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# 79-81 FAIRFAX ROAD, LONDON

Report 12004.ADR.01 Rev.A

Prepared on 23 December 2014

For:

**Sympro Ltd.**

**79-81 Fairfax Road**

**London**

| Site Address | Test Date | Tested by |
|---|---|---|
| Ground Floor, 79-81 Fairfax Road, London | 17/12/2014 | Duncan Arkley TechIOA<br>Spyros Polychronopulous MIOA |

# Contents

## 1.0 INTRODUCTION

KP Acoustics Ltd., Britannia House, 11 Glenthorne Road, London, W6 0LH has been commissioned by Sympro Ltd., 79-81 Fairfax Road, London, to undertake a sound and vibration insulation investigation between the proposed gym space at 79-81 Fairfax Road, London and the residential premises located directly above the site.

The main objective of this report is to provide all in-situ findings with regards to the current sound insulation properties of the separating floors. The underlying motivation is to provide a bespoke design which would render any noise and vibration from the operation of the proposed gym, as unimpeding as possible to the amenity of all neighbouring residential spaces to the proposed gym.

## 2.0 METHODOLOGY

### 2.1 Airborne Tests

High volume "pink" noise was generated from two loudspeakers in the source room, positioned to obtain a diffuse sound field. A spatial average of the resulting one-third octave band noise levels between 100 Hz and 3150 Hz was obtained by using a moving microphone technique over a minimum period of 15 seconds at each of two positions.

The same measurement procedure was used in the receiver space.

The results of the tests were rated in accordance with BS EN ISO 717-1: 1997 "Rating of sound insulation in buildings and of building elements. Part 1 Airborne sound insulation".

### 2.2 Background Noise

The background noise levels in the receiver rooms were measured during the tests and the receiving room levels corrected in accordance with BS EN ISO 140 Part 4.

The dominant source of background noise observed during the tests was road traffic noise from adjacent roads.

## 3.0 INSTRUMENTATION

The instrumentation used during testing is shown in Table 3.1 below.

| Instrument | Manufacturer and Type | Serial Number |
|---|---|---|
| Precision integrating sound level meter & analyser | 01dB-Sell Blue Solo<br>Calibration Certificate AC/08/209/02 | 60065 |
| Active Loudspeaker | RCF ART 310A | KLXF29324 |
| Active Loudspeaker | RCF ART 310A | HAX20864 |
| Pink Noise Source | Acoustic Solutions – 513/4043 | N/A |
| Pink Noise Source | Acoustic Solutions – 513/4043 | N/A |
| Calibrator | B&K Type 4231<br>Calibration No: AC/10/003/02 | 1897774 |
| Specialist Software | 01dB-Metravib dBBati | V5.050 |

**Table 3.1 Instrumentation used during testing**

## 4.0 DESCRIPTION OF SITE

The current site is comprised of an unoccupied former hi-fi shop space with a large suspended ceiling and large cavity stud walls still in place. It occupies a Ground Floor space with smaller rooms the rear.

The receiver spaces which were investigated during the sound insulation investigation regime were residences located immediately above the proposed gym space.

## 5.0 SPACES UNDER INVESTIGATION

The measurements were undertaken within spaces which would reflect worst-case scenarios during the operation of the gym, therefore rendering the on-site assessment exercise as robust as possible.

## 6.0 RESULTS

The results are summarised in the tables below. For airborne tests, the higher the value, the better the performance. All tests have been assessed by using $D_w$ as the main airborne sound insulation descriptor. This descriptor was chosen as it would encompass all current features of the spaces within the calculation procedure and provide a more realistic appreciation of the airborne insulation envelope of the separating constructions.

| Test Element | Source | Receiver | Test Result |
|---|---|---|---|
| Front façade | Ground Floor main space | Immediately outside | $D_w$ 28 dB |
| Floor | Ground Floor main space | 1st Floor residential lounge | $D_w$ 47 dB |
| Floor | Ground Floor main space | 1st Floor residential hallway | $D_w$ 53 dB |

**Table 6.1 Airborne Test Results**

In terms of airborne sound insulation, it would be expected that the current sound insulation performance of the separating party floor between the existing commercial property and residents above would be sufficient to ensure that low level noise was not perceivable in residences on the first floor. Furthermore, the existing front façade would provide sufficient attenuation to minimise any risk of noise intrusion to nearby residences via the flanking path or the external façade.

## 7.0 DISCUSSION

It is understood that the Client intends to remove the current suspended ceiling on site in order to maximum ceiling height. It has however been confirmed through discussion with the Client that a suspended ceiling with a smaller cavity can be installed, if necessary. Based on the above sound insulation investigation results as well as on the current architectural constraints, we would recommend the following upgrade measures for the separating walls and floors.

**Ground Floor main gym area - Residential immediately above**

Installation of 2x15mm SoundBloc on GAH1 resilient hangers to provide 150mm total void depth infilled with 100mm mineral wool insulation (RWA3, or any similar mineral wool insulation with 60kg/m3 density).

**Wall Upgrades**

While the walls to either side of the main gym space do not lead directly into noise sensitive spaces, and therefore would not be considered critical partitions, we would recommend the following upgrade measures to minimise any potential complaints in future.

***Option 1***
Installation of 2x12.5mm SoundBloc, or 2x10mm Fermacell boards on GypLiner system incorporating 50mm mineral wool (RWA45, or any similar product with 45kg/m$^3$ density) within 50mm cavity formed by channels.

***Option 2***
Installation of 2x12.5mm SoundBloc, or 2x10mm Fermacell boards on IsoMax clips (37mm deep) incorporating 25mm mineral wool insulation within cavity (RWA45, or any similar product with 45kg/m$^3$ density)

***Option 3***
Installation of 2x12.5mm SoundBloc, or 2x10mm Fermacell boards on an independent timber stud wall to provide a 150mm cavity, incorporating 100mm mineral wool insulation within cavity (RWA45, or any similar product with 45kg/m$^3$ density)

It is understood that the existing spaces to the rear of the site are intended to be used as changing rooms only. As such the only anticipated noise emissions from these spaces would be from low level background music. In this case, it would be recommended that either the existing suspended ceiling be maintained, or a replacement ceiling is installed as follows:

- 2x12.5mm SoundBloc installed on GAH1 resilient hangers to provide a 150mm cavity.
- 100mm mineral wool insulation (RWA45, or any similar product with 45kg/m3 density) installed within the 150mm gap.

## 8.0 FREE WEIGHTS ISOLATION

It is understood that the primary purpose of the gym is for rehabilitation and therapy, as opposed to athletic training facility. As such, all activities are closely monitored by training staff on site, and it has been assured that no free-weights are regularly dropped, or regularly exceed 30-40kg.

Tests have been with a weight stack of 30kg dropped from 1m to the floor. The existing floor on site is finished with a carpet walking surface on top of original flooring tiles. It is assumed that the primary structural element of this floor is a concrete slab 200-300mm thick.

A number of tests were undertaken on the untreated floor in its current state and repeated with a combination of different floor treatments in order to establish the most effective mitigation measures for this scenario.

Vibration measurements were also conducted at a structural wall boundary within the residential apartment directly above the proposed gym space.

The vibration transducer (accelerometer) was secured via a magnet to a washer that was glued directly onto a steel cube positioned immediately next to the aforementioned column.

The equipment which was used was comprised of the following:

- Svantek 958 Class 1 Noise and Vibration Meter
- Dytran 3233A accelerometer

All results are shown in Figure 8.1 and Table 8.2:

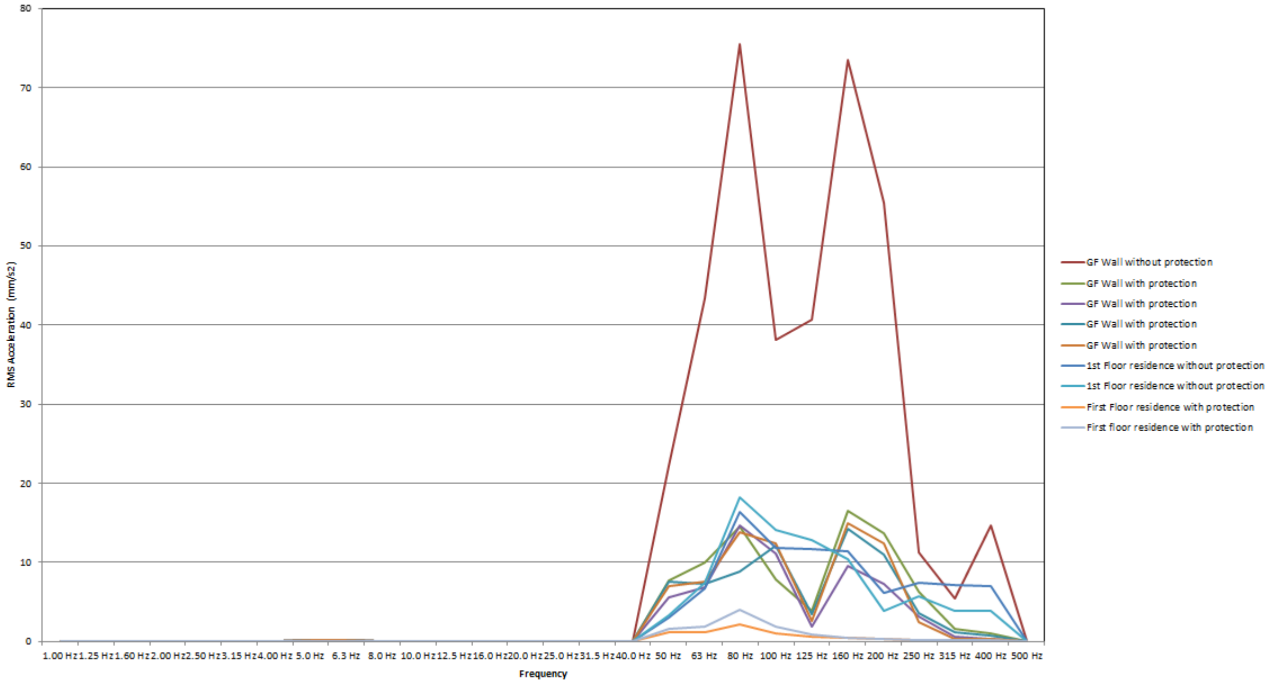


**Figure 8.1 Vibration spectra with/without isolation in place**

| | RMS Vibration (m/s²) | | |
|---|---|---|---|
| | X-Axis | Y-Axis | Z-Axis |
| Ground Floor Wall w/out Protection | 0.05 | 0.08 | 0.14 |
| Ground Floor Wall w/out Protection | 0.04 | 0.08 | 0.14 |
| Ground Floor Wall w/out Protection | 0.05 | 0.09 | 0.18 |
| Ground Floor Wall w/ Protection | 0.02 | 0.04 | 0.04 |
| Ground Floor Wall w/ Protection | 0.03 | 0.05 | 0.05 |
| Ground Floor Wall w/ Protection | 0.02 | 0.04 | 0.03 |
| Ground Floor Wall w/ Protection | 0.03 | 0.06 | 0.06 |
| Ground Floor Wall w/ Protection | 0.02 | 0.04 | 0.03 |
| Ground Floor Wall w/ Protection | 0.02 | 0.04 | 0.03 |
| 1st Floor Residence w/out Protection | 0.02 | 0.04 | 0.03 |
| 1st Floor Residence w/out Protection | 0.02 | 0.04 | 0.03 |
| 1st Floor Residence w/ Protection | 0.00 | 0.00 | 0.00 |
| 2nd Floor Residence w/ Protection | 0.00 | 0.00 | 0.01 |

**Figure 8.2 Overall RMS Vibration values with/without isolation in place**

As shown in Table 8.2, measurements of overall RMS Vibration indicate that the preferred values shown in Table 8.3 are exceeded at the structural wall with no isolation in place. While measurements on the first floor do not currently exceed these recommendations, the measurements undertaken still present a perceivable value. In order to minimise the likelihood of any complaints or adverse impact on the amenity of the neighbouring residences, a solution which aims towards rendering vibrations imperceptible would be recommended.

| | | Preferred values | | Maximum values | |
|---|---|---|---|---|---|
| **Location** | **Assessment period** | **z-axis** | **x- and y-axes** | **z-axis** | **x- and y-axes** |
| **Impulsive vibration** | | | | | |
| Critical areas | Day- or night-time | 0.0050 | 0.0036 | 0.010 | 0.0072 |
| Residences | Daytime | 0.30 | 0.21 | 0.60 | 0.42 |
| | Night-time | 0.10 | 0.071 | 0.20 | 0.14 |

**Table 8.3 Preferred and maximum weighted RMS values for impulsive vibration acceleration ($m/s^2$) in a residential environment**

As shown in Figure 8.1 and Table 8.2, use of the isolation materials completely minimise vibration received on the First Floor as a result of dropping weight in the Ground Floor space. Due to the proposed use of the gym, it would therefore be expected that no vibration would be perceivable within the residence in the first floor following the installation of floor treatments as follows:

- 2 layers of Getzner SR42 (12.5mm each) adhesively installed on the sub-floor
- 2 layers of Getzner SR28 (12.5mm each) adhesively installed on the previous layers
- TVS Sportec Tile (40mm) laid dimple-side down. This would act as the final floor finish.

*Alternative Isolation Strategy*

- Favim FVM 55 (25mm) laid dimple side down on the concrete sub-floor
- 3 layers of Favim FVM 10 (10mm each) on the FVM55
- 12mm ply adhesively installed
- Proprietary resilient layer (3-4mm) from Farrat

In both cases, the proposed floor treatments should be isolated from the perimeter walls by means of strips of Regupol 6010SH which would act as flanking bands.

The above floor isolation strategy has filtered-out any low-frequency energy which is the principal component causing structural excitations. Moreover, any energy content at higher frequencies (160Hz and above) has been attenuated by more than 80% in each frequency band. Please note that the above treatment will need to be localised, i.e. applied only on the area of the free weights.

This would mean in practical terms, that any potential physical floor vibration due to any free weights would be minimised. Any final perceived aural component would therefore be comparable to the ambient noise footprint of the area.

For the remaining areas of the gym which would not entail high vibration-generating activities (e.g. treadmills, exercise classes, etc.) we would recommend the installation of a uniform floor treatment such as TVS Sportec tile (10mm), adhesively installed on the concrete sub-floor.

**Isolation of Training Machines**

We would recommend the installation of isolation pads (combination of Sylodyn NB/ND) at the lower end of all rails accommodating the weight packs on all weight-training machines.

## 9.0 VARIOUS ELEMENTS

### Column Isolation

All steel columns are to be boxed-in by means of 2x12.5mm layers of SoundBloc plasterboard (or similar). Deflection heads to follow attached technical drawing.

**Distributed Sound System**

A loudspeaker system employing relatively few speakers requires each unit to generate high noise levels to maintain a given noise level in the space.

A distributed system with numerous speakers allows each speaker to operate at a lower volume. This ensures that localised noise levels are lower, which reduces the noise directly incident on the structure and improves the environment in quieter areas, where communication is important.

This also allows the division of the system into separately controlled zones and focus areas. Such design measures can be used to maintain “quiet” areas in the gym and provide focused loud areas (e.g. over aerobics classes).

The specifications of the speakers will be dependent on the use of each zone or focus area but should allow sufficient capacity for them to operate at optimum efficiency.

Speakers must not be ceiling-mounted and will require specific acoustic isolation treatment. A layer of Regupol 6010XHT should be introduced between the fixing plate of the loudspeaker and the fixing in order to isolate any vibroacoustic excitations transferring into the structural wall. Hilti fixings should will be incorporated if the fixings penetrate into the columns. Alternatively, Regupol Isolating collars should be used under to bolt-heads, in conjunction with the aforementioned Regupol isolating layer.

**Loudspeaker Mounting**

Rigid mounting systems are entirely inadequate for the control of transmitted sound from loud speakers. To ensure efficient control of noise it is recommended that a proprietary frame support is used for each speaker.

This must incorporate suitable anti-vibration mounting between support and speaker enclosure, with no rigid connections permitted to short-circuit the isolation.

Provided that the weight of the loudspeakers is low, the use of neoprene mounts or hangers is recommended. These are expected to provide a static deflection of approximately 3mm (ie. under the load of the speaker). High stiffness neoprene / rubber and metal springs should be avoided in general. The use of neoprene mounts or hangers in fully-enclosed metal casings is not advisable as if these are angled the casings can short circuit. Any mount / hanger must be capable of maintaining a 30 degree offset without any rigid components short-circuiting the mount. It must be noted, however, that vertical alignment is more effective.

Generally available speaker vibration mountings are not typically effective for isolation of this standard. Use of heavy duty, proprietary supports coupled with hangers / mounts will be far more effective.

## 10.0 CONCLUSIONS

Sound Insulation tests were undertaken between the proposed gym at 79-81 Fairfax Road, London and neighbouring residential and commercial spaces.

Rating of the airborne sound insulation of the floor tested has been calculated in accordance with the measurement and rating procedures defined in BS EN ISO 140 Part 4 and BS EN ISO 717 Part 1, respectively.

The sound and vibration insulation investigation has allowed the proposal of a number of upgrade measures. Practical measures for the upgrade of the separating walls/floors performance have also been proposed based on Good Practice Documents.

Following the completion of the upgrade measures recommended it would be ensured that there would be no negative impact on any nearby noise and vibration sensitive receivers from the operation of the gym.

The acoustic design review and advice provided in this document are based on the assumption that there will be no major mistakes in workmanship regarding the acoustic detailing and finishing of the party elements proposed in this development.

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# APPENDIX A

## GENERAL ACOUSTIC TERMINOLOGY

### Decibel scale - dB

In practice, when sound intensity or sound pressure is measured, a logarithmic scale is used in which the unit is the 'decibel', dB. This is derived from the human auditory system, where the dynamic range of human hearing is so large, in the order of $10^{13}$ units, that only a logarithmic scale is the sensible solution for displaying such a range.

### Decibel scale, 'A' weighted - dB(A)

The human ear is less sensitive at frequency extremes, below 125Hz and above 16Khz. A sound level meter models the ears variable sensitivity to sound at different frequencies. This is achieved by building a filter into the Sound Level Meter with a similar frequency response to that of the ear, an A-weighted filter where the unit is dB(A).

**$L_{eq}$**

The sound from noise sources often fluctuates widely during a given period of time. An average value can be measured, the equivalent sound pressure level $L_{eq}$. The $L_{eq}$ is the equivalent sound level which would deliver the same sound energy as the actual fluctuating sound measured in the same time period.

**$L_{10}$**

This is the level exceeded for no more than 10% of the time. This parameter is often used as a "not to exceed" criterion for noise.

**$L_{90}$**

This is the level exceeded for no more than 90% of the time. This parameter is often used as a descriptor of "background noise" for environmental impact studies.

**$L_{max}$**

This is the maximum sound pressure level that has been measured over a period.

### Octave Bands

In order to completely determine the composition of a sound it is necessary to determine the sound level at each frequency individually. Usually, values are stated in octave bands. The audible frequency region is divided into 11 such octave bands whose centre frequencies are defined in accordance with international standards. These centre frequencies are: 16, 31.5, 63, 125, 250, 500, 1000, 2000, 4000, 8000 and 16000 Hertz.

Environmental noise terms are defined in BS7445, *Description and Measurement of Environmental Noise*.

# APPENDIX A

## APPLIED ACOUSTIC TERMINOLOGY

### Addition of noise from several sources

Noise from different sound sources combines to produce a sound level higher than that from any individual source. Two equally intense sound sources operating together produce a sound level which is 3dB higher than a single source and 4 sources produce a 6dB higher sound level.

### Attenuation by distance

Sound which propagates from a point source in free air attenuates by 6dB for each doubling of distance from the noise source. Sound energy from line sources (e.g. stream of cars) drops off by 3dB for each doubling of distance.

### Subjective impression of noise

Hearing perception is highly individualised. Sensitivity to noise also depends on frequency content, time of occurrence, duration of sound and psychological factors such as emotion and expectations. The following table is a guide to explain increases or decreases in sound levels for many scenarios.

| Change in sound level (dB) | Change in perceived loudness |
|---|---|
| 1 | Imperceptible |
| 3 | Just barely perceptible |
| 6 | Clearly noticeable |
| 10 | About twice as loud |

### Transmission path(s)

The transmission path is the path the sound takes from the source to the receiver. Where multiple paths exist in parallel, the reduction in each path should be calculated and summed at the receiving point. Outdoor barriers can block transmission paths, for example traffic noise. The effectiveness of barriers is dependent on factors such as its distance from the noise source and the receiver, its height and construction.

### Ground-borne vibration

In addition to airborne noise levels caused by transportation, construction, and industrial sources there is also the generation of ground-borne vibration to consider. This can lead to structure-borne noise, perceptible vibration, or in rare cases, building damage.

### Sound insulation - Absorption within porous materials

Upon encountering a porous material, sound energy is absorbed. Porous materials which are intended to absorb sound are known as absorbents, and usually absorb 50 to 90% of the energy and are frequency dependent. Some are designed to absorb low frequencies, some for high frequencies and more exotic designs being able to absorb very wide ranges of frequencies. The energy is converted into both mechanical movement and heat within the material; both the stiffness and mass of panels affect the sound insulation performance.