



Anderson
Acoustics

Improving access to listening in mainstream schools

Reasonable adjustments for acoustic design





of teachers who have been teaching for more than 10 years believe that **improved acoustics would have a positive impact** on pupil's learning

Anderson Acoustics 2016 Schools Survey

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Listening is one of the most important activities within a school. If the acoustic environment is poor, pupils struggle to understand and retain information.

It's particularly challenging for pupils who have special hearing or communication needs (SHCN), English as an additional language (EAL), or for young children in primary schools.

New school buildings in the UK must comply with Building Regulations for both acoustics and access.

Equality law requires that schools must ensure that 'people with disabilities, including those with hearing impairment, are not placed at a disadvantage'. However, the acoustic design strategy for mainstream classrooms to achieve this aim can be confusing. It is further complicated by other design factors and funding constraints.

The purpose of this white paper is to:

- Clarify requirements for acoustics and where they apply
- Define and quantify the extent of Special Hearing and Communication Needs (SHCN) in our schools
- Develop acoustic criteria to deliver 'inclusive acoustics' for children with SHCN in mainstream classrooms, to minimise listening disadvantage
- Offer practical guidance to improve accessibility using a 'reasonable adjustments' approach, which is underpinned by Equality Law
- Introduce "A+ Grade" acoustic design best practice for mainstream classrooms

The reasonable adjustments for acoustic design can in many cases be achieved at neutral cost.

Acoustics requirements vs The Equality Act

To ensure mainstream classrooms provide an inclusive and accessible listening environment, key standards are considered in greater depth.

Building Bulletin 93 (BB93)

BB93 was first published in 2003, when the Disability Discrimination Act was still in place. Its main purpose was to accompany building regulations and define suitable acoustic criteria for new build schools as the normal means of compliance with the regulations.

The BB93 criteria are now enshrined by several overarching requirements, regulations and drivers. In 2014 the bulletin was updated to include more relaxed criteria for refurbished buildings.

When do BB93 acoustic performance standards apply?

Regulations and standards	New build	Refurbishment
Building regulations – Approved Document E	✓	✗
EFSA Employer’s Requirements (output specification)	✓	✓
School premises regulations	✓	✓
Independent school standards	✓	✓
BREEAM (Hea 05)	✓	✓

That means that since 2003, new build schools have had to achieve the BB93 acoustic criteria, unless a technically justified alternative standard or ‘derogation’ was signed off by building control. This was common practice until 2014, when BB93 was updated and the use of alternative standards became better regulated.

Acoustic standards in refurbishments have been less well-regulated in the past but this has improved since the introduction of the ESFA’s output specification and the 2014 BB93 update.

BB93 sets out different performance standards for various teaching and learning spaces in primary and secondary schools. The criteria affecting speech clarity comprise limits for reverberation time (RT, how echoey the sound is), and indoor ambient noise (so that speech can be heard clearly above the noise, the so-called speech-to-noise ratio, SNR).



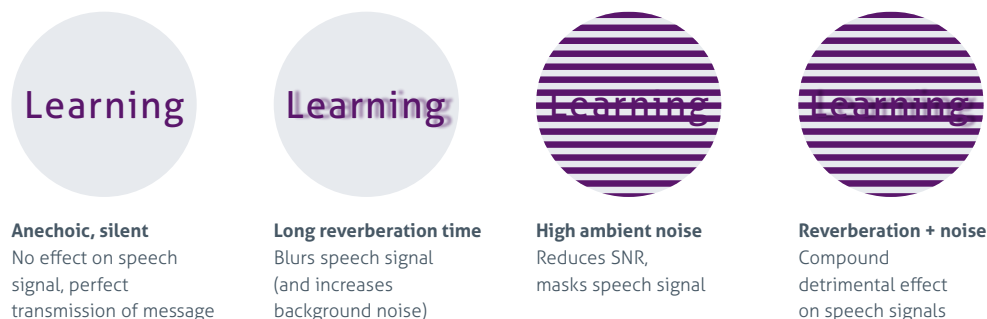
The Equality Act

The public sector duty is a provision of the Equality Act 2010 which says that protected groups must not be placed at a disadvantage. It requires all schools to prepare and implement an accessibility strategy to improve the physical environment of the school for pupils with special educational needs and disabilities (SEND), by making 'reasonable adjustments' to put children with SEND on a more level footing.

The Equality Act also covers age discrimination and people with English as an Additional Language (EAL). Both may be disadvantaged by poor acoustic conditions and so the needs of these protected groups must also be considered.

As you will learn from this document, 'reasonable adjustments' can be practically implemented in a range of situations to ensure that good inclusive listening conditions are delivered.

Effect of acoustic conditions on speech intelligibility



BB93 specifies enhanced acoustic criteria for 'rooms designed specifically for children with SHCN', listing a number of diverse needs under this banner, including hearing impairment, which are all affected to different extents by the acoustic environment.

There is strong evidence that hearing-impaired children and also younger children need shorter reverberation times and higher SNR to achieve understanding of speech (speech intelligibility) equal to their peers.

There is moderate evidence that children with other SHCN needs also benefit from enhanced speech intelligibility.

“In order to fulfil their duties under the Equality Act 2010, school client bodies should **anticipate the needs of deaf and other disabled children** as current and potential future users of the school”

Building Bulletin 93

How many children are affected?

To understand and meet the needs of children with SHCN it is important to define, quantify and understand prevalence in mainstream schools.

At Anderson Acoustics we have analysed the prevalence of children with SHCN in mainstream schools based on the Government's own statistics. The infographic lists types of SHCN as defined by BB93. Young children (11 years and under) and children with EAL are also considered.

Special Hearing and Communication Needs

National averages should be treated with caution and prevalence will vary with individual school location and circumstances. However the statistics show that the need to provide appropriate acoustic conditions for children with SHCN should be anticipated in **every classroom**.

The most common forms of SHCN in mainstream schools are speech language and communication needs (3% of entire mainstream population), specific learning need, which includes AD/HD and dyslexia (2%), and autistic spectrum disorder (1%).

Hearing impairment has a very low prevalence of 0.3%, which is less than 1 child per average sized primary school, and less than 3 per average sized secondary school. Where there is a significantly larger proportion of children with SHCN in a school cohort, this may suggest the need for a specialist resource provision or designated unit.

EAL and age discrimination

To prevent age discrimination, primary schools need to consider enhanced acoustic criteria to assist younger children who are more impacted by poor acoustics. BB93 recognises this with a slightly shorter (enhanced) reverberation time criterion for primary school classrooms.

Children with English as an additional language (EAL) represent 19% of the mainstream population, that's 7 children per average sized primary classroom and 4 per secondary classroom.

Prevalence of SHCN in mainstream schools



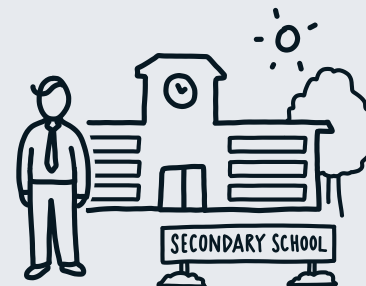
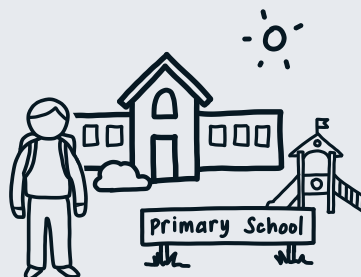
Young Children

19% 

English as additional language (EAL)

6% 

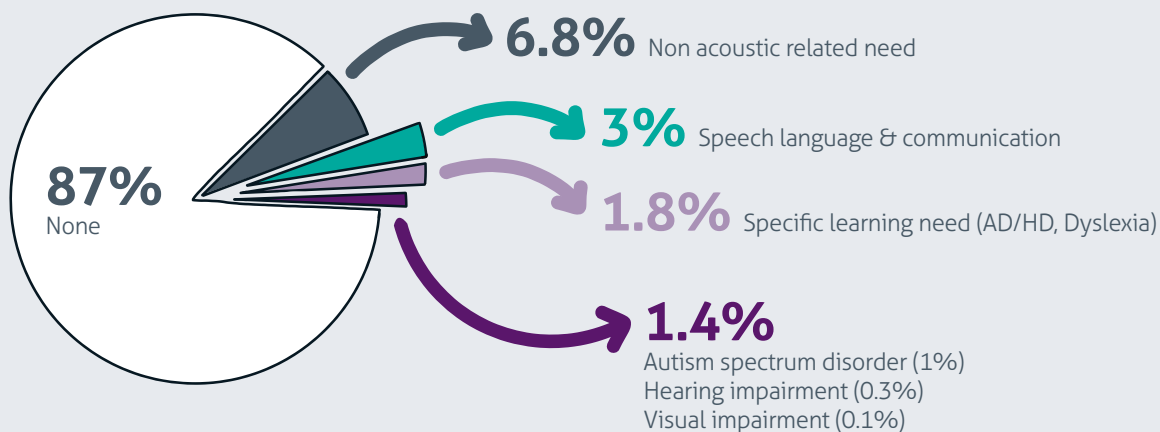
Special hearing & communication needs (SHCN)



-  Mild or temporary hearing impairment
-  Permanent hearing impairment
-  Speech, language & communication needs

-  AD/HD, Autistic spectrum disorder
-  Auditory processing disorder
-  Visual impairment

Prevalence of SHCN in mainstream schools by individual SHCN need





The attainment impact

It's not only hearing impaired children

Whilst the attainment gap for hearing impaired students is significant (remember it's a sensory impairment, not a learning disability), it is smaller than for other forms of SHCN.

Although EAL students have lower achievement on starting school, this effect is largely eliminated by age 16, with no apparent gap in national progress scores.

The BB93 enhanced acoustic criteria are based primarily on the needs of children with hearing impairment. The lack of experimental speech perception evidence for other SHCN needs is concerning, considering that they form the vast majority of the SHCN population in mainstream schools.

National progress scores attainment gaps

10%

gap for **hearing impaired** children

25%

gap for **ASD**

30%

gap for **speech and communication** needs

The challenge

Designers, architects, teachers, audiologists, parents and local authorities are aware that children with SHCN should not be disadvantaged by poor classroom acoustics, yet the extent of disadvantage for each need is not well quantified, and there is confusion over when and how to apply the enhanced acoustic standards.

And just how accommodating are mainstream classrooms, where SHCN children may wish to spend a significant portion of their school day?

Whilst quiet rooms are vital for children with SHCN seeking a place of refuge from the sensory overload of classroom noise when they need to, the design guide supporting BB93 alludes to teaching pupils with SHCN in smaller groups in an adjacent quiet room, in order to overcome acoustic challenges of the mainstream classroom.

Whether this practice is inclusive is questionable and disability groups are beginning to challenge this.

Constraints

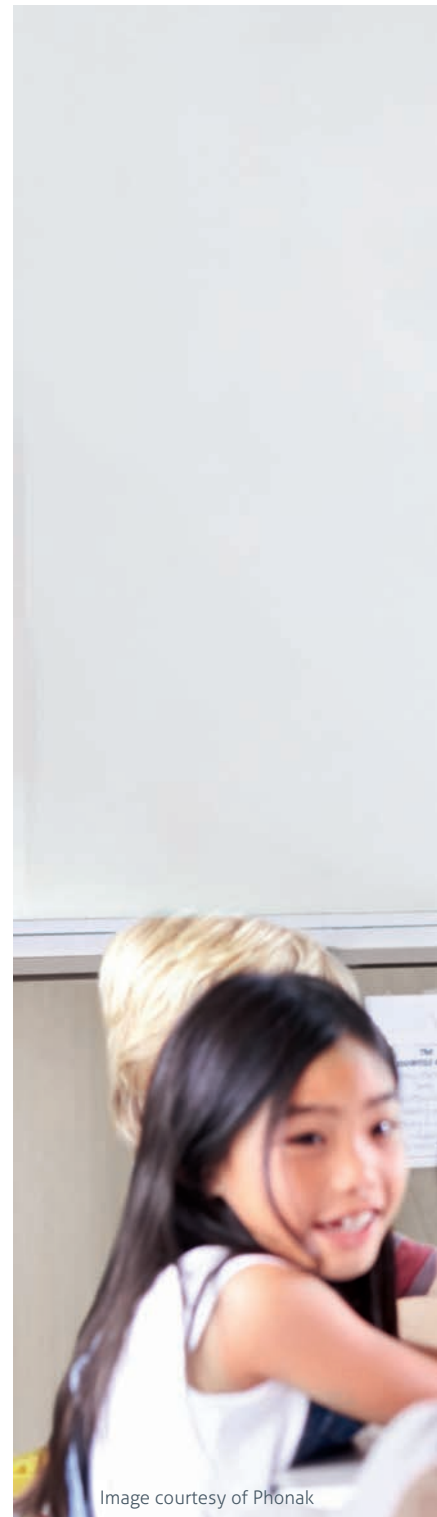
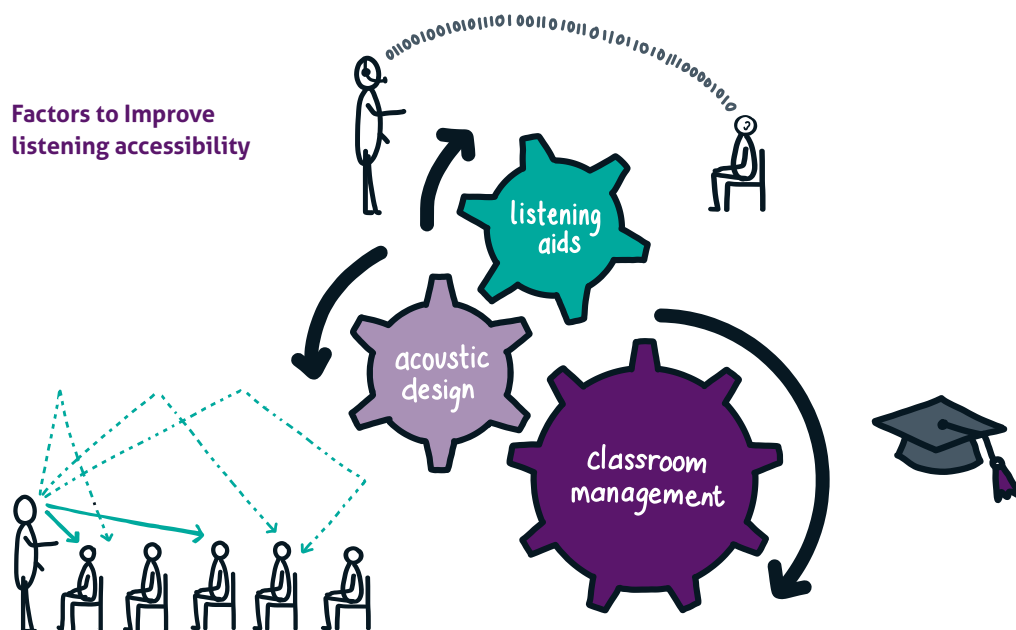
It is not feasible to simply apply the BB93 enhanced standard to mainstream classrooms because:

- Providing sound absorption to achieve the very short reverberation times vies with competition for use of wall space, and trends for exposed soffits for sustainability
- The standard school building budget does not allow for provision of sound absorption to achieve low frequency reverberation time limits
- Very short reverberation times are not appropriate because early sound reflections are needed to support the teacher's voice and avoid vocal strain.
- It is not feasible to target the low enhanced noise limits, given the number of children in the space, priority for natural ventilation, and the practicable limit that even the quietest natural ventilation systems can achieve.
- The standard school building budget does not allow for provision of enhanced partition and door constructions to achieve enhanced sound insulation criteria.

How to make things better

A reasonable adjustments approach.

The major effect of poor acoustics in a classroom is the reduction of speech intelligibility. To help solve this problem there are three reasonable adjustment factors which must be considered holistically to deliver inclusive listening conditions for each learning mode: Listening aids, acoustic design and classroom management.



Personal listening aids

Given the low prevalence of SHCN, and the very low prevalence of children with hearing impairment, personal listening aids are a feasible approach to help boost acoustic conditions and support access to learning.

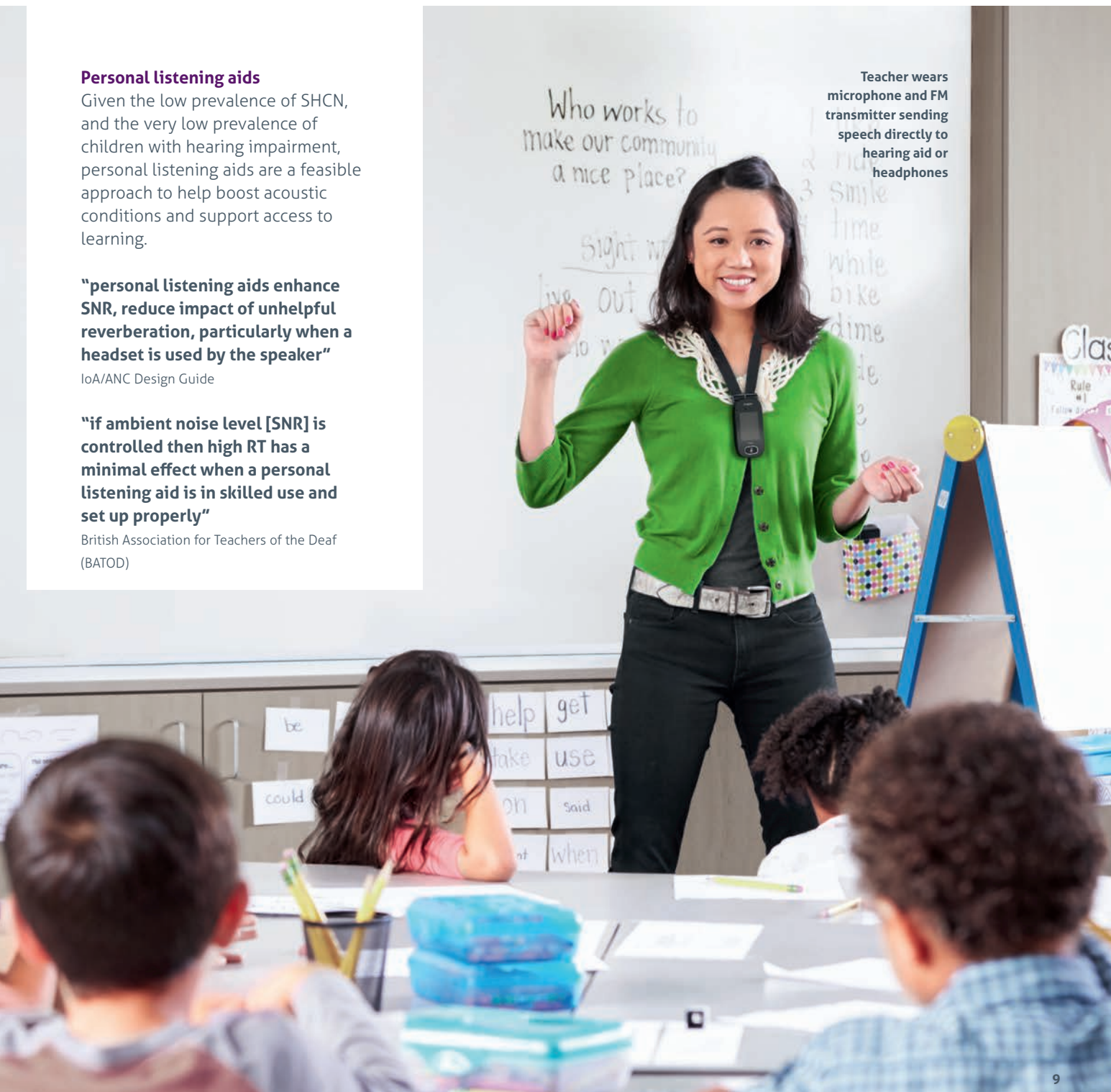
"personal listening aids enhance SNR, reduce impact of unhelpful reverberation, particularly when a headset is used by the speaker"

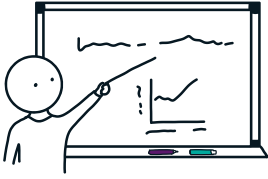
IoA/ANC Design Guide

"if ambient noise level [SNR] is controlled then high RT has a minimal effect when a personal listening aid is in skilled use and set up properly"

British Association for Teachers of the Deaf (BATOD)

Teacher wears microphone and FM transmitter sending speech directly to hearing aid or headphones





Classroom management

Effective classroom management is a crucial non acoustic factor for pupils to hear all that is spoken. Teachers should use simple everyday strategies for each listening mode to improve speech intelligibility.

Classroom management strategies to improve access to listening

Teacher speaking in quiet: Gather young children together for whole class instruction

Teacher facing away: Avoid speaking when facing away, hearing impaired children will not be able to lip read

Class is active/others talking: Use visual, non-vocal cues to quieten an active class before speaking. Do not shout, be aware of voice care techniques

Teacher moving around classroom/working in groups: Use roaming tactics and address small groups or individuals

Other pupils answering: Repeat child's answer to secure speech intelligibility of answer

Quantifying the listening gap

For some needs, even when acoustic conditions are optimised (silent, anechoic test environments), children will still experience a significant reduction in speech perception scores compared to their typically developing peers. We call this the inherent listening gap, which we have quantified by analysing the evidence base of experimental speech perception studies.

Children with a severe-to-profound hearing loss are most disadvantaged compared to their typically developing peers, with an inherent listening gap of up to 12%. However, the listening gap is much worse when acoustic conditions are poor. Even when secondary school classrooms meet BB93 standards for reverberation time and ambient noise, the listening disadvantage for this group will still be up to 40% (reducing to an estimated 20-30% with a personal listening aid, which reduces effective RT for the listener, but less so classroom noise).

For some forms of SHCN such as minimal hearing loss, EAL and younger primary school children, the inherent listening gap is small, 4% or less, which is not considered significant as it is comparable to the variation observed within the group itself. Nevertheless, these milder needs are still affected by poor acoustics when the listening disadvantage can increase significantly.

For example, for primary school children, even under BB93 compliant reverberation times in refurbished schools, the listening gap can double as a result of increased classroom noise and hence reduced SNR. Significantly higher reverberation times and noise levels may arise in pre-existing, unrefurbished building stock, or refurbishments outside EFSA funding scope.

Inherent listening gap and ideal acoustic conditions for different needs

SHCN need	Inherent listening gap	Ideal acoustic conditions		Personal listening aid needed?
		SNR	RT	
Minimal loss	4%	+12 dB	0.3-0.4 s	✗
Mild-to-moderate loss	7%	+20 dB	0.4 s	✓
Severe-to-profound loss	9-12%	+20 dB	0.3 s	✓
EAL	1-4%	+12 dB	0.4-0.5 s	✗
Age< 11 years	11 yrs: 2%	11 yrs: +9 dB	0.4-0.5 s	✗
	8 yrs: 3%	8 yrs: +13 dB		
	6 yrs: 4%	6 yrs: +15 dB		
Autism, AD/HD	Not known	+12 to +18 dB	Not known	In some cases

Acoustic design

The ideal acoustic conditions needed to avoid any disadvantage caused by acoustics have been established for each need. The key is to achieve these ideal conditions through the combined effort of the acoustic design of the classroom space and, where needed, a personal listening aid.

Our analysis shows that, at the right reverberation time conditions, +15 dB SNR can be achieved throughout a typical classroom when a teacher speaks with a typical raised voice and the class is quiet, attentive and listening, and the ambient noise level does not exceed 40 dBA. This level of ambient noise helps to promote natural ventilation where appropriate.

The teacher’s voice will be protected when the reverberation time is at least 0.4-0.5 seconds. This condition also effectively controls buildup of classroom noise. A target reverberation time of 0.5 seconds is recommended as a reasonable adjustment for all primary and secondary mainstream classrooms. SNR may then be boosted and effective RT reduced for children with a significant hearing impairment (and in some cases for children with ASD and AD/HD) when a personal listening aid is used.

“With so many schools still in need of reasonably adjusted acoustic improvements, **we must act now to ensure our current and future school building stock is inclusive** and does not place listeners at a disadvantage”

Reasonable adjustment vs BB93 standards

So what is the impact of this reasonable adjustment approach, compared to sticking with the current BB93 standards? Well, some increase in sound absorption provision is necessary, particularly for secondary schools, but making informed design decisions about factors like room height, floor covering and thermal cooling strategy can minimise costs and even achieve cost neutrality.

Of the nearly 20,000+ state funded schools in England and Wales in existence since before 2003, the majority remain untouched by major school capital building projects (BSF, PSBP, school expansions under CIF, Free Schools programme). Those are schools where acoustic conditions may not yet have been subject to regulation.

Some school sites will be subject to high ambient noise levels, and many classrooms will have no specific acoustic treatment, resulting in excessively long reverberation times, especially in old Victorian school buildings. However, investment in school building continues with the Department for Education's offsite construction framework which plans to deliver 400 new school projects by 2023.

Helping you achieve the **A+ Grade acoustic standard™** for your classroom.

This white paper has identified A+ Grade best practice to ensure all mainstream classrooms provide inclusive and accessible listening environments.

Room design

- 40 dBA maximum ambient noise
- 0.5 second reverberation time
- +15 dB signal to noise ratio

Use of assistive devices to provide

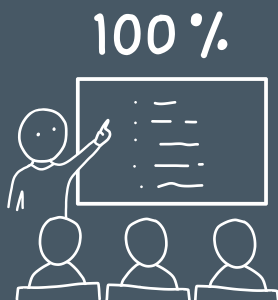
- 0.3-0.4 second reverberation time
- controlled low frequency reverberation time
- +5 dB signal to noise boost

Non acoustic factors

- Classroom management – matching teaching style to listening mode

With 6% of children having special hearing and communication needs, good acoustic design is required in every mainstream classroom and every school.

Designing to the A+ Grade standard will help you meet your duties to anticipate the needs of deaf and other disabled children under the Equality Act 2010 and provide great sounding learning environments for all our children.

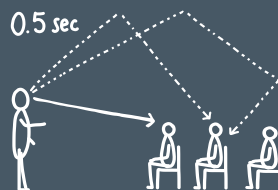


100 %

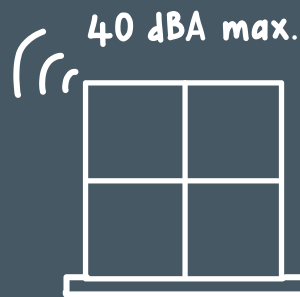
mainstream
classrooms



classroom
management

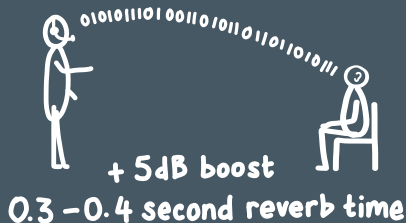


reverb time



ambient noise
natural ventilation

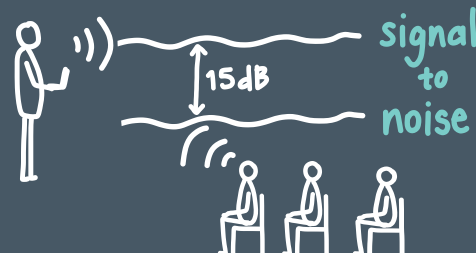
assistive devices



0.3 - 0.4 second reverb time



Classroom
acoustics



Need help?

Contact us for advice or a free consultation

If you need to improve acoustics for inclusion and access in a mainstream school, we can help.
Drop us an email hello@andersonacoustics.co.uk or call us to discuss your requirements.

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