

Victoria Riverside Manchester Amenity Spaces

Acoustic Commissioning Report

31308/RP1

20 May 2025

For:

CubicWorks
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Spinnaker Court
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Sound Insulation Test Report 31308/RP1

Document Control

Rev	Date	Comment	Prepared by	Authorised by
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1.0 Introduction

Hann Tucker Associates visited CubicWorks on 01 May 2025 to undertake airborne, impact sound insulation testing between Amenity Spaces and residential dwellings in Tower B, Podium B and Tower C, including impact weight drop commissioning tests on the as-built gymnasium floor in Tower C.

This report presents the results of the tests and compares them with recommended sound insulation standards described in the Building Regulations Approved Document E: 2003 Edition and 5 dB project requirement uplift.

In addition, the Employers Requirement's set out in the Arup specification states "*a minimum of 10 airborne sound insulation tests and 5 impact sound insulation tests between dwellings and non-residential areas shall be carried out, to include:*

- *Amenity area to dwelling (airborne)*
- *Gym to dwelling below (airborne and impact)*
- *Commercial unit to dwelling above (airborne)"*

In regard to the above, CubicWorks are appointed for the Fit-Out of Amenity Spaces and the testing of commercial units are the responsibility of the Landlord/Main Contractor.

It was noted during coordination of testing at the Site, no adjoining walls to residential areas are present for any of the Amenity Spaces within Tower B, Podium B and Tower C. Therefore, airborne testing was conducted for floors only.

2.0 Objectives

To undertake airborne and impact sound insulation tests on separating floor/wall constructions between selected residential dwellings in Tower B, Podium B and Tower C at CubicWorks.

To compare the results of the tests with recommended sound insulation standards described in the Building Regulations Approved Document E: 2003 Edition and 5 dB project requirement uplift.

To undertake a series of weight-drop tests on the as-built gym floor within Tower C to adjacent residential apartment above.



To compare the results of the tests in line with recommendations as set out in the gym assessment undertaken during design stages of the development for Cubic Works and comment on acceptability in regard to residential gym use, depending on context.

3.0 Sound Insulation Between Amenity and Apartments

To satisfy Requirement E1 of Approved Document E: 2003 Edition and the 5 dB project requirement uplift, the following sound insulation values should be achieved: -

Table 1a: Dwellings – Performance Standards for Separating Walls, Separating Floors, and Stairs that have a Separating Function.		
	Airborne Sound Insulation $D_{nT,w} + C_{tr}$ dB (Minimum Values)	Impact Sound Insulation $L'_{nT,w}$ dB (Maximum Values)
Purpose built dwellings		
Walls	50	-
Floors and stairs	50	57

The minimum value of weighted standardised level difference ($D_{nT,w}$) plus the spectrum adaptation curve (C_{tr}) as defined in BS EN ISO 717-1: 1997 specified in Approved Document E: 2003 Edition: Sound Insulation Standards for airborne sound tests is 45 dB for purpose built dwellings. However, the project requirements are such that a 5 dB betterment is targeted. As such, the project requirement for airborne sound tests is 50 dB $D_{nT,w} + C_{tr}$.

The maximum values of weighted standardised impact sound pressure level ($L'_{nT,w}$) as defined in BS EN ISO 717-2: 1997 specified in Approved Document E: 2003 Edition: Sound Insulation Standards for impact sound tests on purpose built dwellings is 62 dB. However, the project requirements are such that a 5 dB betterment is targeted. As such, the project requirement for impact sound tests is 57 dB $L'_{nT,w}$.

4.0 Requirements for Gymnasium Use

4.1 Impact Noise from Weight Drops

The Employers Requirements set by ARUP do not have any specific guidance in relation to the operation of gyms due to the time the site was granted planning permission. However, the 'ProPG: Gym Acoustics Guidance (GAG)' was published in March 2023 and presents a standardised methodology for assessing buildings and environments for the location of Gymnasiums, fitness and exercise spaces.



Following consultation with the Client, it has been agreed that the recommended criteria for a residential gymnasium be designed on a 'G-Curve' framework to ensure good practice when assessing and implementing any mitigation measures. As such, the criteria has been relaxed to be as follows:

Receptor Type	Airborne Sound (e.g, music) $L_{eq,T}$ (31.5Hz to 8KHz)	Heavy Impact Sound $L_{max,F}$ (31.5Hz to 8KHz)
Residential Rooms	G30 – G35	G30 – G35

It should be noted that the heavier weights and slam balls would be extremely difficult to mitigate completely, and the above criteria would only be achievable up to an agreed weight or activity. Management of the space would always be an expectation to ensure correct and proper use of equipment.

4.2 Maximum Noise Limits – Music Noise Transfer

MCC recommends that noise (L_{eq}) breaking out through the building frontage of any commercial venue should be limited to not exceed 5 dB below the background noise level (L_{90}) at all octave band frequencies at the nearest noise sensitive windows. For this development, the nearest proposed receptor boundary is 22m from the residential gym to the northeast of the site (North View Development).

Assessment to Residential Receptor	Octave Band Centre Frequency (Hz)						
	63	125	250	500	1k	2k	4k
NR20 Daytime Criteria (07 :00 – 23 :00)	47 ^[1]	41 ^[1]	31	24	20	17	14
NR15 Night-time Criteria (23 :00 – 07 :00)	47 ^[1]	41 ^[1]	26	18	15	12	9

¹ Based upon threshold of audibility.

5.0 Sound Insulation Test Procedure

5.1 Hann Tucker Personnel

The testing was carried out by the following engineers:

- Will Robertson
- Nick Mitchell



5.2 Equipment

The measurement equipment used during the airborne and impact sound insulation testing is as follows:

Description	Manufacturer	Type	Serial Number	Calibrationon
Type 1 Data Logging Sound Level Meter	Bruel & Kjaer	2250	3007292	25/01/2024
Type 1 ½" Condenser Microphone	PCB	7052E	106753	25/01/2024
Preamp	Bruel & Kjaer	ZC0032	27782	25/01/2024
SLM Calibrator	Brüel and Kjær	4231	2271905	22/08/2025
Tapping Machine	Norsonic	277	2775527	01/11/2024
Noise Source - Custom made, un-ported sealed cabinet type	N/A	N/A	N/A	N/A

5.3 Airborne Sound Insulation Test Method (Separating Floors)

Hann Tucker Associates attended site on 01 May 2025, to undertake airborne sound insulation tests to selected separating floor constructions. The tests were undertaken in full accordance with Approved Document E: 2003 Edition incorporating 2004 and 2010 amendments and BS EN ISO 140-4:1998 '*Acoustics – Measurement of airborne sound insulation in buildings and of building elements – Part 4: Field measurement of airborne sound insulation between rooms*'.

The sound level differences were determined by generating a broad band, random diffuse sound field within the source room. A spatial average of the resulting $\frac{1}{3}$ octave band noise levels was obtained within the source room from measurements undertaken over a time period of a least 30 seconds. The measurement procedure was repeated in the receive room. A second speaker position was then selected in the source room and the measurement procedure was repeated.

The receive levels were corrected for background noise where necessary as follows:

Where the measured background noise level in each $\frac{1}{3}$ rd octave band was more than 6 dB but less than 10dB below the receive level, the following formula was applied:

$$L = 10 \log \left(10^{\frac{L_{SB}}{10}} - 10^{\frac{L_B}{10}} \right) \text{ dB}$$



where

L is the adjusted signal level in decibels;

L_{SB} is the level of the signal and background noise levels combined, in decibels;

L_B is the background level in decibels.

Where the measured background noise level was less than 6 dB below the receive level, a correction of 1.3 dB was applied (corresponding to a level difference of 6 dB) and the $\geq$ symbol was added to the results to show that the reported values are the limit of measurement.

The corrected receive levels are subtracted from the source levels to determine the level differences over the frequency range 100-3150 Hz from each source position. The level differences for each source position are arithmetically averaged at each frequency band to give the level difference, D .

Reverberant decays were then recorded in the receive room to determine the reverberation times over the same frequency range using a combination of broadband and impulsive noise sources. For each receiver room 6No. measurements were made, comprising of 2No. source positions and 3No. microphone positions per source position. The reverberation time, T , used in subsequent calculations is an average of the 2No. source positions.

Having established $\frac{1}{3}$ octave band level differences and reverberation times over the frequency range 100-3150 Hz, the Standardised Level Difference, D_{nT} , is calculated for each $\frac{1}{3}$ octave band by applying the following formula:

$$D_{nT} = D + 10 \log_{10} \left(\frac{T}{T_0} \right)$$

where $T_0=0.5$ seconds

The $\frac{1}{3}$ octave band results are then compared with a standard curve using the method described in BS EN ISO 717-1: 1997 to determine the single figure descriptor of airborne sound insulation, the Weighted Standardised Level Difference, or $D_{nT,w}$.

The $\frac{1}{3}$ octave band results are also weighted using spectrum adaptation term No.2, C_{tr} , as detailed in BS EN ISO 717-1: 1997, to allow a more rigorous assessment of sound insulation performance with respect to low frequency noise.

The Weighted Standardised Level Difference and spectrum adaptation term are then added to



give $D_{nT,w} + C_{tr}$, allowing comparison with the minimum airborne sound insulation requirements of Approved Document E.

5.4 Impact Sound Insulation Test Method (Separating Floors)

Hann Tucker Associates also undertook impact sound insulation tests on the selected separating floor constructions. The tests were undertaken in full accordance with Approved Document E: 2003 Edition incorporating 2004 and 2010 amendments and BS EN ISO 140-7:1998 Acoustics – Measurement of sound insulation in buildings and of building elements – Part 7: Field measurements of impact sound insulation of floors.

A tapping machine (meeting the requirements of BS EN ISO 140-7:1998, Annex A) was located at four positions in each source room. The machine generated a sound field in the room underneath (receive room) by means of dropping 5, ½kg hammers in sequence onto the floor at 0.1 second intervals.

A spatial average of the resulting $1/3$ octave band noise levels was obtained within the receive room from measurements undertaken over a time period of a least 30 seconds for each of the 4 source positions. The 4 No. resulting receive levels were logarithmically averaged at each $1/3$ octave frequency band to give the receive level L .

The receive levels were corrected for background noise where necessary as follows:

Where the measured background noise level in each $1/3^{\text{rd}}$ octave band was more than 6 dB but less than 10 dB below the receive level, the following formula was applied:

$$L = 10 \log \left(10^{\frac{L_{SB}}{10}} - 10^{\frac{L_B}{10}} \right) \text{ dB}$$

where

L is the adjusted signal level in decibels;

L_{SB} is the level of the signal and background noise levels combined, in decibels;

L_B is the background level in decibels.

Where the measured background noise level was less than 6 dB below the receive level, a correction of 1.3 dB was applied (corresponding to a level difference of 6 dB) and the $\leq$ symbol was added to the results to show that the reported values are the limit of measurement.



Reverberant decays were then recorded in the receive room to determine the reverberation times over the same frequency range using a combination of broadband and impulsive noise sources. For each receiver room 6No. measurements were made, comprising of 2No. source positions and 3No. microphone positions per source position. The reverberation time, T , used in subsequent calculations is an average of the 2No. source positions.

Having established the $\frac{1}{3}$ octave impact sound pressure levels and reverberation times over the frequency range 100-3150Hz, the standardized Impact Sound Level is calculated for each $\frac{1}{3}$ octave by applying the following formula:

$$L'_{nT} = L - 10 \log_{10} \left(\frac{T}{T_0} \right)$$

where $T_0 = 0.5$ seconds

The $\frac{1}{3}$ octave band results are then compared with a standard curve using the method described in BS EN ISO 717-2: 1997 to determine the single figure descriptor of impact sound insulation, the Weighted Standardised Impact Sound Pressure Level, or $L'_{nT,w}$.

5.5 Background Noise

The background noise levels were measured in each receive room in order to correct the received noise measurements for the effect of the prevailing noise climate.

The prevailing background noise comprised of nearby construction noise and rail noise from the surrounding tracks which both trams and trains travel.

5.6 Sound Insulation Test Locations

All areas to receiving rooms tested had all doors and windows fitted and closed. The rooms were unfurnished. The following airborne wall tests were undertaken:

Test	Source Room		Receive Room		Tested Construction Details
	Location	Approximate Volume (m ³)	Location	Approximate Volume (m ³)	
AF01	Tower B Concierge	288	Tower B 204 B	26	Concrete slab with plasterboard ceiling below. In Bedrooms (B) carpet was installed. In Living rooms/Kitchens
AF02	Tower B Concierge	288	Tower B 204 LKD	79	
AF03	Tower B Resident Lounge	174	Tower B 207 B	38	



Test	Source Room		Receive Room		Tested Construction Details
	Location	Approximate Volume (m ³)	Location	Approximate Volume (m ³)	
AF04	Tower B Resident Lounge	174	Tower B 207 LKD	60	(LKD) LVT flooring was installed
AF05	Tower C Gymnasium	398	Tower C 201 B	29	
AF06	Tower C Gymnasium	398	Tower C 201 LKD	90	

*There were carpets present on all bedroom floors and not present in any of the LKDs. The Gymnasium has a step stagger to Tower C apartment 201, whereby half of the gym roof is exposed to atmosphere.

The following impact tests were undertaken:

Test	Source Room		Receive Room		Tested Construction Details
	Location	Approximate Volume (m ³)	Location	Approximate Volume (m ³)	
IF01	Tower B 207 LKD	60	Tower B Residents Lounge	174	Concrete slab with plasterboard ceiling below. In Bedrooms (B) carpet was installed. In Living rooms/Kitchens (LKD) LVT flooring was installed
IF02	Tower B 204 LKD	79	Tower B Concierge	288	

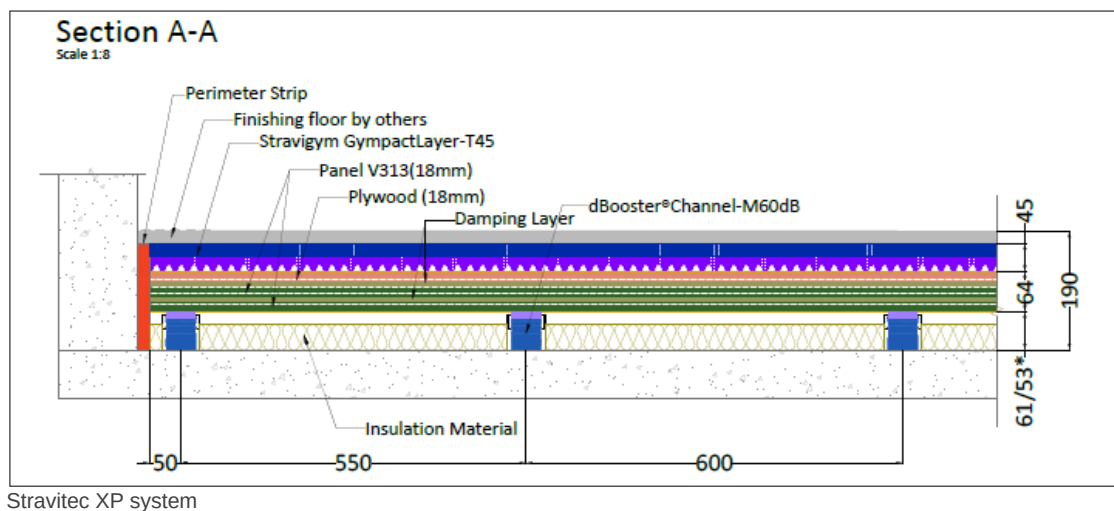
*There were carpets present on all bedroom floors, and not present in any of the LKDs. There were no step/staggers on the floors.

6.0 Gym Weight Drop Test Procedure

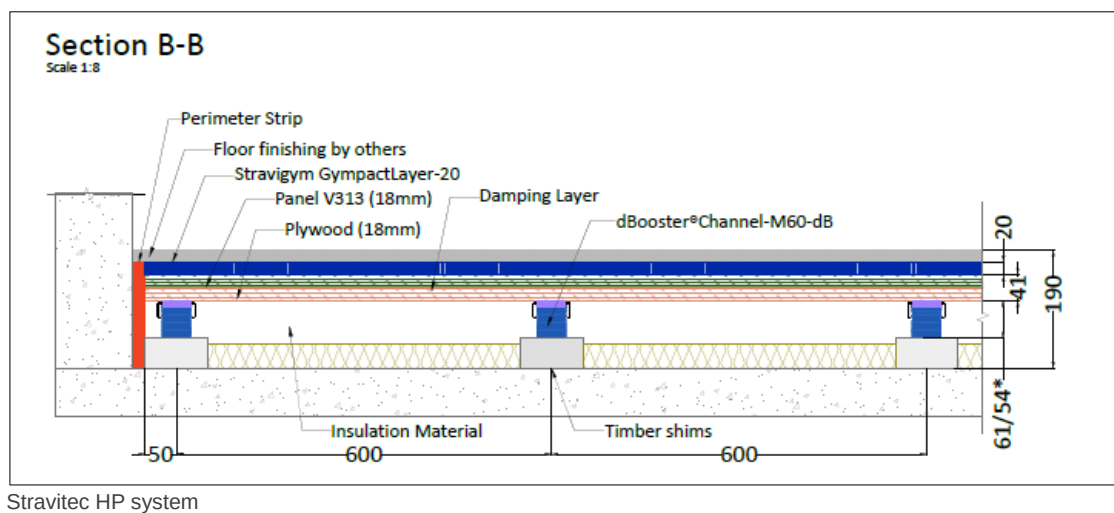
6.1 Installed Products

It is understood that the CDM-Stravitec XP and HP systems were installed.

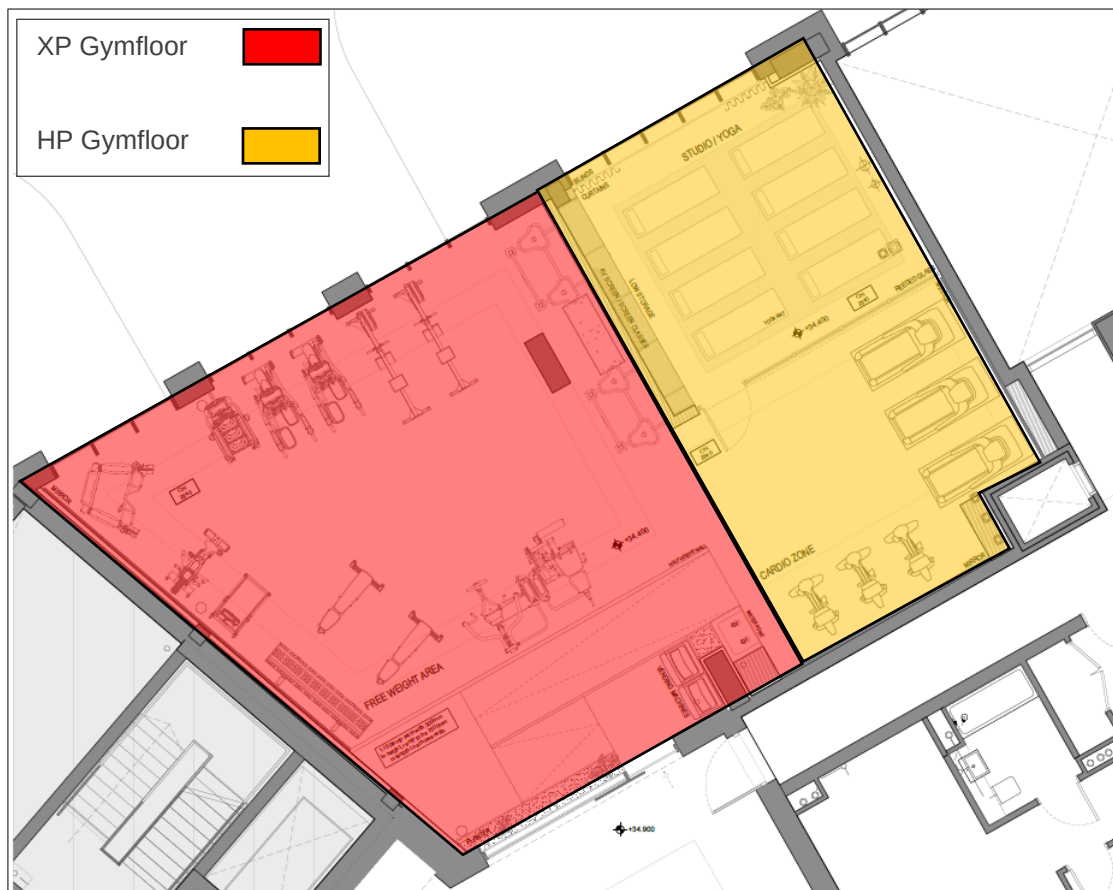
The XP system (Extreme Performance) has been installed over the free-weight area and is as follows:



Other areas including the “Cardio Zone”, and the “Studio / Yoga Zone” that require less mitigation against impact noise from weight drops include the HP system.



The above systems are independent of each other and have been marked up on the following plan.



Gym Floor Markup (Document reference: 22012-JS-TC-01-DR-I-20002_Rev-P01, dated 14.08.23)

6.2 Methodology

The weight drop testing involved dropping a range of weights on the as-built gym floor.

12 kg and 24 kg kettlebells were used to be representative of the intended gymnasium activities. Both the 12 kg and 24 kg kettlebells were cast iron (no casing or coating).

5No. weight drops were released from knee height per weight category for both the Bedroom and Living/Kitchen/Dining above. All results (of the 5No. drops) has been considered in our analyses.

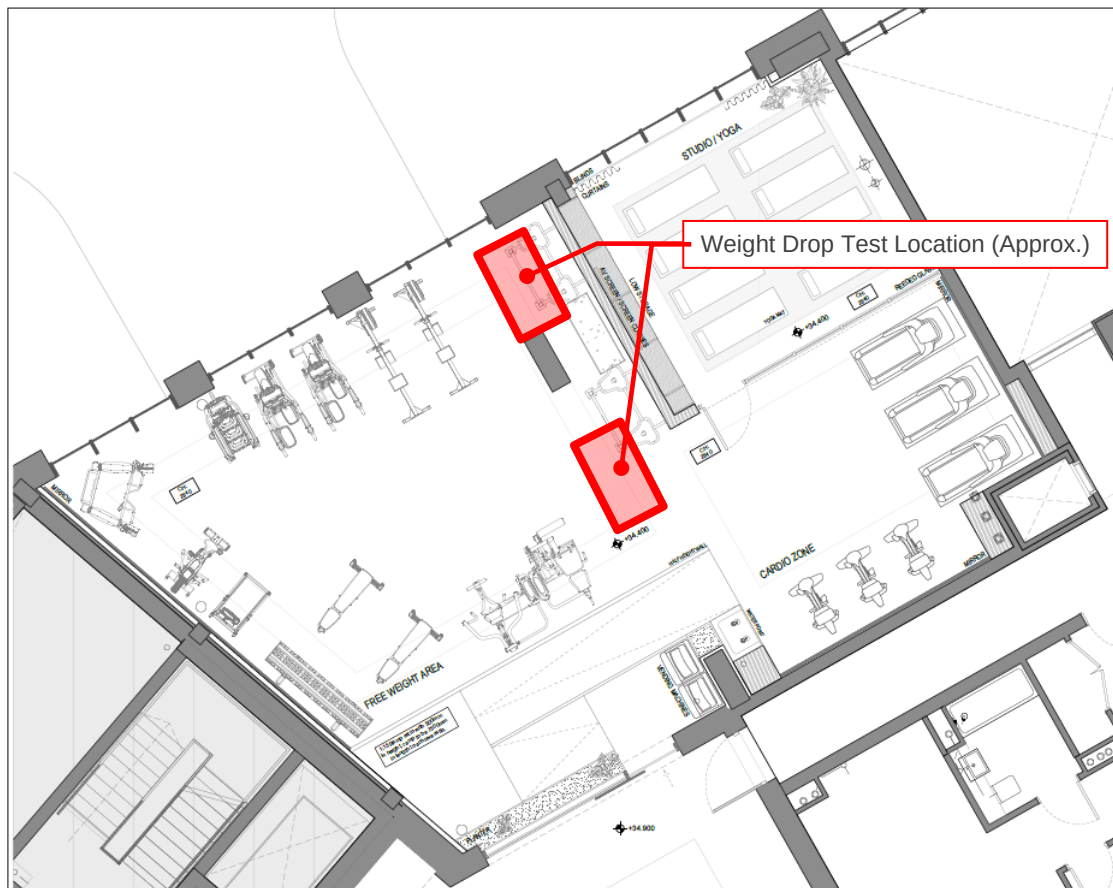
Time synchronised sound level meters were set up in the following locations to log sound levels during the weight drop tests.

- In the residential amenity area of Tower C (Source Room) gymnasium space.
- In the residential apartment located directly above in Apartment 02 of the second floor (Receive Room).



Please note, the majority of weight drop area is exposed to atmosphere above, with no adjoining residential apartment. However, impact noise typically excites the structure with a slight overlap with Apartment 02 of the second floor.

The weight-drop area within the residential gymnasium is indicated on the plan overleaf.



Weight Drop Test Area Markup (Document reference: 22012-JS-TC-01-DR-I-20002_Rev-P01, dated 14.08.23)

6.3 Equipment

The measurement equipment used during the weight drop impact testing is as follows:

Location	Description	Manufacturer	Type	Serial Number	Calibration on
Source Room	Type 1 Data Logging Sound Level Meter	Larson Davis	LxT	4568	30/05/2024
Receiver Room	Type 1 Data Logging Sound Level Meter	Larson Davis	LxT	4569	30/05/2024
Source & Receiver Room	SLM Calibrator	Larson Davis	LxT	3083	28/02/2025



Each sound level meter was calibrated prior to and on completion of the measurements. No significant changes were found to have occurred (no more than 0.3 dB).

7.0 Test Results

7.1 Sound Insulation Test Results

The results of the tests and analysis are given in the attached Certificates 31308/C1 to 31308/C08.

The following tables summarise our findings:

Airborne Tests Across Separating Floors	D _{nT,w} + C _{tr} (dB)		Compliance
	Test Result*	Required	
AF01	≥ 64	≥ 50	Pass
AF02	≥ 65	≥ 50	Pass
AF03	61	≥ 50	Pass
AF04	≥ 59	≥ 50	Pass
AF05	≥ 71	≥ 50	Pass
AF06	69	≥ 50	Pass

*Tests results including the ≥ symbol are background limited

Impact Tests Across Separating Floors	L' _{nT,w} (dB)		Compliance
	Test Result*	Required	
IF01	≤ 35	≤ 57	Pass
IF02	≤ 33	≤ 57	Pass

*Tests results including the ≤ symbol are background limited

7.2 Weight Drop Tests

The as-measured sound pressure levels within the apartment during the weight drop tests are tabulated below, presented in terms of L_{AFmax} and G-value. Note that these levels are not yet corrected for airborne noise transfer or reverberation time.

Test Ref.	Location	Dropped Weight (kg)	Measured Sound Level in Receive Room	
			L _{AFmax} (dB)	G-Value (dB L _{max,F})
D1	Bedroom	12	29	31
D2			30	30
D3			31	32



Test Ref.	Location	Dropped Weight (kg)	Measured Sound Level in Receive Room	
			L _{AFmax} (dB)	G-Value (dB L _{max,F})
D4			30	30
D5			29	31
D6		24	32	31
D7			30	31
D8			30	32
D9			30	32
D10			30	31
D11	Living/Kitchen / Dining	12	27	23
D12			27	23
D13			28	23
D14			27	23
D15*			26	23
D16		24	28	23
D17			29	26
D18			27	23
D19			28	23
D20			28	23

Based on the results of the weight drop testing, the measured sound levels complied with the criteria for both the 12kg and 24kg drops in both areas.



8.0 Discussion

8.1 Airborne Tests

With reference to Section 7.1, the results for the floors tested are equal to or greater than the minimum value for airborne sound insulation as stated in Approved Document E: 2003 Edition, and project design uplift and thus should be considered to satisfy the requirements.

8.2 Impact Tests

With reference to Section 7.1, the results for the floors tested are equal to or less than the maximum value for impact sound pressure level stated in Approved Document E: 2003 Edition, and project design uplift and thus should be considered to satisfy the requirements.

8.3 Weight Drop Tests

8.3.1 Gym Floor Test

The as-built gym floor performed generally well, with the measured noise levels falling below G25 in the Living/Kitchen and around G30 in the Bedroom. However, generally, the subjective view was that noise from weight drops indicated a minor risk of disturbance, but overall, the system is deemed suitable, providing the gym use is properly managed.

It is important to note that the tests were conducted with weights up to 24kg. If heavier weights, such as 50kg, are used, the noise transfer could exceed the criteria, potentially breaches of the G30 – G35 threshold and a higher likelihood of disturbances. Therefore, managing gym activities, especially regarding the use of heavier weights, is crucial.

However, there is no requirement in the ERs to control weight drop impacts. As such, the above is a quality aspiration for CubicWorks rather than an ER stipulated by the Client at Stage 3.

8.3.2 Maximum Limiting Level for Music Noise

An assessment of the as-built separating floor has been undertaken to provide a maximum limiting level for the commercial units. The table below outlines the summary calculations for the maximum operational music/activity noise levels. It is noted that the adopted MCC criteria is to achieve a level of 5 dB below background within the apartment, and we have presented the daytime and night-time noise limiting levels in line with Section 4.2.

The assessment utilises the test results between commercial to both Apartment 02 Bedroom and Living/Kitchen/Dining room.



Assessment to Residential Receptor	Octave Band Centre Frequency (Hz)						
	63	125	250	500	1k	2k	4k
NR20 criteria (Daytime)	47 ^[1]	41 ^[1]	31	24	20	17	14
Measured D (dB) to Living Room	41	56	61	68	70	70	67
Maximum Internal noise level (dB L_{eq}) SPL_{in}	88 ^[2]	97	92	92	90	87	81 ^[2]
Notes: ^[1] Based upon the threshold of audibility. ^[2] Data taken from testing between spaces prior to fit-out. Measured results are likely to be of a higher performance.							

Assessment to Residential Receptor	Octave Band Centre Frequency (Hz)						
	63	125	250	500	1k	2k	4k
NR15 criteria (Night-time)	47 ^[1]	41 ^[1]	26	19	15	12	9
Measured D (dB) to Bedroom	41	56	61	68	70	70	67
Maximum Internal noise level (dB L_{eq}) SPL_{in}	88 ^[2]	97	87	87	85	82	76 ^[2]
Notes: ^[1] Based upon the threshold of audibility. ^[2] Data taken from testing between spaces prior to fit-out. Measured results are likely to be of a higher performance.							

The maximum limiting level in the gymnasium therefore must meet the octave band criteria as detailed above, resulting in a maximum overall internal sound pressure level of 95 dBA during the daytime and 90 dBA at night.

8.3.3 Additional Comments of Gym Management

Any heavy weight drops, for example deadlifts or heavy dumbbells, or gym miss-use would likely result in more noise transfer than has been measured in our testing.

It is strongly advised that the space is actively managed, and occupants are advised to place weights down rather than drop them. Strict policies should be put in place with regards to miss-use of the gym with access being restricted to those who abide by the rules.

If music is to be played within the gym this should be at a moderate level. As outlined in Section 8.3.2, the specified noise limits are significantly higher than those of typical background music in gyms, ensuring that music noise should not pose a problem.



9.0 Conclusion

Hann Tucker Associates have undertaken airborne and impact sound insulation tests across separating wall and floor constructions between selected residential dwellings at CubicWorks.

The airborne sound insulation performance ($D_{nT,w} + C_{tr}$) of the separating floor constructions tested are equal to or greater than the minimum value stated in Approved Document E: 2003 Edition, and project design uplift and thus should be considered to satisfy the requirements.

The Impact Sound Insulation Performance Level ($L'_{nT,w}$) of the separating floor constructions tested are equal to or less than the maximum value stated in Approved Document E: 2003 Edition, and project design uplift and thus should be considered to satisfy the requirements.

The as-built gym floor performed generally well, with the measured noise levels falling below G25 in the Living/Kitchen and around G30 (driven by a single 1/3 octave band) in the Bedroom.

Maximum Limiting Levels for amplified music within the gymnasium have been provided and should be adhered to when setting any music limiting device for operation of the space.

Additional guidance on the management of the gym has been provided and should be implemented into operation of the space.