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CERTIFICATE OF PERFORMANCE

IMPACT NOISE TESTING

ARC FLOORS AQUA PRIME HYBRID FLOORING

FLOOR DISTRIBUTORS PTY LTD

Date: Tuesday, 3 March 2020

DOCUMENT CONTROL

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Approved by	Michael Fan Chiang, MAAS Acoustical Consultant

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ARC FLOORS

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1.0 CONSULTANT'S BRIEF

Koikas Acoustics was requested by Floor Distributors Pty Ltd to conduct impact noise tests on the Arc Floors Aqua Prime Hybrid Flooring. A total of one (1) test was conducted which included the base ceiling/ floor system and the selected hybrid floor covering ·

The purpose of undertaking the impact noise test was to quantify the acoustic performance of the hybrid flooring system in conjunction with the sub-base being concrete with suspending ceiling.

Test results were compared to the acoustic requirements of *Part F5 of BCA (Building Codes of Australia)*, the standards prescribed by the *Association of Australian Acoustical Consultants (AAAC)* and City of Sydney Council's DCP 2012 requirements.

All measurements were carried out in accordance with the guidelines and procedures outlined in *AS/NZS ISO 140.7:2006 "Field measurements of impact sound insulation of floors"* with the rating determined in accordance with *AS ISO 717.2-2004 "Rating of sound insulation in buildings and of building elements"*.

2.0 IMPACT NOISE COMPLIANCE TESTING

The impact noise test was taken within residential flat units in Rockdale NSW.

2.1 PARTITION SYSTEM

Koikas Acoustics has been advised that the ceiling/floor system between the residential units is constructed with following building materials:

Approximately 200 mm thick concrete slab;

80~120 mm mm deep suspended ceiling cavity, and

13 mm thick plasterboard ceiling.

Hereafter referred to as the "*existing ceiling/floor system*" (ECFS). The test was conducted with the Arc Floors Aqua Prime Hybrid Flooring over the ECFS:

3.0 IMPACT NOISE CRITERIA

3.1 BCA REQUIREMENT

For verification of the impact noise rating for floors, Part FV5.1 (b) of the latest update of the Building Code of Australia (BCA) 2019 states:

> *Impact: a weighted standardised impact sound pressure level with spectrum adaptation term (L_{nTw}) not more than 62 when determine under AS/ISO 717.2*

3.2 AAACSTAR RATING PERFORMANCE REQUIREMENTS

Reproduced from the Association of Australian Acoustical Consultants (AAAC) Guideline for Apartment and Townhouse Acoustic Ratings, the following Table (Section C) describes the acoustic ratings with reference to the Star Rating System.

Table 1. Star Rating requirements for Inter -tenancy Activities – Published by the AAAC

INTER -TENANCY ACTIVITIES	2 Star	3 Star	4 Star	5 Star	6 Star
(a) Airborne sound insulation for walls and floors					
- Between separate tenancies $D_{nTw} + C_{tr} \geq$	35	40	45	50	55
- Between a lobby/corridor & bedroom $D_{nTw} + C_{tr} \geq$	30	40	40	45	50
- Between a lobby/corridor & living area $D_{nTw} + C_{tr} \geq$	25	40	40	40	45
(b) Corridor, foyer to living space via door(s) $D_{nTw} \geq$	20	25	30	35	40
(c) Impact isolation of floors					
- Between tenancies $L_{nTw} \leq$	65	55	50	45	40
- Between all other spaces & tenancies $L_{nTw} \leq$	65	55	50	45	40
(d) Impact isolation of walls					
- Between tenancies	No	Yes	Yes	Yes	Yes
- Between common areas & tenancies	No	No	No	Yes	Yes

3.3 CITY OF SYDNEY DCP 2012

Furthermore, the impact isolation requirement of the floor system stated in *Part 10 of Section 4.2.3.11 Acoustic Privacy of City of Sydney DCP 2012* is also considered.

> *(10) To limit the transmission of noise to and between dwellings, all floors are to have a weighted standardised impact sound level ($L'_{nT,w}$) less than or equal to 55 where the floor separates a habitable room and another habitable room, bathroom, toilet, laundry, kitchen, plant room, stairway, public corridor, hallway and the like.*

4.0 IMPACT NOISE TESTING

The testing of the ceiling/floor system with the underlays (including floor covering with timber or vinyl) were conducted inside the unfurnished bedrooms from one residential unit (upper floor level) to another unit (lower floor level) directly below within a residential building in Rockdale NSW on Tuesday, 25th February 2020.

4.1 ASSESSMENT PROCEDURES

Spectrum sound level measurements of transmitted impact noise were recorded in 1/3 octave band centre frequencies between 50 and 10,000 Hertz.

A standardised Cesva MI006 S/N T 249742 Tapping Machine was used to generate the sound field in the source rooms for the impact noise test. Impact noise measurements were carried out in accordance with the recommendations of *AS/NZS ISO 140.7:2006 "Field measurements of impact sound insulation of floors"*. This document provides information on appropriate measurement equipment and the proper implementation of measurement practices so as to achieve reliable results of impact sound insulation between rooms in buildings.

For determining a single number quantity for impact sound insulation between rooms in buildings when measurements are conducted "in-situ", $L_{nT,w}$ (weighted standardised impact sound pressure level), the relevant standard is *AS/NZS ISO 717.2-2004 "Impact sound insulation"*. The calculated $L_{nT,w}$ derived from applying the formulae in this standard allows for a comparison between these calculated levels and the nominated acceptable levels outlined in the *Verification Methods* of the *Building Code of Australia (BCA).*

4.2 AMBIENT BACKGROUND NOISE MEASUREME NT

A measure of the underlying ambient noise was taken in the receiving rooms to account for the perceived noise floor in the space. Inaccuracies in the measurements and calculations can occur in areas of high ambient noise however the location of the site and receiver rooms meant little ambient noise was evident in this case.

Ambient noise levels in each 1/3 octave frequency bands were measured to take into account the effect of ambient noise during the recording of the transmitted impact noise levels.

4.3 REVERBERATION TIME MEASUREMENTS

To determine the $L_{nT,w}$ reverberation time measurements need to be performed in the receiving rooms. The reverberation time in the receiver room is calculated to 'standardise' the airborne/impact noise transmission measurements to reference reverberation time of 0.5 seconds as required by AS/NZS ISO 140.7:2006 Section 3.4, and AS ISO 140.4-2006 Section 3.4.

Reverberation time measurements were conducted using the balloon source method. This consisted of bursting a large balloon and measuring the decay of sound pressure level using a spectrum analyser. This transient response was analysed by the sound level meter and a measure of the reverberation time in 1/3 octave bands was used to calculate the standardised impact noise rating.

4.4 INSTRUMENTATION AND CALIBRATION

NTi XL2 Type Approved (TA) precision spectrum analyser S/N A2A-06312-E0 was used to measure the impact noise levels. The equipment used for taking noise level measurements is traceable to NATA certification. Field calibrations were taken before and after the impact noise measurements with a NATA calibrated pistonphone. No system drifts were observed.

5.0 MEASURED RESULTS

The results of the impact noise tests are summarised in Table 2.

Table 2. Impact Noise Insulation Performance Summary for Ceiling/Floor System			
System Tested	**L'_{nTw}[3]**	**Equivalent AAAC[4] Star Rating**	**FIIC[5,6]**
Bare concrete floor (ECFS only)	62	2	41
Arc Floors Aqua Prime Hybrid Flooring	42[2]	5	63

Detail calculations of the partition system's impact noise insulation of the ceiling/floor systems are attached as Appendix A .

The following are also noted:

1. The Arc Floors Aqua Prime Hybrid Flooring was tested with the existing ceiling/floor system (ECFS) consisting of approximately 200 mm thick concrete sub-base with the inclusion of 80~120 mm suspended ceiling cavity and one layer of 13 mm thick plasterboard ceiling.

2. The Arc Floors Aqua Prime Hybrid Flooring was tested and found to have met both the BCA 2019 criterion ($L'_{nTw} \leq 62$) and City of Sydney DCP 2012 requirement ($L'_{nTw} \leq 55$) for impact noise insulation.

3. The lower the rating number the better the acoustic performance for L_{nTw} ratings.

4. The higher the AAAC Star Rating the better the impact insulation.

5. The relation between Field Impact Isolation Class (FIIC) and Impact Isolation Class (IIC) can be described by the formula FIIC + 5 ≈ IIC.

6. The higher the IIC and FIIC the better the impact insulation.

7. The information contained herein should not be reproduced except in full.

8. The information provided in this report relates to acoustic matters only. Supplementary advice should be sought for other matters relating to flooring installation, construction, design, structural, fire-rating, water-proofing, and the likes.

9. Product installation details and methodologies must be sought from product supplier, installer or other experts. Koikas Acoustics is not liable for any product defects.

10. The acoustic ratings provided in this report are indicative and for comparative purpose only. Acoustic ratings will vary depending on the testing environment/conditions including, materials/structures of the existing ceiling/floor system, room volume, internal layout and workmanship. Even with the same testing environment, acoustic ratings can vary from room to room and so buildings to buildings as no two buildings are identical.

11. Floor covering must not make contact with any walls or joineries (kitchen benches, cupboards etc). During the installation of any hard floor coverings, temporary spaces of 5~10mm should be used to isolated the floor covering from walls and/or joineries and the resulting gaps should be filled with a suitable mastic type sealant or off-cut of underlay or the equivalent where available. Acoustic ratings could be degraded if the above precautions and treatments are not implemented. Refer to Figure 1 & 2 below for illustration.

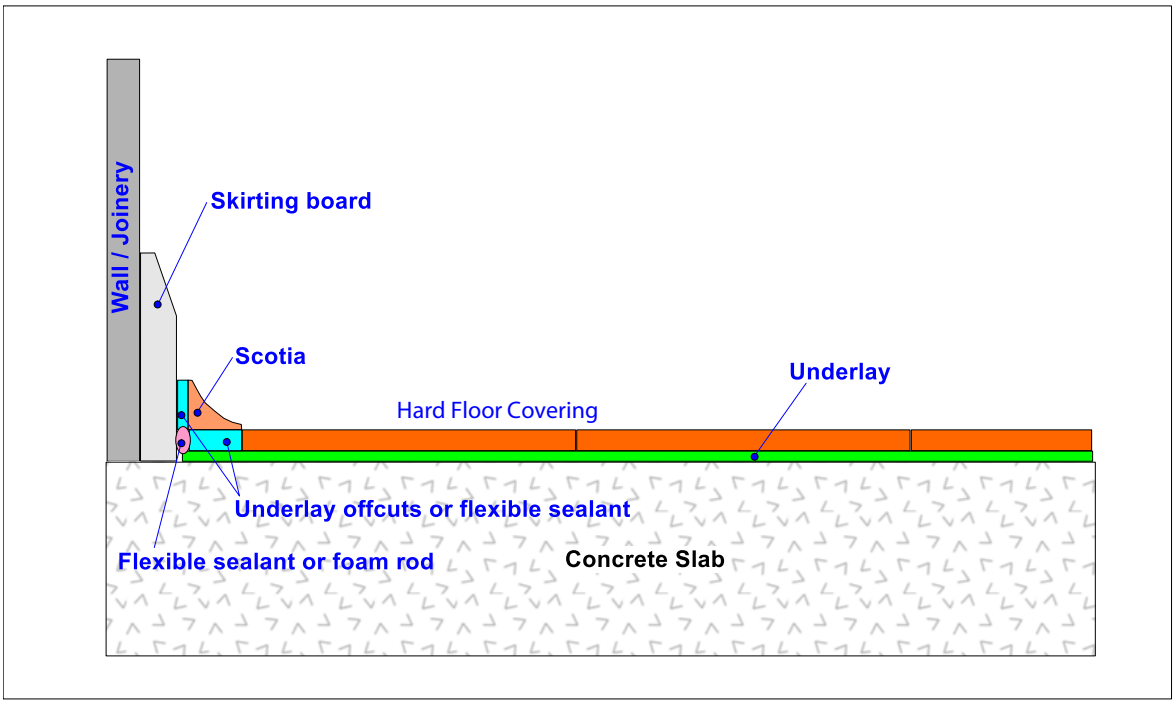

Figure 1. Wall / Joinery details (skirting board & scotia)

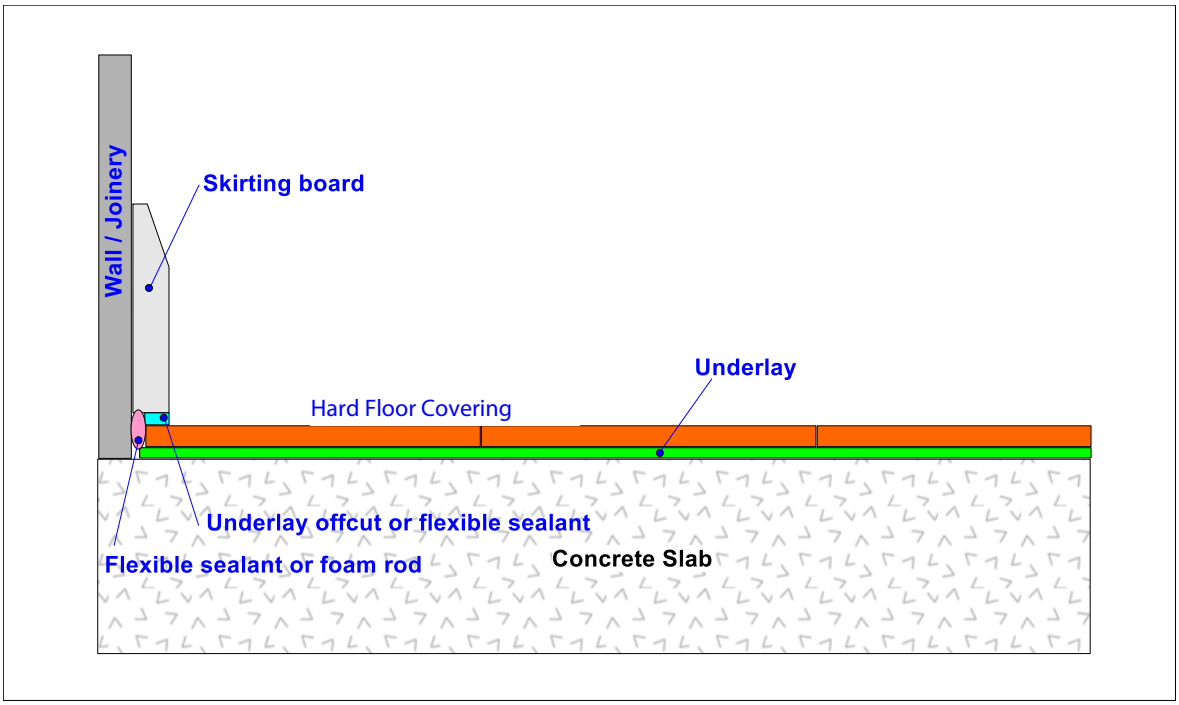

Figure 2. Wall / Joinery details (skirting board)

6.0 CONCLUSION

Koikas Acoustics was requested by Arc Floors to undertake impact noise test of the Arc Floors Aqua Prime Hybrid Flooring. The acoustic performances of the ceiling/floor configuration were calculated and compared against the acoustic requirements of the current BCA , AAAC of Star Ratings and City Sydney Council's DCP 2012 requirements that are commonly used in Australia.

The calculated acoustic rating of each tested flooring sample was summarised and presented in Table 2 of this report. Detailed graphically presentation of the acoustic performance of each tested flooring sample is attached as Appendix A .

The acoustic ratings provided in this report are indicative and for comparative purpose only . Acoustic ratings will vary depending on the testing environment/conditions including, materials/structures of the existing ceiling/floor system, room volume, internal layout and workmanship. Even with the same testing environment/conditions, acoustic ratings would still vary from buildings to buildings.

It is recommended that testing be conducted prior to any full fit-out as the sub-base ceiling floor system and the wall junctions can impact upon the resultant flanking noise in the unit below.

The above report should be reproduced in full including the attached Appendix.

Floor covering must not make contact with any walls or joineries (kitchen benches, cupboards etc). During the installation of any hard floor coverings, temporary spaces of 5~10mm should be used to isolated the floor covering from walls and/or joineries and the resulting gaps should be filled with a suitable mastic type sealant or off-cut of underlay or the equivalent where available. Acoustic ratings could be degraded if the above precautions and treatments are not implemented.

APPENDIX A

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FIELD MEASUREMENTS OF IMPACT SOUND INSULATION OF FLOORS

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CONSULTANTS IN NOISE & VIBRATION

Date of Test :	Tuesday, 25 February 2020
Project No. :	3743
Testing Company :	Koikas Acoustics
Checked by :	Nick Koikas
Place of Test:	Residential building in Rockdale NSW
Client	Arc Floors
Client Address	-

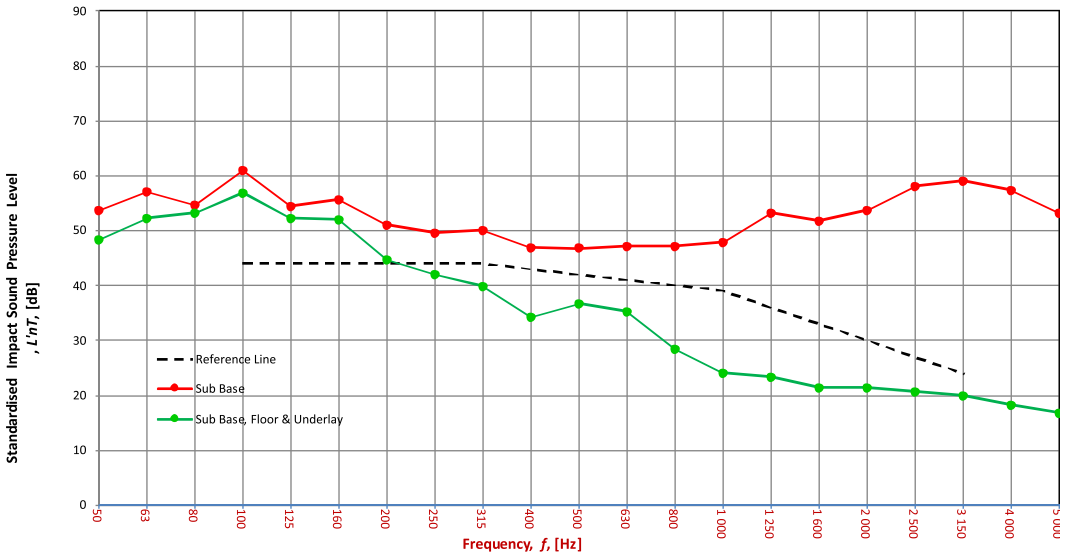
	Name	Thickness (mm)	Density (Sl)
Description of Floor System	Arc Floors Aqua Prime Hybrid Flooring	--	--
	--	--	--
	200 mm reinforced concrete slab	200	--
	80~120 mm suspended ceiling cavity + 13 mm plasterboard ceiling	80~120 + 13	--

Room Floor Dimensions	Width :	3.5	m
	Length :	3.2	m
	Area :	11.2	m²
Sample Dimensions	Width :	1	m
	Length :	1	m
	Area :	1	m²

	Location	Width	Length	Area	Height	Volume
Receiver Rm	Level 1 bedroom	3.5	3.2	11.2	2.6	29.12

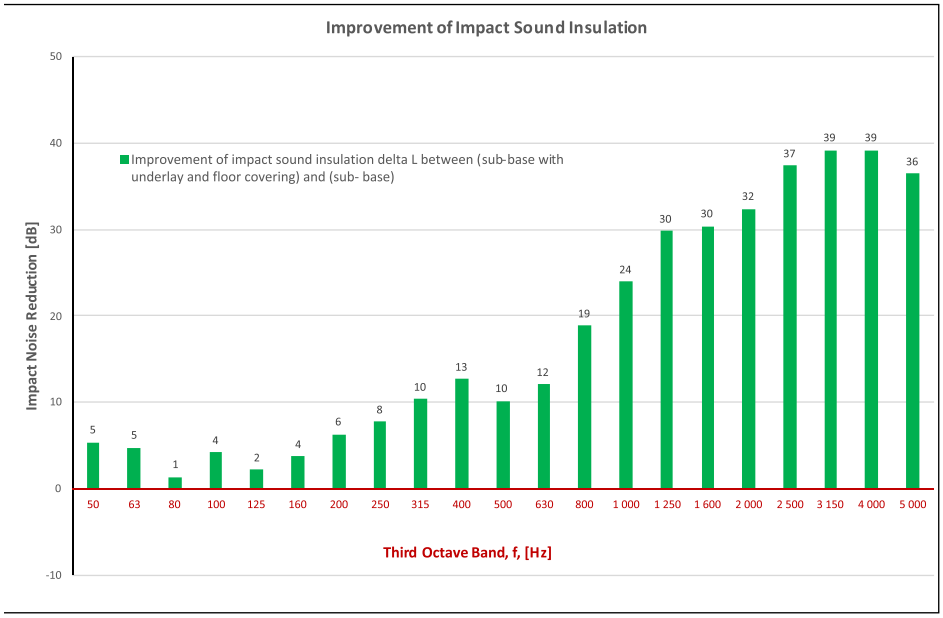
Room Surfaces		
Walls	Floor	Ceiling
Plasterboard	Concrete	Plasterboard

Frequency f Hz	L'nT (one-third octave) dB Sub Base		Sub Base Floor Underlay
50	53.6		48.3
63	57.0		52.3
80	54.6		53.3
100	61.0		56.9
125	54.3		52.2
160	55.6		51.9
200	50.9		44.7
250	49.7		42.0
315	50.1		39.8
400	46.9		34.3
500	46.8		36.7
630	47.1		35.1
800	47.1		28.3
1 000	47.9		24.0
1 250	53.1		23.3
1 600	51.6		21.3
2 000	53.7		21.4
2 500	58.0		20.6
3 150	59.0		19.8
4 000	57.4		18.3
5 000	53.2		16.8



Sub Base		
L'nT,w	62	AS ISO 717.2 - 2004
Ci	-11	AS ISO 717.2 - 2004
Ci(50-2500)	-10	AS ISO 717.2 - 2004
Ci(63-2000)	-11	AS ISO 717.2 - 2004
AAAC ★	2 Star	AAAC Guideline
FIIC	41	ASTM E1007-14

Sub Base, Floor & Underlay		
L'nT,w	42	AS ISO 717.2 - 2004
Ci	2	AS ISO 717.2 - 2004
Ci(50-2500)	4	AS ISO 717.2 - 2004
Ci(63-2000)	4	AS ISO 717.2 - 2004
AAAC ★	5 Star	AAAC Guideline
FIIC	63	ASTM E1007-14



Definitions of Noise Metrics

FIIC:
Field Impact Insulation Class is a single-number rating of how well a floor system attenuates impact type sounds, such as footsteps. Calculated from third-octave band normalised impact sound pressure level data and referenced to 10 m² as described in ASTM E989. The higher the single-number rating, the better its impact

L'nT,w:
The Weighted Standardised Impact Sound Pressure Level when measured in situ referenced to a reverberation time (RT60) of 0.5 seconds. Used by the AAAC to determine their respective Star Rating

Ci:
Spectrum adaption term is a low frequency correction factor. Typically for massive floors such as concrete, the values are about zero while for timber joist floors Ci is positive because of the low resonant frequencies. Considers frequency range between 100 -and 2500 Hz.

Ci(50-2500):
Same as above, but for the frequency range 50 -2500 Hz.

Ci(125-2000):
Same as above, but for the frequency range 125 -2000 Hz.

AAAC Star R.	2	3	4	5	6
L'nT,w	65	55	50	45	40
FIIC	45	55	60	65	70
Comments	Below BCA 62	Clearly Audible	Audible	Barely Inaudible	Normally Inaudible