Tesco Express
Shelton Street
Covent Garden
WC2H 9SB

Sound Insulation
Test Report

On behalf of

TESCO

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Document Information

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For and on behalf of Noise Solutions Ltd				

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Appendices

1.0 Introduction

1.1. Noise Solutions Ltd (NSL) has been commissioned by Tesco to undertake airborne sound insulation testing between the proposed sales floor/back of house of a planned Tesco Express store located on Shelton Street in Covent Garden and the adjoining residential properties located on the first floor.

1.2. Testing was required to determine whether the sound insulation of the floor between the two premises will be sufficient to adequately control noise from the Tesco Express into the adjoining residential properties.

1.3. This report contains details of the sound insulation test conducted and the results achieved.

1.4. A glossary of acoustic terminology is given in **Appendix A**.

2.0 Details of development proposals

2.1. The proposed Tesco Express store is to occupy the ground floor of 43-47 Shelton Street in Covent Garden at its corner with Endell Street. The building is between one and four stories in height, with the ground floor occupied by retail space and the upper floors by residential accommodation.

2.2. The rear (west) of the store, which will be occupied by the back of house area, is single-storey. There is a courtyard area above, overlooked by the flats.

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 must be at least 45 dB $D_{nT,w}$ + C_{tr}.

3.3. The Approved Document E requirement for impact sound insulation apply only when the dwelling 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

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 categorization of each space.

3.8. As a worst case, the Tesco Express store could be considered as a space which is not private and with a high activity noise level. The residential properties above 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.

3.10. This requirement is in addition to the criterion in Building Regulations.

4.0 Sound insulation testing

Floor constructions

4.1. The following separating partitions have been tested between the store and the residential properties on the 1st floor.

Table 1 Tested partitions between the Tesco Express store and the adjoining residential properties

Partition type	Store space	Residential properties	Composition
Floor	Proposed Tesco Express	1st floor flat 1 – Living room	Concrete slab
Floor	Proposed Tesco Express	1st floor flat 1 – Bedroom	Concrete slab

Measurement methodology

4.2. The sound insulation testing was undertaken on Wednesday 19th December 2018. The following instrumentation was used during the testing;

Table 2 Details of sound insulation test equipment

Equipment Description	Type/Number	Manufacturer	Calibration certificate no.	Date of Last Calibration
Noise Generator	Minirator MR-PRO	NTI	-	N/A
Powered loudspeaker	Promaxx12a	FBT	-	N/A
Powered loudspeaker	IX15	Turbosound	-	N/A
Class 1 Sound level meter	Svantek 977/ 69747	Svantek	Factory conformity declaration	17/10/2018
Condenser microphone	ACO Pacific 7052E / 70829			
Preamplifier	Svantek SV12L / 73687			
Calibrator	Svantek SV 40A / 10843		14010559	26/09/2018

4.3. The meter was calibrated before and after testing using the Svantek SV40A Class 1L Acoustical Calibrator with a level of 114dB at 1000Hz applied to the measurement equipment. The readings were found not to have deviated.

4.4. Table 3 below provides details of the sound insulation tests performed.

Table 3 Details of sound insulation testing

Test	Source Room	Receiver Room	Element	Type
A1	Proposed Tesco Express	1st floor flat 1 – Living room	Floor	Airborne
A2	Proposed Tesco Express	1st floor flat 2 – Bedroom	Floor	Airborne

4.5. The test detailed in Table 3, above, was undertaken in accordance with BS EN ISO 16283-1:2014 *'Acoustics: Field measurement of sound insulation in buildings and of building elements. Part 1: Airborne sound insulation',* with the exception of the averaging procedure which follows the guidance advocated in Annex B (Paragraph B2.6) in Approved Document E of the Building Regulations 2000.

Testing methodology

4.6. Measurements of airborne sound insulation between rooms were undertaken and the airborne sound insulation ratings were calculated in accordance with BS EN ISO 717-1:2013 *'Acoustics – Rating of sound insulation in buildings and of building elements – Part 1 Airborne sound insulation'*.

4.7. Pink noise was generated in the source room during testing using a loudspeaker. The loudspeaker was set within the source room in different positions separated by a distance greater than 2m. Two separate one-third octave band sound pressure levels were measured in the source room and two in the receiver room using a moving microphone. The measurement time with each individual microphone position was 30 seconds. One 60-second background sound pressure level was undertaken in the receiver room using a moving microphone.

4.8. Reverberation times were measured in the receiving room, twice at each of the three microphone positions using an impulse as the noise source.

4.9. The following separation distances were respected during the testing:

- 0.5 m between any microphone position and the room boundaries;
- 1.0 m between any microphone position and the loudspeaker

Sound insulation test results

4.10. The results of the sound insulation test are provided in Appendix B. Table 4, below, summarises the assessment of the test results against the design criteria detailed in Section 3.0.

Table 4 Summary of airborne sound insulation test results

Test	Source Room		Receiver Room		Measured Sound Insulation	Recommended Performance	Pass / Fail
	Description	V (m^3)	Description	V (m^3)			
A1	Proposed Tesco Express	-	Flat 1 – Living Room	-	51dB $D_{nT,w}$	(BS 8233:2014) 47dB $D_{nT,w}$	Pass
					49dB $D_{nT,w}$ + C_{tr}	(Building Regulations) 45dB $D_{nT,w}$ + C_{tr}	Pass
A2	Proposed Tesco Express	-	Flat 1 – Bedroom	-	53dB $D_{nT,w}$	(BS 8233:2014) 47dB $D_{nT,w}$	Pass
					50dB $D_{nT,w}$ + C_{tr}	(Building Regulations) 45dB $D_{nT,w}$ + C_{tr}	Pass

Discussion of results and recommendations

4.11. The performance of the separating floor/ceiling between the proposed store and residential properties above has been established to be 51 and 53dB $D_{nT,w}$ and 49 and 50dB $D_{nT,w}$+C_{tr}. This meets Building Regulation requirements for separating floors between residential dwellings, and exceeds the guidance provided in BS 8233:2014.

Plant vibration

4.12. It is recommended that all plant, and connected ducts and pipes, is resiliently isolated to reduce the risk of vibration entering the building structure.

Structure-borne transmission (roll cage movements)

4.13. 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 adjoined 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.

4.14. 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 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 15mm thick and the floating floor must be isolated from the surrounding walls to ensure flanking transmission will not occur. The floor finish must be smooth with no ridges or steps.

- b) Timber floor: Timber board or timber board on battens supported above 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 15mm thick and the floating floor must be isolated from the surrounding walls 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.

5.0 Summary

5.1. Noise Solutions Ltd (NSL) has been commissioned by Tesco to undertake an airborne sound insulation test between the proposed sales floor/back of house of a Tesco Express store located on Shelton Street in Covent Garden and the adjoining residential properties located on the first floor.

5.2. The result of the sound insulation test has demonstrated that the composite sound insulation of the floor construction does meet the minimum performance levels recommended under the guidance given in BS 8233:2014 – *'Guidance on sound insulation and noise reduction for buildings'*. The results also meet the Building Regulations requirements for 'residential properties'.

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 s1 and s2 is given by 20 log10 (s1/s2). 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 20μPa. 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.

Appendix B Results of sound insulation tests

Standardized Level Difference According to ISO 140-4:1998 and Approved Document E
Field Measurements of Airborne Sound Insulation Between Rooms

Client: Tesco Express

Date of Test: 19/12/2018

Address of Test: Tesco Express Shelton Street
Source Room: Tesco Express
Receiving Room: Flat 1 - Living Room
Test Element: Floor

No of test report: A1

Description of Building Construction:
Concrete slab

Frequency f, Hz	D_{nT} (1/3 octave) dB
50	
63	
80	
100	41.9
125	40.7
160	40.7
200	45.2
250	46.7
315	45.8
400	44.8
500	45.3
630	47.9
800	50.2
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1250	54.0
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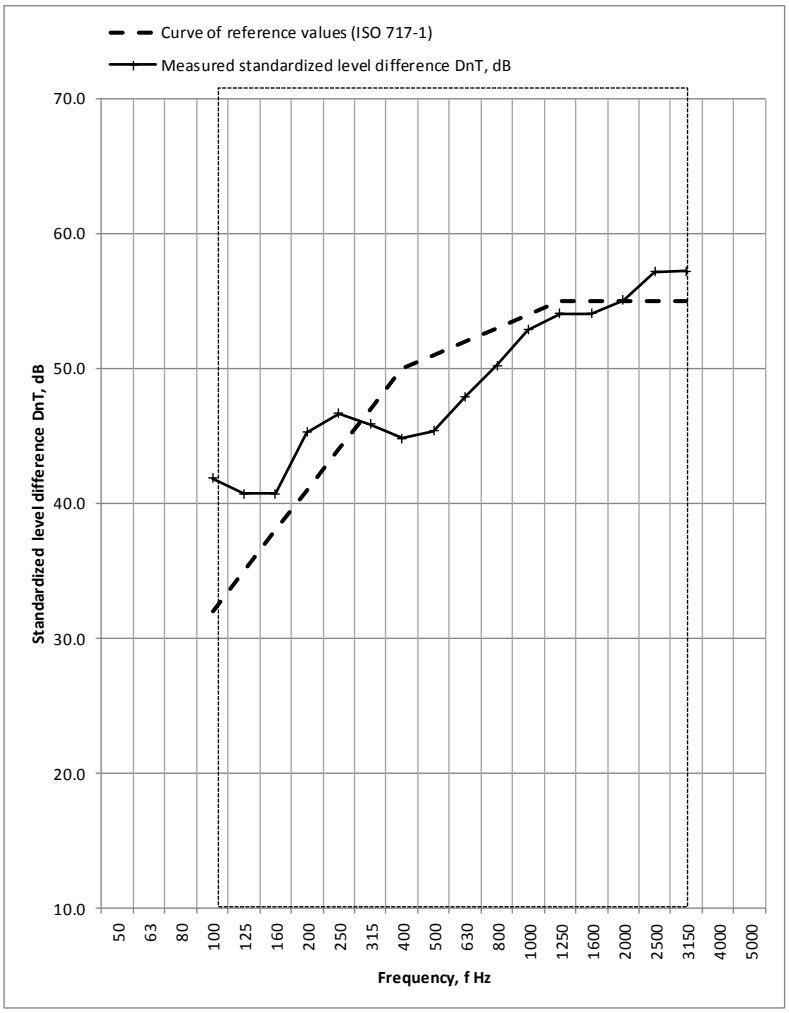
2000	55.0
2500	57.2
3150	57.2
4000	
5000	



Rating in accordance with ISO 717-1

$D_{nT,w}$ (C;Ctr) = 51 (0 ; -2) dB

Evaluation based on field measurement
results obtained by an engineering method

No of test report	A1	Name of testing organisation:	Noise Solutions Ltd
Date	19/12/2018	Signature:	Miriam Pratap

Standardized Level Difference According to ISO 140-4:1998 and Approved Document E
Field Measurements of Airborne Sound Insulation Between Rooms

Client: Tesco Express

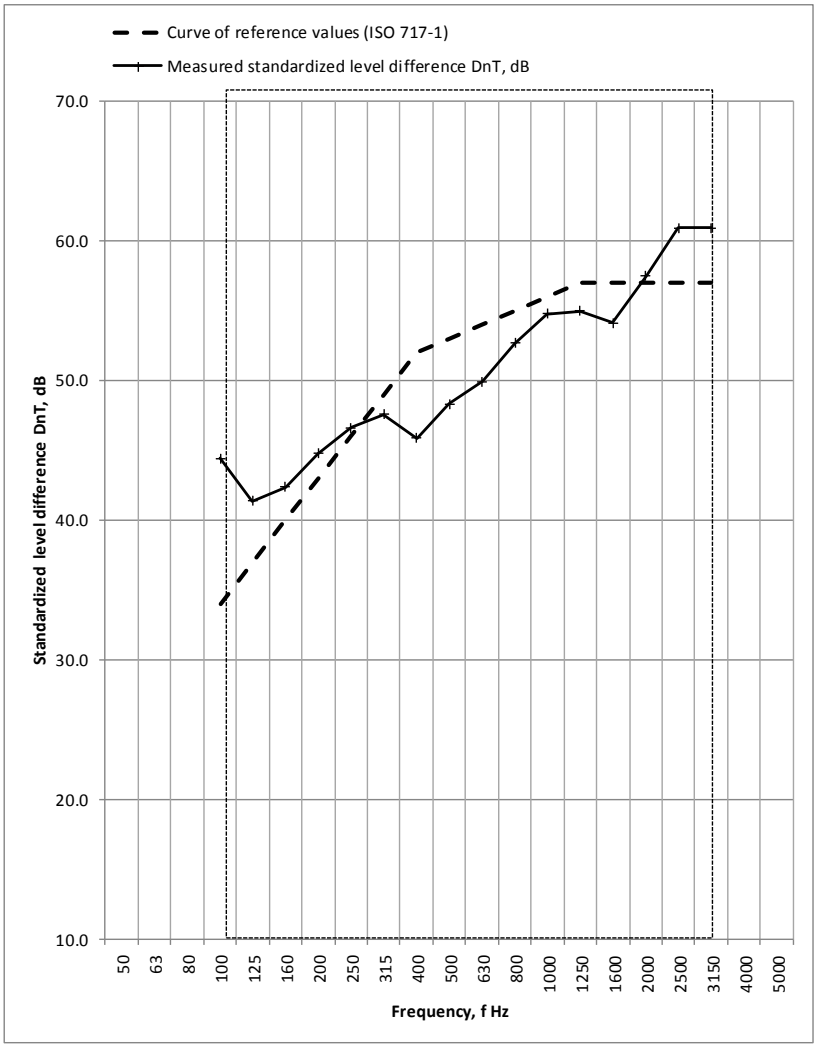
Date of Test: 19/12/2018

Address of Test: Tesco Express Shelton Street
Source Room: Tesco Express
Receiving Room: Flat 1 - Bedroom
Test Element: Floor

No of test report: A2

Description of Building Construction:
Concrete slab

Frequency f, Hz	D_{nT} (1/3 octave) dB
50	
63	
80	
100	44.4
125	41.4
160	42.3
200	44.7
250	46.6
315	47.6
400	45.9
500	48.3
630	49.9
800	52.6
1000	54.7
1250	54.9
1600	54.1
2000	57.4
2500	60.9
3150	60.9
4000	
5000	



Rating in accordance with ISO 717-1

$D_{nT,w}$ (C;Ctr) = 53 (-1 ; -3) dB

Evaluation based on field measurement
results obtained by an engineering method

No of test report	A2	Name of testing organisation:	Noise Solutions Ltd
Date	19/12/2018	Signature:	Miriam Pratap