

Tesco Stores Limited

Sky Gardens
1 Castlefield
Manchester
M15 4LY

Sound Insulation Assessment

On behalf of



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Appendix A Acoustic terminology

1.0 Introduction

- 1.1. Noise Solutions Ltd (NSL) has been commissioned by Tesco Stores Limited to undertake an assessment of the sound insulation of the separating floor between the sales floor and back of house (BoH) areas of a proposed new Tesco Express store.
- 1.2. The proposed store is to be located on the ground floor of a mixed-use development, located at Sky Gardens, 1 Castlefield, Manchester, M15 4LY, with adjoining residential flats located above.
- 1.3. The airborne sound insulation of the separating floor has been predicted, based on drawings provided, and an assessment of its acoustic suitability has been made by reference to recognised Standards and guidance.
- 1.4. A glossary of acoustic terminology is given in [Appendix A](#).

2.0 Details of development proposals

- 2.1. The proposed Tesco Store will occupy one of two proposed ground floor commercial units within the newly constructed 13-storey Sky Gardens development. The remainder of the building is assumed to be residential in use.

3.0 Assessment criteria

Building Regulations Approved Document E

- 3.1. Building Regulations Approved Document E *Resistance to the Passage of Sound* gives minimum standards for airborne and impact sound insulation between dwellings, and between dwellings and other occupancies, and are primarily aimed at controlling domestic noise transfer.
- 3.2. Under the requirements of Approved Document E, the airborne sound insulation provided by the separating floor between a residential dwelling or room for residential purposes (RRP) and any other part of the same building must be at least $45 \text{ dB } D_{nT,w} + C_{tr}$.
- 3.3. The Approved Document E requirements for impact sound insulation apply only when the dwelling/RRP is below the separating floor, and therefore need not be considered in this case.
- 3.4. Building Regulations do not give specific guidance on any enhancement to the sound insulation that may be required where, for example, noise levels in a commercial unit are higher than would be expected in a dwelling.

BS 8233:2014 Guidance on Sound Insulation and Noise Reduction for Buildings

Airborne sound insulation

- 3.5. The minimum standards in the Building Regulations may not be sufficient to control noise, if the noise levels in the non-residential premises may be higher than would usually be expected for a dwelling. Guidance is therefore sought from BS 8233:2014 – ‘Guidance on sound insulation and noise reduction for buildings’.
- 3.6. Section 7.5 ‘Internal Sound Insulation’ of BS 8233, states the following:

“... sound from adjacent spaces can affect the intended use, depending on the noise activity, noise sensitivity and privacy requirement. A matrix may be used to determine the sound insulation requirement of separating partitions once the noise activity, noise sensitivity and privacy requirements for each room and space. An example matrix, which can be adapted according to the specific building use, is given in Table 3. Each room may be both a source and a receiving room. Where adjacent rooms have different uses, the worst case sound insulation should be specified.”

Table 3 Example on-site sound insulation matrix (dB $D_{nT,w}$)

Privacy requirement	Activity noise of source room	Noise sensitivity of receiving rooms		
		Low sensitivity	Medium sensitivity	Sensitive
Confidential	Very high	47	52	57 ^{A)}
	High	47	47	52
	Typical	47	47	47
	Low	42	42	47
Moderate	Very high	47	52	57 ^{A)}
	High	37	42	47
	Typical	37	37	42
	Low	No rating	No rating	37
Not private	Very high	47	52	57 ^{A)}
	High	37	42	47
	Typical	No rating	37	42
	Low	No rating	No rating	37

NOTE Background noise can also influence privacy. See also 7.7.6.3.

^{A)} $D_{nT,w}$ 55 dB or greater is difficult to obtain on site and room adjacencies requiring these levels should be avoided wherever practical.

- 3.7. There is an element of professional judgement required with regard to the acoustic categorisation of each space.
- 3.8. As a worst case, the shop floor and BOH could be considered as a space which is not private and with a high activity noise level. The residential properties adjoined can be considered as spaces with a high level of sensitivity.
- 3.9. Based on these considerations, the sound insulation of the partition separating these spaces should not be lower than 47dB $D_{nT,w}$ based on the matrix table in BS8233: 2014.

- 3.10. In practice, where the Building Regulations requirement described above is achieved, the minimum performance resulting from the BS 8233:2014 recommendations would normally be achieved "by default".

Criterion for residential dwellings

- 3.11. BS 8233:2014 *Guidance on sound insulation and noise reduction for buildings* recommends desirable internal noise levels within different room spaces, including residential dwellings.
- 3.12. The applicable internal noise criteria for residential properties given in BS 8233:2014 are summarised in the following table:

Table 1 Summary of relevant guidance given BS 8233:2014 with regard to internal noise levels affecting residential premises

Period	Space	Recommended Noise Level (dB)
Daytime (07.00 – 23.00 hours)	Living rooms and Bedrooms	< 35 $L_{Aeq, T}$
Night-time (23.00 – 07.00 hours)	Bedrooms	< 30 $L_{Aeq, T}$

- 3.13. It should be noted that these criteria target levels are typically used to assess noise from general environmental noise break-in (i.e. road traffic) rather than intrusive sources of noise. Therefore, it is recommended to reduce the above limits in around 5dB, as the noise produced by the rolling of metal cages may be both tonal and intermittent. In addition, BS8233 also states that:

"Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or $L_{Amax, F}$, depending on the character and number of events per night. Sporadic noise events could require separate values"

- 3.14. As a consequence, it is also appropriate to use a limit in terms of $L_{Amax, F}$. WHO Guidelines for Community Noise 1999 stated that:

"If negative effects on sleep are to be avoided the equivalent sound pressure level should not exceed 30 dBA indoors for continuous noise. If the noise is not continuous, sleep disturbance correlates best with L_{Amax} and effects have been observed at 45 dB or less. This is particularly true if the background level is low. Noise events exceeding 45 dBA should therefore be limited if possible. For sensitive people an even lower limit would be preferred."

Tesco Developers Shell Building works

- 3.15. Tesco outline their sound insulation requirements in the document reference *Brief Specification of Developers Shell Building works VERSION – QTR 3-2018*. Section 4.3 of that report refers to the airborne sound insulation and Table 1 details the criteria for where there are 'Residential or Rooms for Residential Purpose' within the same building as the proposed Tesco Express demise. The criteria to be met by the developer is $D_{nT,w} + C_{tr}$ 60 dB or above. It should be noted that this is significantly in excess of the minimum standard required by Building Regulations and thereby provides additional protection to occupiers of adjacent dwellings / RRP's.

4.0 Separating floor

Existing floor construction and performance

- 4.1. Based on drawings provided to NSL, it is understood the separating floor construction is to comprise:
- Floating layer of 65mm sand/cement screed on a separation layer, ABOVE
 - A 25mm resilient layer of mineral wool, ABOVE
 - A 150mm thick concrete floor slab

Outline assessment of existing floor construction

- 4.2. A floor of this construction typically has the following sound reduction index (SRI) values:

Floor	63	125	250	500	1000	2000	4000	8000	R_w
150mm Concrete slab + 62mm floated sand/cements creed on 25mm M/W	35	38	42	48	53	55	59	60	51

- 4.3. The R_w value for a floor construction of this type is 51 dB. The prediction noted above is based on typical laboratory-test data for similar constructions with corrections made for dimensions of the rooms, separating wall / floor areas, likely flanking conditions, and assuming that good standards of workmanship were maintained during construction. Taking that into consideration, the approximate in-situ performance of the floor would be approximately 44dB $D_{nT,w} + C_{tr}$ and approximately 47dB $D_{nT,w}$.
- 4.4. The existing separating floor is therefore **unlikely** to achieve the specified performances noted in paragraphs 3.15 regarding Tesco specifications. It would also fall slightly short of the airborne

sound insulation required in Building Regulations Approved Document E (as noted in paragraph 3.2).

Recommendations – proposed flats

- 4.5. As the 1st floor above the store is expected to be comprised of flats, a higher performance mass barrier ceiling will be required. This should comprise 2No. 15mm SoundBloc layers supported from the soffit using resilient hangers to create a void at least 300mm deep. The void should be infill to two-thirds depth with high density mineral wool. All joints between SoundBloc boards are to be staggered.
- 4.6. Please note that in all cases there should be no penetrations through the mass layer ceiling.
- 4.7. High standards of workmanship will be required to ensure that the separating floor provides the optimum performance. The perimeter of the separating partition must be isolated from the walls using appropriate perimeter isolation strips and ceiling fixings must not bridge the isolating elements.

5.0 Structure-borne transmission (roll cage movements)

- 5.1. The movement of roll cages through retail premises can be a significant source of structure-borne noise transmission. Vibrational energy from roll cage movements can transmit through the structure and reradiate as noise within adjoining premises. Structure-borne sound transmission from cage movements cannot be treated through the installation of acoustic ceilings; a resilient floor treatment is required to minimise transmission into the building structure.
- 5.2. Within the sales floor and back-of house (i.e. all areas where roll cages are normally used) it is recommended that a floating floor should be installed. This could comprise one of the following options:
 - a) Screed floating floor: Screed cast onto resilient layer. The resilient layer should either have a ΔL_w of not less than 30dB or have a natural frequency of not more than 24 Hz. The resilient layer should be at least 10mm thick and the floating floor must be isolated from the surrounding walls and columns to ensure flanking transmission will not occur. The floor finish must be smooth with no ridges or steps. There must be no rigid fixings through the screed finish into the resilient layer.
 - b) Timber floating floor: Timber boards supported on resilient acoustic cradle and batten system. Boarding would typically comprise 2No. 9mm ply layers supported via resilient cradle and battens to form a 70mm deep cavity loosely filled with mineral wool. The resilient cradles should either have a ΔL_w of not less than 30dB or have a natural frequency of not

more than 24 Hz. The floating floor must be isolated from the surrounding walls and columns to ensure flanking transmission will not occur. There must be no rigid fixings through the timber floor finish into the resilient layer. The floor finish must be smooth with no ridges or steps.

6.0 Control of noise flanking

- 6.1. To control the potential for noise flanking transmission between the store/BoH and bathrooms and WCs in the flats above via soil vent pipes (SVP), it is recommended that any SVPs within the store demise but not within the void above the ceiling described are boxed in. The pipe enclosures should be constructed from boards with a mass of at least 15kg/m² (e.g. two layers of 12.5mm thick plasterboard). The interior of the enclosures should be lined with 25mm thick mineral wool or glass wool.

7.0 Summary

- 7.1. Noise Solutions Ltd (NSL) has been commissioned by Tesco Stores Limited to undertake an assessment of the sound insulation of the separating floor between the sales floor and back of house (BoH) areas of a new, proposed Tesco Express store.
- 7.2. The airborne sound insulation of the separating slab has been assessed. This shows that a mass barrier suspended ceiling will be required in order to meet the airborne sound insulation requirements specified in the Tesco shell spec. Details of a suitable mass barrier ceiling have been proposed.
- 7.3. Advice has also been provided to reduce the risk of transmission of impact sound and vibration between the store and the bedrooms above, and to control noise flanking via soil vent pipes.

Appendix A Acoustic terminology

Parameter	Description
Decibel (dB)	A scale for comparing the ratios of two quantities, including sound pressure and sound power. The difference in level between two sounds s_1 and s_2 is given by $20 \log_{10} (s_1/s_2)$. The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is $20\mu\text{Pa}$. The threshold of normal hearing is in the region of 0 dB and 140 dB is the threshold of pain. A change of 1 dB is only perceptible under controlled conditions.
dB(A), L_{Ax}	Decibels measured on a sound level meter incorporating a frequency weighting (A weighting) which differentiates between sounds of different frequency (pitch) in a similar way to the human ear. Measurements in dB(A) broadly agree with people's assessment of loudness. A change of 3 dB(A) is the minimum perceptible under normal conditions, and a change of 10 dB(A) corresponds roughly to halving or doubling the loudness of a sound. The background noise in a living room may be about 30 dB(A); normal conversation about 60 dB(A) at 1 metre; heavy road traffic about 80 dB(A) at 10 metres; the level near a pneumatic drill about 100 dB(A).
Fast Time Weighting	Setting on sound level meter, denoted by a subscript F, that determines the speed at which the instrument responds to changes in the amplitude of any measured signal. The fast time weighting can lead to higher values than the slow time weighting when rapidly changing signals are measured. The average time constant for the fast response setting is 0.125 (1/8) seconds.
Free-field	Sound pressure level measured outside, far away from reflecting surfaces (except the ground), usually taken to mean at least 3.5 metres
$L_{Aeq,T}$	A noise level index called the equivalent continuous noise level over the time period T. This is the level of a notional steady sound that would contain the same amount of sound energy as the actual, possibly fluctuating, sound that was recorded.
$D_{nT,w}$	Weighted standardized level difference. Single-number quantity that characterizes the airborne sound insulation between rooms.
C_{tr}	Spectrum adaption term applied to $D_{nT,w}$ (and similar) parameters to mimic the frequency content of traffic noise sources. Also used in England and Wales Building Regulations to control low frequency noise between dwellings.
R_w	A measure of the sound reduction of a building element. Like $D_{nT,w}$ it is a single-figure value derived from 1/3 octave band data; unlike that parameter, is measured under laboratory conditions, where noise flanking is controlled such that the performance relates to sound only passing through the element being considered.