤ 1.0	≤ 1.5
Administration and ancillary spaces Kitchens Offices, medical rooms, staff rooms Corridors, stairwells Coats and locker areas, changing areas Toilets	 ≤ 1.5 ≤ 1.0 See Section 2.7 ≤ 1.5 ≤ 1.5	 ≤ 2.0 ≤ 1.0 See Section 2.7 ≤ 2.0 ≤ 2.0

2.6 Reverberation and acoustic absorption in sports halls

2.6.1 Objectives and definitions

The objective is to provide suitable reverberation times (RTs) for:

(a) clear communication of speech between teacher and student

(b) clear communication between students

The reverberation time is quoted in terms of the mid-frequency reverberation time, T_{mf}, which is the arithmetic average of the reverberation times in the 500 Hz, 1 kHz and 2 kHz octave bands, or the arithmetic average of the reverberation times in the one-third octave bands from 400 Hz to 2.5 kHz. For sports halls specifically for use by students with special hearing or communication needs, the reverberation time is specified as the arithmetic average of the reverberation times in the 125 Hz to the 4 kHz octave bands, or the arithmetic average of the reverberation times in the one-third octave bands from 100 Hz to 5 kHz.

2.6.2 Acoustic performance standards

Sports halls shall be designed to achieve a mid-frequency reverberation time T_{mf} of ≤ 2.0s (except where they are for use by students with special hearing or communication needs, see 2.6.1, where the reverberation time is averaged over the wider frequency range specified in 2.6.1).

2.6.3 Other considerations

Internal finishes must be robust, due to the nature of activities carried out in sports halls. The type of sound absorbers used in other areas of the school may therefore not be appropriate.

Achieving acceptable reverberation times in sports halls requires a good distribution around the roof surfaces of absorptive finishes, together with diffusion provided by irregular surfaces. Without these finishes reverberation times are likely to be high and reflections between large, parallel surfaces such as opposing walls can cause flutter echoes.

It is usual for the underside of the roof to be used as the primary method of providing absorption. In addition to the roof liner, location of absorptive wall panels at high level can be effective, but requires significant coverage. As a general rule, the closer to the floor the absorbent treatment can be provided, the less the coverage required.

Absorption fixed to the walls must be evenly distributed, i.e. spread along the lengths of the wall surfaces, and fitted as low above finished floor level as practicable. Absorption on the soffit alone will not meet the performance target.

Bodies such as Sport England have criteria that will have an impact on the acoustic design, such as walls needing to be flush and limitations on absorbent panels within 3 m above the floor. Some successful recent designs have included fair faced blockwork (having Class D absorbent finish) from ground floor up to 3 m, in addition to a Class C perforated roof liner. This can provide adequate distribution of absorption and diffusion within the listener plane, in addition to an impact resistant finish.

2.6.4 Demonstrating compliance

For sports halls, compliance with the reverberation time criterion given in Table 6 may be demonstrated by either design in accordance with the *Acoustics of Schools – A Design Guide*[1], or measurement of the mid-frequency reverberation time in accordance with the Association of Noise Consultants Good Practice Guide[7].

Evidence of compliance can be provided by submission of the acoustic model results or design calculations together with acoustic laboratory test data (where available) for all sound absorbing finishes used in the sports hall construction, showing that the installed

finishes can achieve the design objective. Assumptions for values used in calculations should be explained and justified where laboratory test data are not available. Commissioning measurements of the reverberation time would not be required with the use of this method and correct installation of the materials in accordance with the design calculations.

2.7 Sound absorption in corridors and stairwells

2.7.1 Objectives and definitions

The objective is to absorb sound in corridors, entrance halls and stairwells so that it does not interfere with teaching and study activities in adjacent rooms.

The amount of absorption required should be calculated according to Approved Document E, Section 7. This describes two calculation methods, A and B, for controlling reverberation in the common internal parts of domestic buildings. Either of these methods can be used to determine the amount of absorption required in corridors, entrance halls and stairwells in schools.

2.8 Open plan teaching and learning

In order to comply with the School Premises Regulations and the Independent School Standards it is necessary to consider the speech intelligibility in open plan spaces.

For enclosed teaching and study spaces it is possible to achieve good speech intelligibility through specification of the indoor ambient noise level, sound insulation and reverberation time. Open plan spaces require additional specification as they are significantly more complex acoustic spaces. The main issue is that intrusive noise arising from activities in adjacent learning areas and circulation spaces significantly increases the background noise level, which in turn decreases speech intelligibility and can cause distraction. Occupants working and talking within the space tend to raise their vocal effort as the background noise level increases, resulting in a spiralling increase in noise levels. This can be reduced, but not eliminated, by the provision of large amounts of acoustic absorption.

Open plan teaching and learning spaces should not be regarded as a simple alternative to traditional classrooms, and may be unsuitable for some children, particularly those with special hearing or communication needs.

2.8.1 Objectives and definitions

The objective is to control the build-up of occupancy noise, provide clear communication of speech within teaching groups, and provide sufficient speech privacy between teaching groups.

The expected open plan layout and activity plan should be agreed with the Client at an early stage of the design as the basis on which compliance with the Speech Transmission Index (STI) performance standard can be demonstrated.

An activity management plan should be documented and used to establish (via a computer prediction model) the overall noise level due to all activities in the open plan space.

2.8.2 Acoustic performance standards

Table 7 gives basic performance criteria for open plan spaces, to be achieved in conjunction with the values given in other Tables.

Table 7: Performance standard for speech intelligibility and privacy in open plan spaces – Speech Transmission Index (STI)

	Speech Transmission Index (STI)
Instruction or critical listening activity – within group	≥ 0.6*
Between groups (during critical listening activities)	≤ 0.3

* It should be noted that a higher STI value may be more appropriate for students with special hearing or communication needs.

The STI should be calculated in accordance with EN 60268-16[11].

A computer prediction model should be used to calculate the STI in the open plan space. The background noise level used in the STI calculation should be the overall occupancy noise level (established from a prior computer prediction model) for the expected open plan layout and activity management plan (see Section 2.8.5). The background noise level is the overall noise level due to all activities in the open plan space (including teaching and study from adjacent classbases, but excluding the relevant speech signal).

The computer prediction software used for this process should be capable of simulating an impulse response and should have been verified previously for this type of calculation. In general this type of software requires considerable expertise in room acoustics. The software should be used to create a three-dimensional geometric model of the space, comprising surface materials with scattering coefficients and sound absorption coefficients for each relevant octave frequency band. The model should allow for the location and orientation of single and multiple sources with user-defined sound power levels and directivity.

2.8.3 Exceptions

In some instances, open plan designs may not be intended for critical listening activities, or multiple and simultaneous independent instruction. For example, critical listening activity may only occur as a single, plenary session (i.e. having negligible intrusive noise from adjacent areas), followed by 'breakout' activity sessions. These breakout sessions may only involve less critical personal listening activities (for example one-to-one or small group instruction, paired or small group work) or individual study. In this case it is necessary to demonstrate STI compliance for the plenary session only, provided that the reverberation time target given in Table 6 is also achieved. Refer to *Acoustics of Schools, A Design Guide*[1] for further information on the design of open plan spaces.

2.8.4 Demonstrating compliance

The designer should clearly demonstrate how the open plan space will meet the criteria contained in Table 7, by means of layout plans and activity management plans.

The open plan layout should identify:

- The positions at which teachers will typically instruct, or carry out other critical listening activities with groups of students (e.g. presentations, large group discussions, seminars, etc.);
- The seating plan for the students and teachers;
- Maximum communication distances for instruction or other critical listening activities; and
- Furniture, fittings and equipment plan.

The activity management plan should include (where applicable):

- The number, size and location of teaching groups where 'critical listening' activities occur (e.g. large group instruction, presentations, large group discussions, seminars, etc.);
- The number, size and location of teaching groups where instruction or other critical listening activities may occur simultaneously;
- A description of other simultaneous activities which may occur in adjacent areas during critical listening periods, e.g. quiet individual work, paired work, group work, one-to-one or small group instruction, or social time;
- The number of teachers instructing or carrying out other critical listening activity at any one time;
- The number of students and the size of the groups they could be working in at any one time;
- Circulation routes to other parts of the building that may be used during teaching and study periods; and

- Any equipment (e.g. engraving machines, CNC machines, dust and fume extract equipment, data projectors, computers, printers, AVA etc.) operating in the open plan space.

The expected open plan layout and activity management plan should be agreed as the basis on which compliance with these guidelines can be demonstrated to the client

The activity management plan should be used to establish the overall noise level due to the combination of the indoor ambient noise level, all activities in the open plan space (including teaching and study), and transmitted noise from adjacent spaces. A computer prediction model should be used to calculate the Speech Transmission Index (STI) in the open plan space, using the overall noise level as the background noise level. The computer model used to predict the STI should be consistent with this activity management plan and the output from the model should be documented either graphically or in the form of numerical output.

The recommended performance standards for speech intelligibility in open plan spaces are described in terms of the Speech Transmission Index in Table 7. These performance standards apply to speech transmitted from teacher to student, student to teacher and student to student.

The performance standards in Table 7 are intended to ensure that open plan spaces in schools are only built when suited to the planned activities and layout, and users are actively committed to adopting the activity management plan in order to avoid noise conflict. With some activity plans, room layouts and open plan designs it will not be possible to achieve these performance standards. At this point in the design process, the decision to introduce an open plan space into the school should be thoroughly re-assessed, either by altering the design and open plan layout or revisiting the activity management plan. If, after re-assessment, there is still a need for the open plan space, then the inclusion of moveable walls between learning bases should be considered. Where these moveable walls form fully enclosed (cellular) classrooms they will be subject to the airborne sound insulation requirements in Table 2. It is not appropriate to simply adjust the activity management plan until the performance standards for speech intelligibility are met.

Assumptions to be made in the assessment of speech intelligibility are:

- for students, when seated, the head height (for listening or speaking) is 0.8 m for nursery schools, 1.0 m for primary schools and 1.2 m for secondary schools
- for students, when standing, the head height (for listening or speaking) is 1.0 m for nursery schools, 1.2 m for primary schools and 1.65 m for secondary schools
- for teachers, when seated, the head height (for listening or speaking) is 1.2 m
- for teachers, when standing, the head height (for listening or speaking) is 1.65 m.

3 Demonstrating compliance

3.1 Procedures

The preferred means of demonstrating compliance with Building Regulations on acoustics, prior to construction, is to submit to the Building Control Body a set of plans, construction details, material specifications, and calculations, as appropriate for each area of the school that is covered by Requirement E4 of the Building Regulations.

There is no requirement in Building Regulations for acoustic commissioning although it is strongly recommended that this should be required for contractual purposes, in which case pre-completion testing should be carried out in accordance with the testing and reporting procedures set out in the Association of Noise Consultants' publication *Good Practice Guide – Acoustic Testing of Schools*.

3.2 Alternative Performance Standards

In some circumstances alternative performance standards may be appropriate for specific areas within individual schools for particular educational, environmental or health and safety reasons (see Section 1.5). In these cases, the following information should be provided to the Building Control Body:

- a written report by a specialist acoustic consultant clearly identifying (a) all areas of non-compliance with the performance standards (b) the proposed alternative performance standards and (c) the technical basis upon which these alternative performance standards have been chosen
- written confirmation from the educational provider (e.g. school or Local Authority) of areas of non-compliance, together with the justification for the need and suitability of the APS in each space.

3.3 Acoustic commissioning

Pre-completion testing and subsequent reporting should be carried out by a specialist acoustic consultant in accordance with the test and reporting procedures described in the Association of Noise Consultants' publication *Good Practice Guide – Acoustic Testing of Schools*.

References

[1] Acoustics of Schools – A Design Guide, expected to be published in 2014 by the Association of Noise Consultants and the Institute of Acoustics

[2] Building Bulletin 93, The Acoustic Design of Schools, 2003, DfES

[3] Approved Document E – Resistance to the passage of sound. 2010. ISBN 978 1 85946 204 1

[4] Statutory Instrument: No.1943 The Education (School Premises) Regulations 2012: Education England and Wales.

[5] Statutory Instrument No.2962 The Education (Independent School Standards) (England) (Amendment) Regulations 2012. A consolidated version of the regulations showing the 2012 revisions is available at http://www.isi.net/images/271112_web%20consolidated%20version%20-%20independent%20school%20standards%20regulations%202010_001.pdf

[6] The Equality Act 2010: advice for schools. DfE departmental advice for school leaders, school staff, governing bodies and local authorities

[7] Association of Noise Consultants – Good Practice Guide – Acoustic Testing of Schools, 2011

[8] Approved Document M: 2010 Access to and use of buildings, in support of the Building Regulations, ISBN 978 1 85946 211 9

[9] BS 8300: 2009, Design of buildings and their approaches to meet the needs of disabled people. Code of practice

[10] BS EN ISO 140-18 Acoustics – Measurement of sound insulation in buildings and of building elements – Part 18: Laboratory measurement of sound generated by rainfall on building element

[11] BS EN 60268-16: 2011 Sound system equipment – Part 16: Objective rating of speech intelligibility by speech transmission index

Department for Education

Any enquiries regarding this publication should be sent to us at AcousticStandards.CONSULTATION@education.gsi.gov.uk

This document is also available to download from: www.gov.uk/government/consultations

Reference: DFE-00069-2014