LABS

ACOUSTIC DESIGN STANDARD

LABTECH INVESTMENT LIMITED

LABS COLLABRATIVE WORK SPACES
ACOUSTIC DESIGN STANDARD

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1. INTRODUCTION 1

2. GUIDANCE 2

3. INTERNAL AMBIENT NOISE LEVELS 3

4. INTERNAL SOUND INSULATION 4

5. CONTROL OF REVERBERATION 8

6. VIBRATION 11

7. BUILDING SERVICES 12

1. INTRODUCTION

Sol Acoustics Ltd (Sol) has been commissioned on behalf of Labtech Investments Limited to develop an Acoustic Design Standard (ADS) for their LABS Work Space development scheme.

LABS Works Spaces provide contemporary designed collaborative office space, individual offices, meeting rooms and social areas. It is understood that the LABS design ethos typically features exposed concrete soffits, exposed building services, hard surfaces, glass partitions, and wooden or hard floor surfaces.

Figure 1.1 LABS Interior Design Example – Circulation Spaces

Noise in the workplace is increasing as a result of greater activity and higher density of people. The evolution of the open plan office, flexible working, new technology, and team working are just a few of the driving forces behind changes to office space design. These have led to the requirement for a wide variety of work zones all of which place increasing demands on acoustic performance.

Each function will have its own acoustic requirements, which will form the basis for providing the correct acoustic environment for each area and a balance between the need to communicate, the need for privacy and the ability to concentrate need to be appropriately managed.

This document identifies the acoustic issues to be addressed when creating LABS Work Space designs and provides the following recommended acoustic design performance standards:

- Internal Ambient Noise Levels;
- Building Services Noise Levels;
- Sound Insulation Between Acoustically Critical Areas;
- Reverberation Time Criteria;
- Initial Design Guidance;

2. GUIDANCE

The Acoustic Design Standards within this document are based on the following current UK Standards and guidance:

- BS8233:2014 Guidance on Sound Insulation and noise reduction for buildings;
- British Council of Offices Guide to Specifications 2014;
- Finishes and Interiors Sector Guide to Office Acoustics 2015.

It should be noted that the above documents form best practice guidance only and do not form any statutory requirements.

2.1 BREEAM UK REFURBISHMENT & FIT-OUT

Up to three BREEAM Credits are available for HEA05 Acoustic Performance where refurbished or fit-out office buildings meet the minimum acoustic performance requirements for sound insulation, indoor ambient noise levels, and reverberation times.

The HEA05 performance requirements for offices is based on design guidance presented in BS8233:2014, therefore compliance with the Acoustic Design Standards presented in the document will allow the development to achieve the minimum BREEAM requirements, subject to an appropriate testing programme.

Compliance Note CN7 states that, for Historic Buildings, full credits can still be achieved where full compliance has not been met where it is confirmed that the design has improved the acoustic performance as much as possible taking into account any restrictions detailed in a conservation officer's report.

One additional BREEAM Credit is available for POL05 Noise Attenuation where the noise level from the proposed site/building, as measured in the locality of the nearest or most exposed noise-sensitive development, meets the design criterion.

3. INTERNAL AMBIENT NOISE LEVELS

It is commonly accepted that if the background noise of an office is too high, productivity is likely to suffer. Fluctuating noise, such as phones ringing, laughter and loud speech, affect concentration. Conversely, if background noise levels are too low, privacy can suffer.

Section 7 of BS8233:2014 includes ambient noise criteria for a variety of spaces used for work and speech, which is reflected in both the BCO and FIS guidance. Target ambient noise levels should not normally exceed the design ranges given in Table 3.1 below. In areas where acoustic privacy is important, it is recommended that the minimum design range level is achieved to ensure a level of 'masking noise' is present in the space.

Room Function	Internal Ambient Noise Level Design Range $L_{Aeq,T}$ (dB)
Meeting Rooms	35 – 45
Executive Office	35 – 40
Cellular Offices	40 – 50
Open Plan Offices	45 – 50
Reception Rooms	40 – 45
Circulation Spaces, Toilets	45 – 55
Bar / Lounge Areas	50 – 55

Table 3.1 Internal Ambient Noise Level Design Range

In addition, BCO 2014 recommends that rain noise should be controlled to 60 dB $L_{Aeq,T}$ during heavy rainfall (as defined within BS EN ISO 140-18: 2006).

3.1 INTERNAL NOISE FROM BUILDING SERVICES

The maximum internal noise limits for building services noise are shown in Table 3.2. The table shows the criteria in terms of maximum Noise Rating level (*NR*).

Room Function	Maximum Building Services Noise Limits *(NR)*
Cellular Office, Meeting Rooms	35
Executive Office	30
Open Plan Office	40
Speculative Offices	38
Circulation Spaces, Atria	40
Toilets	45
Bar / Lounge Areas	45

Table 3.2 Building Services Noise Limits

For plant rooms, gyms, and other occupied spaces not listed above, noise levels should be designed to suit the acoustic requirements of adjacent noise sensitive spaces.

4. INTERNAL SOUND INSULATION

4.1 SPEECH PRIVACY

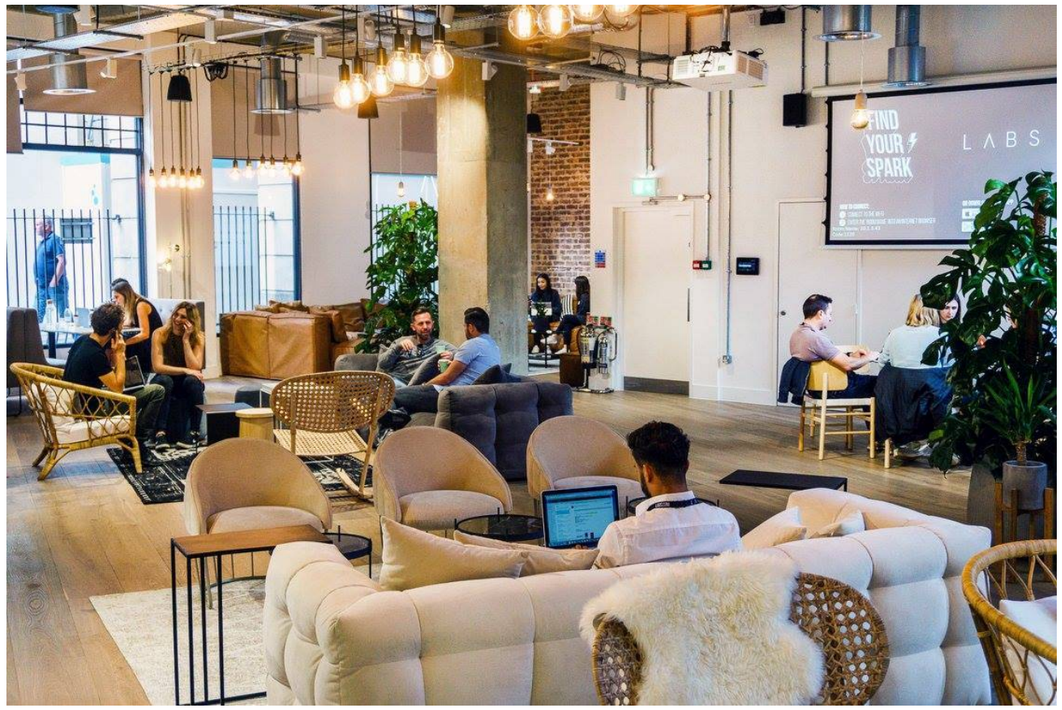


Figure 4.1 LABS Interior Design Example – Lounge Area

When considering the sound insulation performance between noise sensitive spaces the Speech Privacy Factor provides an indication of the likely subjective quality of a room due to the intelligibility and intrusiveness of adjacent speech and conversation. The Privacy Factor (*PF*) is determined by the linear addition of the on-site weighted sound insultation of the partition (D_w) and the level of masking sound (dB) within the receiving room.

For good speech privacy, it is recommended that partitions separating cellular offices, meeting rooms, and open plan offices from adjacent spaces should achieve *PF* 75. Executive offices, and spaces where confidentiality is required should achieve a minimum *PF* 80.

Table 4.1 provides recommended laboratory sound insulation performance values (R_w) between differing room types to achieve speech privacy based on the recommended building services noise level from Table 3.2.

Room Function	Minimum Sound Insulation Performance (dB R_w)
Executive Office (*PF* 80)	58
Cellular Office, Meeting Room (*PF*75)	48
Open Plan Office (*PF* 75)	43

Table 4.1 Recommended Sound Insulation for Office Partitions

The above sound insulation values assume a 8dB reduction in performance between the stated laboratory performance (R_w) and the on-site performance (D_w). Table 4.2 provides typical drywall constructions to achieve the minimum sound insulation performances in Table 4.1.

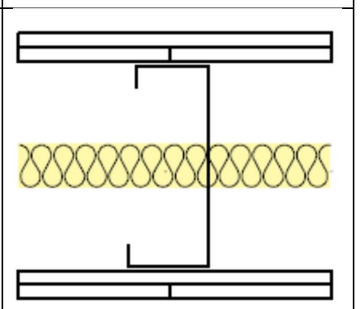
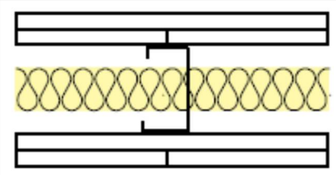
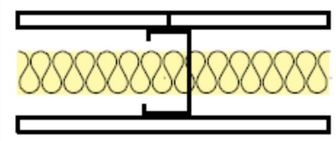
Sound Insulation Performance (dB R_w)	Example Construction	
58	2x 15mm SoundBloc board either side of 146mm C-studs with 25mm insulation (208mm)	
48	2x 12.5mm WallBoard either side of 48mm C-studs with 25mm insulation (100mm)	
43	1x 12.5mm SoundBloc board either side of 48mm C-studs with 25mm insulation. (80mm)	

Table 4.2 Example Partition Constructions

To avoid confusion, it is the R_w parameter only that should be included on the specifications submitted to drywall suppliers.

Example constructions are provided for costing and sizing purposes only and do not form part of the acoustic specification. Alternative constructions can be used if preferred, and should be submitted to Sol Acoustics for approval at the appropriate design stage.

The use of 'acoustic studs' or resilient rails within wall constructions should be avoided, if possible. Whilst these types of construction may be more space efficient, the performance achieved on-site is more prone to workmanship errors and other site issues and therefore can increase the risk of non-compliance.

Plasterboard can be either skimmed or taped & jointed but this is required to the full height of the partition. Where there is more than one lining, the boards should be installed with staggered joints.

4.2 BS8233 SOUND INSULATION MATRIX

BS8233:2014 provides a matrix to determine recommended minimum sound insulation performance ($D_{nT,w}$) for separating partitions, according to the noise activity, noise sensitivity, and privacy requirements for each room as shown below in Table 4.3.

It should be noted that a $D_{nT,w}$ of 55dB or greater will be difficult to achieve, therefore room adjacencies between very high source room activities, such as gyms or theatres, and sensitive spaces such as offices should be avoided though the use of appropriate zoning.

Privacy Requirement	Activity Noise of Source Room	Noise Sensitivity of Receiving Room		
		Low	Medium	Sensitive
Confidential	Very High	47	52	57
	High	47	47	52
	Typical	47	47	47
	Low	42	42	47
Moderate	Very High	47	52	57
	High	37	42	47
	Typical	37	37	42
	Low	-	-	37
Not Private	Very High	47	52	57
	High	37	42	47
	Typical	-	37	42
	Low	-	-	37

Table 4.3 BS8233 Sound Insulation Matrix (dB $D_{nT,w}$)

Table 4.4 provides typical partition constructions to achieve the minimum sound insulation performances in Table 4.3, an 8dB reduction in performance has been assumed to provide equivalent laboratory performance values (R_w).

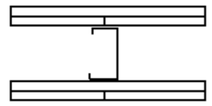
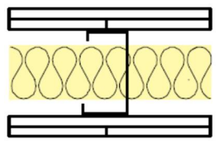
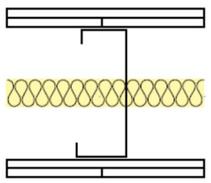
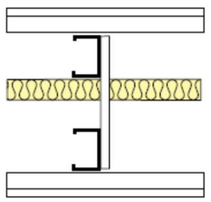
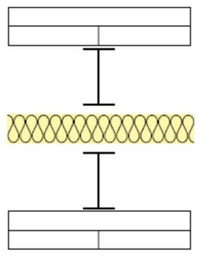
On-site Sound Insulation Performance (dB $D_{nT,w}$)	Laboratory Sound Insulation Performance (dB R_w)	Example Construction	
37	45	2x 15mm WallBoard either side of 48mm C-studs. (110mm)	
42	50	2x 12.5mm WallBoard either side of 70mm C-studs with 50mm insulation. (122mm)	
47	55	2x 12.5mm SoundBloc board either side of 146mm C-studs with 25mm insulation. (198mm)	
52	60	2x 15mm SoundBloc board either side of 2 50mm C-stud channels with 50mm insulation (200mm)	
57	65	2x 15mm SoundBloc boards on independent 48mm I-stud frames with 50mm insulation (200mm)	

Table 4.4 Example BS8233:2014 Partition Constructions

To avoid confusion, it is the R_w parameter only that should be included on the specifications submitted to drywall suppliers. Alternative constructions can be used if preferred, and should be submitted to Sol Acoustics for approval at the appropriate design stage.

Privacy requirements, noise sensitivity and noise activity levels for the differing room functions have been determined in Table 4.5. Where adjacent spaces have different uses the worst-case sound insulation value shall be used.

Room Function	Privacy Requirement	Room Activity Noise Level	Room Sensitivity to Noise
Circulation Spaces, Atria	Not Private	Typical	Low
Toilets	Not Private	Typical	Low
Bar / Lounge Areas	Moderate	High	Low
Reception Room	Moderate	Typical	Medium
Gym	Not Private	Very High	Low
Theatre	Not Private	Very High	Sensitive

Table 4.5 Typical Room Function Classification

4.3 FLANKING NOISE

To suitably control flanking noise, all partitions should be built tight to the soffit with a suitable deflection head detail. Where raised access flooring is used, suitable cavity barriers should be installed for the full length and covering the width of the partition.

Internal partitions should be suitably detailed to ensure sound does not flank through the internal linings or the cavity behind.

Where internal partitions abut glazed curtain walling systems suitable acoustic detailing should be used to achieve a minimum flanking performance of 53dB $D_{nf,w}$. Where possible, it is recommended that unitised curtain walling is used with a thermal/acoustic break between adjacent rooms.

In addition to the above, careful design is required to control flanking through HVAC systems, especially where floor voids are used as plenums.

4.4 INTERNAL DOORSETS

Figure 4.2 LABS Interior Design Example – Cellular Offices

It is understood that the design preference for room frontages are formed from glazed partitions with solid timber or glass doors. It is recommended that doorsets for cellular office, open plan offices and meeting rooms, inclusive of frames, seals and hardware, provide a minimum sound insulation of 35dB (R_w).

For executive offices and rooms with confidential speech privacy, it is recommended that timber doorsets should be used to provide a minimum sound insulation of 40dB (R_w).

Where rooms have a high or very high source activity level, high performance or lobbied acoustic doorsets may be required depending on the sensitivity of the adjacent spaces.

4.5 VERTICAL SOUND INSULATION

Vertical airborne sound insulation between individual office floors should provide a minimum of 48dB $D_{nT,w}$.

4.6 IMPACT SOUND INSULATION

There is no specific requirement for impact sound insulation between individual office floors. It is normally recommended that carpet is used across office spaces to control footfall noise and provide acoustic absorption. However, as LABS designs often feature hard floor finishes, it is recommended that an acoustic resilient layer is included below the floor finish.

5. CONTROL OF REVERBERATION

5.1 OPEN PLAN OFFICES

For open plan offices the ceiling finish should be as acoustically absorbent as possible to control unwanted primary noise reflections and the reverberant build-up of sound. This is achieved conventionally with an acoustic ceiling falling into Sound Absorption Class A (BS EN ISO 11654:1997) covering all areas except lights, grilles and plasterboard margins.

However, as LABS typical design makes use of open, hard soffits and floor finishes, alternative soffit finishes and acoustic treatments will be required to control primary reflections and achieve an equivalent standard of acoustic separation/privacy between work stations.

Sound absorption can be introduced into the room using ceiling canopies, barriers, baffles, islands and rafts. Alternatively, for an even soffit finish an acoustic spray product can be applied. It is recommended that ceiling heights should be kept below 3m FFL between working clusters.

Figure 5.1 Example of Suspended Ceiling islands

Figure 5.2 Example of Hanging Ceiling Baffles

Figure 5.3 Example of Acoustic Soffit Treatment

Additional absorption can be distributed through the space, using acoustic wall panels, for example open slatted timber or stretch fabric over a resin bonded mineral wool, and the use of soft furnishings.

Figure 5.4 Example of Acoustic Wall Panel

Within an open plan office there is likely to be varying acoustic requirements for privacy and intelligibility across the floorplate. Where good speech intelligibility within working clusters is required it is recommended that the Speech Transmission Index for the zone is greater than 0.6.

Between adjacent working groups a maximum Speech Transmission Index no greater than 0.4 is recommended to provide a reasonable standard of privacy. Speech Transmission Indices for proposed spaces should be assessed in accordance with ISO 3382-3:2012.

5.2 CELLULAR ROOMS

Control of reverberation in enclosed spaces such as offices, meeting rooms and conference rooms must be appropriate to the use of the space - for example, discussions by telephone or between people in the same room. It is recommended that the mid-frequency reverberation time within these spaces should not exceed 0.8s (T_{mf}).

It should be noted for larger rooms in which speech needs to be understood by a number of people, the mid-frequency reverberation time should exceed 0.6s (T_{mf}) otherwise it may unduly deaden the room.

It is understood that LABS Audio Visual specification requires a reverberation time of 0.5s within rooms used for video conferencing.

In order to achieve the above reverberation time criteria additional acoustic absorption, similar to that for the open plan office spaces, will be required through the use of hanging ceiling rafts or islands and acoustic wall panels

Figure 5.5 Example of Slatted Timber Acoustic Panel

5.3 COMMON SPACES

The reverberation time (T_{mf}) within circulation spaces that adjoin noise sensitive rooms should not exceed 1.5s.

5.4 ATRIA / LOUNGE AREAS

Atria and lounge / bar areas often feature large room volumes and hard surfaces with poor acoustic absorption. Long reverberation times and high background noise levels can lead to reduced speech intelligibility and consequently increased vocal effort which has the adverse effect of increasing the room sound level. When connected to other office areas this can lead to distraction and poor working environments for concertation tasks.

It is recommended that wherever possible acoustic absorption is introduced within atria and lounge spaces through the use of ceiling rafts and wall panels to reduce reverberation times.

Figure 5.6 Example of Acoustic Absorption in Atria / Bar Space

6. VIBRATION

Vibration transfer from building services plant to internal areas should not be more than 0.01 m/s^2 peak acceleration (based on W_b weighting as defined in BS 6472-1:2008).

It is recommended that all HVAC plant and equipment is suitably isolated in line with the guidance presented in the ASHRAE Handbook 2015. Example principle vibration isolation products and their typical usage is shown in Table 6.1, final isolation selection will depend on forcing frequency, mass, and natural frequency of the isolation and mechanical systems, further guidance should be sought from Sol Acoustics at individual project design stages.

Where gyms and cinema theatres are included within the design it is highly recommended that these areas are appropriately isolated from the supporting structure to minimise vibration and noise transfer to other occupied areas of the building. Further guidance on suitable mitigation requirements should be sought from Sol Acoustics for individual room designs.

To reduce the adverse impact of re-radiated structural vibration from lift guiderails within rooms adjacent to the lift core, it is recommended that the external lift core walls feature an independent plasterboard lining.

	Type	Application
	Open Restrained Springs	Low frequency mounting specifically designed to limit vertical and horizontal movement on equipment such as cooling towers and chillers.
	Open Spring Mount	Widely used to isolate axial and centrifugal fans, air handling units, and with an inertia base, pumps, generators, and compressors.
	Spring Hanger	Used to suspend pipework, fan coil units, ductwork, and acoustic ceilings.
	Rubber Turret Mounting	Medium to high frequency mounting for axial fans, air handling units, refrigeration plant, and pumps. Also used to provide floating floor systems.

Table 6.1 Vibration Isolation Product Application

7. BUILDING SERVICES

The noise level from the proposed site/building should be assessed against the background sound level at the closest noise sensitive receptors in line with the requirements of POL05 Noise Attenuation.

In order to quantify the background noise level a benchmarking environmental noise survey will need to be undertaken to measure the existing acoustic climate during the daytime and night-time in compliance with BS7445-1:2003 and the procedural guidance presented in BS4142:2014.

Where the noise level from the proposed site/building is greater than the criterion, measures will need to be installed to attenuate the noise at its source to a level where it will comply.

It should be noted that as LABS developments are primarily within the Greater London Authority, significantly more stringent noise emission criteria from the local planning authorities are likely to be applicable and will control plant selection and attenuation requirements. Further guidance should be sought from Sol Acoustics for individual developments at the appropriate design stage.