Good acoustic design supports all students and creates a better place in which to learn and teach in. This overview provides a summary of the Ministry’s new Acoustic requirements for creating quality learning environments that are fit for purpose. The requirements form part of the Ministry’s Designing Quality Learning Spaces (DQLS) suite of documents. This overview covers the target audience, mandatory requirements, and key design concepts.

The target audience for the acoustic requirements is designers and engineers involved in the design of the Ministry’s school buildings.

It is to be used for new builds, including extensions, prefabricated and any new contracts for modular buildings, and refurbishments of existing school buildings, including significant alterations.

The acoustic document covers four key areas:

- The importance of good acoustics for learning
- Acoustic concepts and mandatory requirements
- Design guidance for the main areas of acoustic performance
- Verification methodologies to be used when signing off completed spaces and undertaking Post Occupancy Evaluation (POE)

### Mandatory Requirements for Acoustic Design

The mandatory requirements address four key issues:

- Reverberation Time (RT)
- Sound transmission between learning spaces (STC)
- Impact insulation between floors (IIC)
- Indoor ambient noise levels

Requirements for some common learning spaces are provided in the table below.

<table>
<thead>
<tr>
<th>Space</th>
<th>Reverberation Time (RT) (seconds)</th>
<th>STC ratings of walls*</th>
<th>Indoor ambient noise levels (dB L_{Aeq})</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>New Build &amp; Refurbishment</td>
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<td>New Build</td>
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<tr>
<td>Learning Spaces</td>
<td></td>
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<tr>
<td>&gt; 300 m³</td>
<td>0.4 – 1.1 depending on volume (see DQLS Page 9)</td>
<td>STC 50 separate connected</td>
<td>45</td>
</tr>
<tr>
<td>Learning Spaces</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 300 m³</td>
<td>0.4 – 0.5 Primary 0.5 – 0.6 Secondary</td>
<td>STC 50 separate connected</td>
<td>40</td>
</tr>
<tr>
<td>Breakout spaces</td>
<td>0.4 – 0.5</td>
<td>STC 50 separate connected</td>
<td>40</td>
</tr>
<tr>
<td>Music rooms</td>
<td>0.5 – 0.8</td>
<td>STC 60</td>
<td>40</td>
</tr>
<tr>
<td>Assembly halls</td>
<td>0.5 – 1.3 depending on volume</td>
<td>STC 60</td>
<td>35</td>
</tr>
<tr>
<td>Offices / teacher workspaces</td>
<td>0.4 – 0.5</td>
<td>STC 45</td>
<td>40</td>
</tr>
</tbody>
</table>

* There are STC requirements for doors, windows and openings, and exceptions for some adjoining spaces. The IIC requirements for rooms with suspended floor slabs are IIC 55 for new buildings and IIC 50 for refurbishments.

### Refurbishment Recommendations

- In general terms, acoustic strategies for upgrade projects are much the same as for new buildings because there is generally room for some improvement in acoustics as part of any upgrade
- If there are significant changes to layout, occupancy levels, activity types and/or there are significant problems with the existing acoustic condition, then the requirements set out in the table below should be followed as far as is reasonably practicable
- In existing buildings, not meeting one or more of the acoustic mandatory performance targets is not an automatic trigger for an upgrade
Key Acoustic Design Concepts

Figure 1 shows the key acoustic concepts. Each concept’s colour is applied throughout the Acoustic document to provide a clear distinction between different acoustic concept. For example, pink text is about sound absorption.

**Sound reflectors** Examples include plasterboard, glass, concrete, bricks. When sound hits a reflector, it bounces back into the room. In a room with lots of sound reflectors, the sound keeps bouncing around, giving a high reverberation time, like in a church. If it’s hard and smooth, it’s a sound reflector.

**Sound absorbers** Examples include carpet, acoustic ceiling tiles and acoustic wall treatment. The acoustic performance of a sound absorber is quantified by its NRC rating. When sound hits an absorber, it doesn’t reflect and sound energy is removed from the room. This lowers the reverberation time and provides a more controlled acoustic space, like in a cinema. If it’s soft and fluffy, it’s a sound absorber.

**Impact insulation** is how well a floor stops impact sound like footsteps, dropped objects or chair scrapes travelling through to the room below. It is quantified by its IRC rating. A good solid floor construction and a soft or cushioned floor covering are important for impact insulation.

Carpet works well (and is a sound absorber too). In wet areas with linoleum or tiled floors, an acoustic underlay is usually needed.

**Sound insulation** is how well a wall or floor stops airborne sound passing through it. It is quantified by the STC rating for walls, and CAC rating for ceilings. If a wall has an opening like a door, window or louvre, more sound will pass through. So, the size and location of openings are important and might need acoustic treatment. Solid, heavy materials are good for sound insulation (but most of them are also sound reflectors).

Figure 2: Important acoustic concepts and their colour codes used throughout the Acoustic document

**Helpful Tips and Rules of Thumb**

Here are some helpful tips and rules of thumb to assist with acoustic design:

- **Sound absorption must be well distributed throughout a space.** If it is only placed on one surface, sound will reflect off the other hard surfaces making for a higher RT and possible echoes.

  Treat the ceiling with a highly absorptive product (NRC 0.85 or higher), as well as most of the available wall area.

- **The RT spectrum must be balanced, with similar RTs at low, medium and high frequencies, otherwise the room can sound boomy.** Low frequency noise is only absorbed by thicker materials (i.e. 40mm or thicker). Thin materials (like carpet and acoustic pinboards) only absorb higher frequencies.

  Usually, a combination of thick and thin materials is required to achieve a balanced RT.

- **Glass is very common in classrooms as windows and wall partitions, but it reflects sound.** The size and location of glass panels need to be designed with acoustics in mind to avoid issues.

- **Doors and windows in an acoustically rated wall degrade its acoustic performance.** Careful positioning of doors, selection of door materials, seals and joinery are therefore important.

- **Sliding doors are desirable in large learning spaces, but have poor acoustic performance.** They should be used only where the teachers are going to need the flexibility of changing the size of the teaching space, and they need to be aware of the acoustic compromise.

- **Floor coverings and ceilings are important for achieving the minimum IIC requirements.** Hard flooring and exposed soffits make compliance difficult, but some solutions can be made to work.

This is a brief overview of the acoustic requirements. The Ministry’s full requirements for acoustics in schools is available on the Ministry’s website.

Other documents in the DQLS series that form part of the Ministry’s guidelines are: Lighting and Indoor Air Quality and Thermal Comfort.