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27 February 2024

Sunstar Timber Flooring
Warehouse 4, 94-98 Kirkham Road West,
Keysborough Vic 3173

Attention: Daniel Lyne

Dear Daniel,

ACOUSTIC (IMPACT) PERFORMANCE OPINIONS FOR SUNSTAR FLOOR COVERS

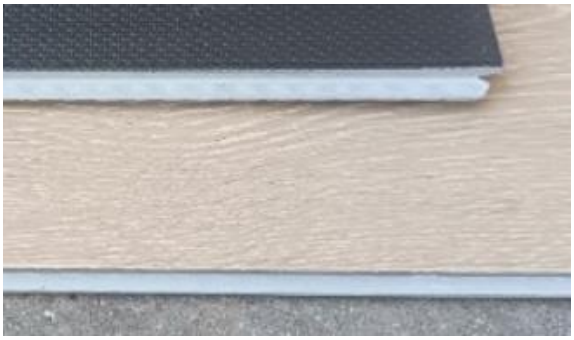
INTRODUCTION

Sunstar Timber Flooring (Sunstar) has commissioned Marshall Day Acoustics (MDA) to provide acoustic opinions of impact sound insulation performance for their floor/ceiling systems.

The following document outlines the Impact sound insulation performance opinion for the floor system outlined in Table 1 below.

Table 1: Product Details

Sunstar 8mm Rigid Core Hybrid Timber Planks	
Floor Covering	
• **PRODUCT NAME:**	Sunstar Rigid Core Hybrid Timber
• **STOCK CODE:**	R304 ('Gunyah')
• **THICKNESS:**	8 mm
• **SURFACE DENSITY:**	13.9 kg/m^2



If required, please see Appendix A for a glossary of relevant acoustic terms used in this document.

ACOUSTIC DESKTOP ASSESSMENT

Overview

The impact sound insulation performance for in-situ floor-ceilings is expressed using a weighted impact sound pressure level (i.e. $L'_{nT,w}$ or $L_{n,w}$ values), which are commonly associated with an industry recognised star rating. These star ratings are quantified using the criteria provided in an Association of Australasian Acoustical Consultants (AAAC) guideline[1]. A brief discussion of relevant criteria from this guideline is provided in Appendix B.

It is important to note these rating values relate to a whole floor-ceiling system (including the building substructure and ceiling beneath the proposed flooring system), and therefore can change subject to installation conditions. Given this, laboratory test results of a flooring system cannot be applied across all install situations. However, they can be used to identify numerical relationships between tested systems and theoretical systems to predict a particular floor system's performance.

Implementing the above and using a combination of:

- established theoretical and empirical modelling methodology,
- Data comparison against other laboratory test data (from MDA's own in-house database) for similar flooring systems, and
- Previous experience

MDA have generated an opinion / estimated impact sound insulation performance for a number of predefined flooring systems incorporating.

Laboratory Measured Impact Sound Insulation

To calibrate our desktop model (used to estimate impact sound insulation performance), Sunstar have provided an impact sound insulation test report from recent laboratory measurements conducted by CSIRO (Report No. INR289-13-1, Dated: 07/02/2024). In the laboratory test report, the subject floor cover was installed on a 150 mm thick concrete slab (360 kg/m^2) with:

- measurements carried out in accordance with AS ISO 140.6-2006[2] and ISO 10140 Part 3 (2010)[3] to determine the impact sound insulation rating ($L_{n,w}$), and
- calculations carried out in accordance with AS ISO 717.2 (2004)[4] to determine the subsequent reduction in impact sound pressure levels due to the floor cover (ΔL_w).

A summary of the above mentioned lab results has been outlined in Table 2 below. For full copy of CSIRO's laboratory report see Appendix C.

Table 2: Summary of CSIRO Lab Results

Section View *(Not to scale)*	Floor System	Weighted Impact Sound Pressure Level of bare slab	Change in Weighted Impact Sound Pressure Level with floor cover
	- Sunstar Rigid Core Hybrid Timber 8 mm thick, 13.9 kg/m^2 - Concrete Slab 150 mm thick, 360 kg/m^2	$L_{n,w}$ 81	ΔL_w 19

[1] Association of Australasian Acoustical Consultants' Document – 'Guideline for Apartment and Townhouse Acoustic Rating', Version 1.0, Dated 2017

[2] AS ISO 140.6-2006: Acoustics – '*Measurement of sound insulation in buildings and of building elements Laboratory measurements of impact sound insulation of floors*'

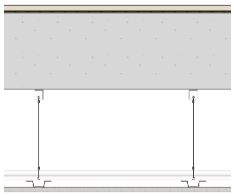
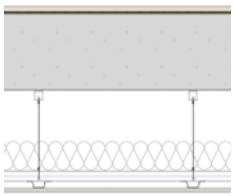
[3] ISO 10140 Part 3-2010: Acoustics – '*Laboratory measurement of sound insulation of building elements—Part 3: Measurement of impact sound insulation*'

[4] AS ISO 717.2-2004: Acoustics – '*Rating of sound insulation in buildings and of building elements—Part 2: Impact sound insulation*'

ESTIMATED IMPACT SOUND INSULATION PERFORMANCE

Our opinions of impact sound insulation performance for Sunstar 8mm Rigid Core Hybrid Timber Planks flooring system, when installed as part of the associated described floor system build-up, are provided in Table 3 below.

Table 3: Opinion of impact sound insulation performance for Sunstar 8mm Rigid Core Hybrid Timber Planks

Section View *(Not to scale)*	Floor System	Estimated Weighted Impact Sound Pressure Level ($L'_{nT,w}$)	Corresponding AAAC Star Rating & BCA Compliance
	- Sunstar Rigid Core Hybrid Timber 8 mm thick, 13.9 kg/m^2 - Concrete Slab 200 mm thick, 465 kg/m^2	$L'_{nT,w}$ 57 ±3	2 Stars ($L'_{nT,w} \leq 65$) ★★☆☆☆☆ BCA ($L'_{nT,w} \leq 62$) ✓ **Yes**
	- Sunstar Rigid Core Hybrid Timber 8 mm thick, 13.9 kg/m^2 - Concrete Slab 200 mm thick, 465 kg/m^2 - Ceiling Cavity 250 mm cavity - Suspended Plasterboard Ceiling Lightweight grid, 13 mm thick 8.4 kg/m^2 plaster	$L'_{nT,w}$ 52 ±3	3 Stars ($L'_{nT,w} \leq 55$) ★★★☆☆☆ BCA ($L'_{nT,w} \leq 62$) ✓ **Yes**
	- Sunstar Rigid Core Hybrid Timber 8 mm thick, 13.9 kg/m^2 - Concrete Slab 200 mm thick, 465 kg/m^2 - Ceiling Cavity with Insulation 250 mm cavity, 75 mm thick 11 kg/m^3 insulation - Suspended Plasterboard Ceiling Lightweight grid, 13 mm thick 8.4 kg/m^2 plaster	$L'_{nT,w}$ 45 ±3	5 Stars ($L'_{nT,w} \leq 45$) ★★★★★☆ BCA ($L'_{nT,w} \leq 62$) ✓ **Yes**

Opinion Limitations

The estimated ratings all have a ±3dB level of uncertainty that should be taken into account when assessing a system acoustic suitability.

The opinions are based on the materials and construction details set out above. Any variations (i.e. decreasing the ceiling cavity depth, reducing plasterboard and/or concrete slab thickness, altering ceiling insulation) to the floor-ceiling systems detailed above have the potential to downgrade the impact sound insulation performance.

The opinions assume that the floor-ceiling system being evaluated presents the *primary* source of impact sound transmission. i.e. The floor-ceiling system's flanking paths are appropriately controlled such that they do not significantly influence the $L'_{nT,w}$ ratings of the floor-ceiling system.

SUMMARY

The above document outlines our opinions of impact sound insulation performance for Sunstar 8mm Rigid Core Hybrid Timber Planks flooring system, when installed as part of a nominal floor system. See Table 3 for details on these floor system build-ups and their associated estimated performance.

Please note, the estimated impact sound insulation performance is a calculated opinion only. If performance certainty is required, it is recommended that acoustic tests are undertaken at a suitably qualified testing laboratory.

Yours faithfully,

MARSHALL DAY ACOUSTICS PTY LTD

Jenna MacDonald

Senior Consultant

APPENDIX A GLOSSARY OF ACOUSTIC TERMINOLOGY

Flanking	Transmission of sound energy through paths adjacent to and/or around the building element being considered. For example, sound may be transmitted around a wall by travelling up into the ceiling space, over the top of the non-full height wall, and then down into the adjacent room.
Impact Sound	Sound produced by an object impacting directly on a building structure, such as footfall noise or chairs scrapping on a floor.
$L_{n,w}$	*Weighted, Normalized Impact Sound Pressure Level* ($L_{n,w}$) A single number rating of the impact sound insulation of a floor/ceiling when impacted on by a standard 'tapper' machine. $L_{n,w}$ is measured in a laboratory. The lower the $L_{n,w}$, the better the acoustic performance.
$L'_{nT,w}$	*Weighted, Standardised Impact Sound Pressure Level* ($L'_{nT,w}$) A single number rating of the impact sound insulation of a floor/ceiling when impacted on by a standard 'tapper' machine. $L'_{nT,w}$ is measured on site. The lower the $L'_{nT,w}$, the better the acoustic performance.
Sound Insulation	When sound hits a surface, some of the sound energy travels through the material. 'Sound insulation' refers to ability of a material to stop sound travelling through it.

APPENDIX B AAAC STAR RATING SYSTEM

The Association of Australasian Acoustical Consultants (AAAC) has established a star rating system which provides guidance on acoustic criteria and perceived quality for occupants as detailed in *Guideline for Apartment and Townhouse Acoustic Rating Version 1.0* dated June 2017. The star ratings range from 2 Star to 6 Star, with 6 Star ratings reflecting the best levels of acoustic performance.

See Table 4 for summery of $L'_{nT,w}$ values associated with AAAC's acoustic star ratings for the impact isolation of floors between residential tenancies.

Table 4: Summary of AAAC Acoustic Star Rating for Inter-Tenancy Sound Insulation Criteria

Inter-tenancy Activities	2 Stars ★★☆☆☆☆	3 Stars ★★★☆☆☆	4 Stars ★★★★☆☆	5 Stars ★★★★★☆	6 Stars ★★★★★★
(c) Impact Isolation of Floors					
Between Tenancies $L'_{nT,w} \leq$	65	55	50	45	40
Between All Other Spaces & Tenancies $L'_{nT,w} \leq$	65	55	50	45	40

APPENDIX C LABORATORY IMPACT TEST REPORT

CSIRO ACOUSTIC MEASUREMENT REPORT

Commonwealth Scientific and Industrial Research Organisation, Infrastructure Technologies
Acoustics Testing Laboratory, Research Way, Clayton, Vic 3168 Australia

Report No: **INR289-18-1**

Client: Sunstar Timber Flooring
Warehouse 4, 94-98 Kirkham Road West, Keysborough, Vic 3173

Measurement Type: Impact Sound Insulation (Floor)

AS ISO 140.6-2006 and ISO 10140 Part 3 (2010): *Laboratory measurement of impact sound insulation of floors.*
AS ISO 140.8 (2006): *Laboratory measurement of reduction of transmitted impact noise by floor coverings on a heavyweight standard floor.*
AS ISO 717.2 (2004): *Acoustics – Rating of sound insulation in buildings and of building elements. Part 2: Impact sound insulation.*

Test Specimen (Area of concrete test floor: 10.8 m² [3.6 x 3.0 m])

Description: • Sunstar 8 mm Rigid Core Timber Hybrid flooring planks
• resting on a 150 mm thick concrete subfloor.

Materials[7]:
a] Sunstar Rigid Core Timber Hybrid planks:-
- Stock code: R304 *('Gunyah')*
- 8 mm rigid core stone/polymer composite planks with 1 mm timber veneer, and integrated 1.5 mm IXPE foam backing
- Dimensions: 1900 x 190 mm
- With interlocking edge profiles
- Mass per unit area: 13.9 kg/m²

b] Concrete slab subfloor (of the laboratory), 150 mm thick, 360 kg/m² approx.

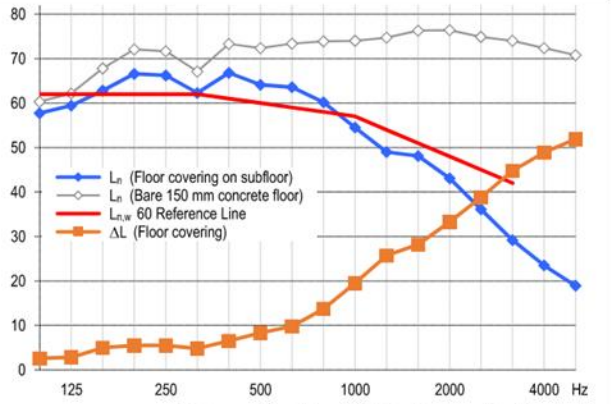
Installation details:
- The concrete subfloor [item b] was swept in preparation for flooring installation.
- Flooring planks [item a] were laid directly on top of the concrete subfloor (no adhesive) mated together via their interlocking edge profiles. Joins were staggered from row-to-row by a combination of simple offsetting, and cutting some planks in half – enabling the locations of the joins to be distributed across the floor area. Excess flooring was allowed to overhang and rest on the surrounding floor of the chamber, level with the test-floor.
- Installation was carried out by laboratory staff.

Close-up of flooring materials

Test specimen installed in laboratory for test

Measurement Details & Results[1,2,4]

Freq. (Hz)	Specimen Floor L_n (dB)	Bare Concrete[3] Floor $L_{n,0}$ (dB)	Improvement ΔL (dB)
100	57.7	60.3	2.6
125	59.4	62.2	2.8
160	62.8	67.8	5.0
200	66.6	72.1	5.5
250	66.2	71.7	5.5
315	62.3	67.1	4.8
400	66.8	73.3	6.5
500	64.1	72.4	8.3
630	63.6	73.4	9.8
800	60.2	73.9	13.7
1000	54.5	74.0	19.5
1250	49.0	74.7	25.7
1600	48.1	76.3	28.2
2000	43.1	76.4	33.3
2500	36.1	74.9	38.8
3150	29.2	74.0	44.8
4000	23.5	72.4	48.9
5000	18.9	70.8	51.9



Performance Index Numbers (laboratory method)
$L_{n,w}$ (C_I) = 60 (-1) dB
IIC[5] = 50 dB
ΔL_w = 19 dB
ΔL_{in} = 9 dB

The tapping machine was placed diagonally in eight different locations across the test floor area; sound levels in the room below were measured over a whole microphone rotation (33 sec) at each location, and the results averaged.

Measurement Conditions	With Floor Covering	Bare Concrete Floor
Date of measurement:	9 January 2024	9 January 2024
On top of floor:	20 °C, 76 % R.H.	20 °C, 77 % R.H.
Chamber underneath floor:	22 °C, 74 % R.H.	21 °C, 75 % R.H.
Atmospheric pressure:	1001 mBar	1001 mBar

Notes, Deviations etc

1. ≤ and ≥ signify results, if any, where measurement was limited by proximity to background level.
2. L_n = dB re 20 µPa, ΔL = dB re bare floor.
3. Bare slab indices: $L_{n,w}$ (C_I) = 81 (-11) dB, IIC = 26 dB.
4. L_n results represent noise levels; i.e. lower = quieter. For ΔL and IIC results, higher = quieter.
5. IIC is calculated as per ASTM E989-89 but from measurements as per AS ISO 140.6 & ISO 10140 part 3.
6. Testing was carried out unloaded; the weight of the tapping machine being the only load on top of the floor.
7. Material details stated are as per client advice; unless identified as (meas), indicating measured by CSIRO.
8. The test specimen material suffered no visible damage during the course of the test.

Issuing Authority

Signed: David Truett
Date: 7 February 2024

Acoustic Instrumentation

Real time analyser: • Brüel & Kjær PULSE LAN-XI type 3160-A-4/2
Microphone/preamp: • GRAS 46AQ microphone/preamp set, rotating continuously with 33 sec period about 1.32 m radius.
Noise source: • Norsonic Nor277 tapping machine (complies with ISO 140)
Calibration: • Brüel & Kjær type 4231 Calibrator: Jan 2023 (NATA cal)
• Analyser: Sep 2021 (NATA cal) • Mic/Preamp: Aug 2022 (NATA cal)
• Sensitivity of measurement system was calibrated against the calibrator at the time of measurement.

Laboratory Construction

Chambers: • 300 mm thick concrete • parallelepiped with dimensional proportions 1:1.3:1.6 for uniform distribution of room modes
• source room (upper): 200 m³ vol, 212 m² surface area (approx.)
• receiving room (lower): 105 m³ vol, 135 m² surface area (approx.).
Diffusers: • 200 m³ room: 20 diffusers (approx 40 m²) • 100 m³ room: none.
Test floor: • Homogeneous heavyweight concrete slab, 150 mm thick, 3.58 x 2.98 m, resting on a full perimeter support ledge in the upper chamber; the perimeter gap filled with sand, with foam backing rod on top.