MARSHALL DAY Acoustics

PHONESTAR TRI
AIRBORNE & IMPACT SOUND OPINION

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Project: **PHONESTAR TRI – AIRBORNE & IMPACT SOUND OPINION**

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1.0 INTRODUCTION

Marshall Day Acoustics has been asked to provide an opinion on the airborne and impact sound insulation performances of floor/ceiling constructions with Phonestar Tri board - a corrugated cardboard product with quartz sand inside.

This opinion is based on previous laboratory tests conducted of four floor/ceiling constructions.

Based on these test results, we provide floor/ceiling configurations that will achieve the New Zealand and Australian Building Code and sound insulation requirements, plus a comparison to the Association of Australasian Acoustical Consultants (AAAC) star rating system.

A glossary of the acoustic terminology used in this report is provided in Appendix A.

2.0 CONSTRUCTIONS

2.1 Floor Covering Constructions

The tested constructions are detailed below:

Construction 1 (Commercial Sheet Vinyl)

- 2 mm thick commercial sheet vinyl, loose laid on
- 4 mm thick Wolf Bavaria Entkopplungsplatte (3.8 kg/m^2) loose laid on
- 1 layer of 15 mm thick PhoneStar Tri board (18 kg/m^2), loose laid on
- 1.4 mm thick Wolf Bavaria Decoupling Fleece, loose laid on
- 20 mm thick Laminex Strandfloor particleboard flooring screw fixed at 200 mm centres to floor joists.

Construction 2 (Commercial Sheet Vinyl)

As per Construction 1 except with two layers of 15 mm thick PhoneStar Tri board (18kg/m^2).

Construction 3 (Tongue & Groove Flooring)

- 12 mm thick Forte/Loft Claremount engineered tongue and groove flooring adhered with
- Selleys Timberflex adhesive applied with a 6 mm V notched trowel (13 mm centre notches) to
- 4 mm thick Wolf Bavaria Entkopplungsplatte (3.8 kg/m^2) adhered with
- Sika Nailbond Premium applied in lines with 150 mm nominal centres to
- 1 layer of 15 mm thick PhoneStar Tri board (18kg/m^2), loose laid on
- 1.4 mm thick Wolf Bavaria Decoupling Fleece, loose laid on
- 20 mm thick Laminex Strandfloor particleboard flooring screw fixed at 200 mm centres to floor joists.

Construction 4 (Ceramic Tiles)

- 10 mm thick (200mm x 600mm) ceramic tiles adhered with
- Prohesive Ecoflex applied with a 10 mm square notched trowel on
- Dribond Primebond primer applied with a roller to
- 4 mm thick Wolf Bavaria Entkopplungsplatte (3.8 kg/m^2) adhered with
- Sika Nailbond Premium applied in lines with 150 mm nominal centres to
- 1 layer of 15 mm thick PhoneStar Tri board (18kg/m^2), loose laid on

- 1.4 mm thick Wolf Bavaria Decoupling Fleece, loose laid on
- 20 mm thick Laminex Strandfloor particleboard flooring screw fixed at 200 mm centres to floor joists.

The impact performance provided by a floor/ceiling system is the result of the combination and interaction of all components including, but not limited to, the underlay adhesive. For the predicted results to be accurate, the underlay and all associated products must be installed as undertaken in the laboratory. Adequate perimeter isolation must also be used.

2.2 Cavity Absorption

The cavity absorption for all tested construction is:

- One layer of 115 mm thick Pink Batts R2.2 ceiling fibreglass insulation.

2.3 Ceiling Construction

The ceiling construction used for all four constructions is as follows:

- 2 layers of 13 mm GIB Fyreline plasterboard
- Supported on GIB Quiet Clips fixed to joists at 1200 mm centres with GIB Rondo 35 CB 0.55BMT furring channels spaced at 600 mm centres to provide a 290 mm ceiling cavity.
- The perimeter of the ceiling is sealed with GIB® Firesound sealant.

3.0 TEST RESULTS

The floor covering constructions described in Section 2.1 were tested by the University of Auckland Acoustic Testing Service (Test Reports: T2321-2, T2321-3, T2321-9, T2321-10 dated 17, 19 & 24 October 2023). Refer to Appendix B for the test results.

4.0 OPINION

Table 1 summarises the airborne and impact sound insulation performance of the flooring systems as described in Section 2.1 and includes a comparison to the New Zealand and Australian Building Code minimum requirements.

Table 1: Sound Insulation Performance Summary

Construction	Airborne performance		Impact performance		Achieves NZ Building Code Clause G6 minimum requirements?	Achieves Australian Building Code minimum requirements?	AAAC Star Rating [2]
	Sound Transmission Class	Sound Reduction Index, R_w (C_{tr})	Impact Insulation Class	Weighted, normalised impact sound pressure level, $L_{n,w}$ [1]			
1 (Vinyl)	STC 64	63 dB (-10)	IIC 56	49 dB	Yes	Yes	3-4 star
2 (Vinyl with 2x PhoneStar Tri)	STC 66	64 dB (-9)	IIC 61	44 dB	Yes	Yes	4-5 star
3 (T&G flooring)	STC 67	65 dB (-11)	IIC 57	52 dB	Yes	Yes	2-3 star
4 (Ceramic tiles)	STC 68	66 dB (-11)	IIC 60	50 dB	Yes	Yes	3-4 star

[1] The $L_{n,w}$ has been calculated based on a receiving room volume of 153 m^3. No allowance has been made for on-site flanking transmission.
[2] Range accounts for a 5 dB tolerance for field performance.

We note that the AAAC Star ratings are limited by the impact sound insulation performance of the constructions. The airborne performance of all the systems would achieve 5-6 star ratings.

5.0 INTERPRETATION

5.1 Rating Systems

5.1.1 NZ Building Code

The Sound Transmission Class (STC) of a wall or floor/ceiling system reflects its ability to reduce sound from one room to another. Higher STC ratings indicate that less noise is transmitted to the other room. The NZ Building Code requires that new inter-tenancy walls and floor/ceiling systems have a laboratory rating of STC 55 or higher. In addition, the wall or floor/ceiling must be constructed to ensure the on-site Field Sound Transmission Class (FSTC) is no less than FSTC 50.

The Impact Insulation Class (IIC) of a floor/ceiling system reflects its ability to prevent impact on its surface from being transmitted as structure-borne vibration and radiating as air-borne noise. Higher IIC ratings indicate that less noise is transmitted to the room below. The NZ Building Code requires that new floors have a laboratory rating of IIC 55 or higher. In addition, the floor must be constructed to ensure the on-site Field Impact Insulation Class (FIIC) is no less than FIIC 50.

5.1.2 Australian Building Code

The Australian Building Code uses different airborne and impact sound insulation metrics to the New Zealand Building Code. For airborne sound, the weighted sound reduction index, including an adjustment for the low frequency performance of the wall is used: $R_w + C_{tr} \geq 50$ dB. For impact sound, the weighted, normalised impact sound pressure level is used: $L_{n,w} \leq 62$ dB. The normalised impact sound pressure level is a measure of sound transmitted through a floor/ceiling from a standardised noise source called a tapping machine. The lower the $L_{n,w}$ value, the better the sound insulation performance of the floor/ceiling.

5.1.3 AAAC Star Rating System

Table 2 provides the sound insulation performance of the various AAAC Star Ratings.

Table 2: AAAC Star Rating System

	Sound Insulation expressed as $D_{nT,w}+C_{tr}$				
	35	**40**	**45**	**50**	**55**
Type of Noise Source	**2 Star**	**3 Star**	**4 Star**	**5 Star**	**6 Star**
Normal Speech	Audible	Just Audible	Not Audible	Not Audible	Not Audible
Raised Speech	Clearly Audible	Audible	Just Audible	Not Audible	Not Audible
Dinner Party/Laughter	Clearly Audible	Audible	Just Audible	Not Audible	Not Audible
Shouting	Clearly Audible	Clearly Audible	Audible	Just Audible	Not Audible
Small Television/ Small Entertainment System	Clearly Audible	Clearly Audible	Audible	Just Audible	Not Audible
Large Television/ Large Hi-fi Music System	Clearly Audible	Clearly Audible	Clearly Audible	Audible	Just Audible
DVD With Surround Sound	Clearly Audible	Clearly Audible	Clearly Audible	Audible	Audible
Digital Television with Surround Sound	Clearly Audible	Clearly Audible	Clearly Audible	Audible	Audible

Intertenancy Activities	**2 Star**	**3 Star**	**4 Star**	**5 Star**	**6 Star**
(a) Airborne Sound Insulation for Walls and Floors					
Between Separate Tenancies $D_{nT,w} + C_{tr} \geq$	35	40	45	50	55
Between A Lobby/Corridor & Bedroom $D_{nT,w} + C_{tr} \geq$	30	40	40	45	50
Between A Lobby/Corridor & Living Area $D_{nT,w} + C_{tr} \geq$	25	40	40	40	45
(b) Corridor, Foyer To Living Space Via Door(s) $D_{nT,w} \geq$	20	25	30	35	40
(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
(d) Impact Isolation of Walls					
Between Tenancies	No	Yes	Yes	Yes	Yes
Between Common Areas & Tenancies	No	No	No	Yes	Yes

5.2 Field Performance

To ensure the on-site measurements are similar to the laboratory results the products must be installed and constructed in a similar way to the laboratory tests and any substitution of materials must be approved by the project's Acoustic Consultant. In addition, potential flanking paths, such as external walls, need to be considered and mitigated against.

Structure-borne vibration is readily transmitted in all directions in lightweight flooring structures. There is often little difference between measured impact noise levels in rooms directly below the source room compared with rooms that are diagonally below. Therefore, the impact isolation to rooms other than those directly below the floor area should also be considered.

The use of materials other than those referred to in Section 2.0 or the introduction of additional materials (e.g. underfloor heating), including the lack of any perimeter isolation, can significantly affect the field performance rating (i.e. may result in a failure in accordance with the NZ/Australian Building Codes). We strongly recommend trial performance testing on site before proceeding with full installation.

APPENDIX A GLOSSARY OF TERMINOLOGY

Sound Insulation	Provision of a degree of acoustical separation between two spaces such that sound is reduced in travelling between the two spaces.
Impact sound	Sound produced by an object impacting directly on a building structure, such as footfall noise or chairs scrapping on a floor.
Flanking Transmission	Transmission of sound energy through paths adjacent to the building element being considered. For example, sound may be transmitted around a wall by travelling up into the ceiling space and then down into the adjacent room.
Structure-Borne Transmission	The transmission of sound from one space to another through the structure of a building.
STC	Sound Transmission Class. A single number system for quantifying the transmission loss through a building element. The measured transmission loss, in third octave bands from 125 Hz to 4 kHz, is compared to a standard reference curve to determine the single number value. Can only be measured in laboratory conditions
FSTC	Field Sound Transmission Class. The performance of a partition in situ, and with all flanking paths minimised as much as practicable. Typically FSTC values are up to 5 points lower than the laboratory STC.
R_w	Weighted Sound Reduction Index. A single number system for quantifying the transmission loss through a building element. The measured transmission loss, in third octave bands from 100 Hz to 3.15 kHz, is compared to a standard reference contour to determine the single number value. Can only be measured in laboratory conditions
R'_w	Apparent Weighted Sound Reduction Index. The performance of a partition in situ, without flanking paths minimised. It is the most direct measure of its real-world performance. Typically, R'_w values are 5 points lower than the laboratory R_w.
C_{tr}	A sound insulation adjustment, commonly used with the R_w and $D_{nT,w}$ single number rating systems. C_{tr} adjusts for low frequency noise, like noise from traffic. C_{tr} values typically range from about -4 to about -12.
IIC	Impact Insulation Class A single number system for quantifying the transmission loss due to impact noise produced by a standard "Tapper Machine" through a building element.
FIIC	The 'field' or in situ measurement of Impact Insulation Class. Building tolerances and flanking noise have an effect on the performance of a partition when it is actually installed, which result in FIIC values lower than the laboratory derived IIC values, typically 5 dB less.
$L_{n,w}$	Weighted, Normalised Impact Sound Pressure Level 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 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.

APPENDIX B LABORATORY TEST RESULTS

B1 Airborne Sound Insulation

Figure 1: 2mm thick commercial sheet vinyl on single layer of PhoneStar Tri board

Sound reduction index, R, in accordance with ISO 10140-2
Laboratory measurements of airborne sound insulation of building elements

Description and identification of the test specimen and test arrangement: Date of test: 17-Oct-23

Airborne sound insulation of a floor system Client: *Woodland Lifestyle*

Floor System:

Source room:
Upper floor layers: 2 mm thick *commercial sheet vinyl* loose laid on 1 layer of 4 mm *Wolf Bavaria Entkopplungsplatte* (3.8kg/m²) loose laid on 1 layer of 15 mm thick *Wolf Bavaria PhoneStar TRI* panels (18kg/m²) loose laid on 1 layer of 1.4 mm *Wolf Bavaria Decoupling Fleece* loose laid on *Strandfloor* flooring
Flooring: 20 mm *Laminex Strandfloor* particleboard flooring screw fixed at 200 mm centres to floor joists
Floor framing: 240 mm x 45 mm *Red Stag* timber joists fixed at 600 mm centres in joist hangers to perimeter 240 mm x 45 mm joists screw fixes to timber test collar
Mid floor insulation: 1 layer of 115 mm thick *Pink Batts* R2.2 ceiling Fibreglass insulation

Receiving room:
Ceiling system: *GIB Quiet clips* fixed to joists at 1200 mm centres with *GIB Rondo 35 CB 0.55BMT* furring channels set at 600 mm centres providing a 290 mm ceiling cavity
Ceiling linings: 2 layers of 13 mm *GIB Fyreline* plasterboard lap jointed and screw fixed at 200 mm centres (outer lining lap jointed from inner lining

Perimeter and joint Sealant: *GIB Firesound® sealant*
Total thickness: 358.4 mm

Source chamber: Chamber A, Receiving chamber: Chamber B . Test specimen installed by client.

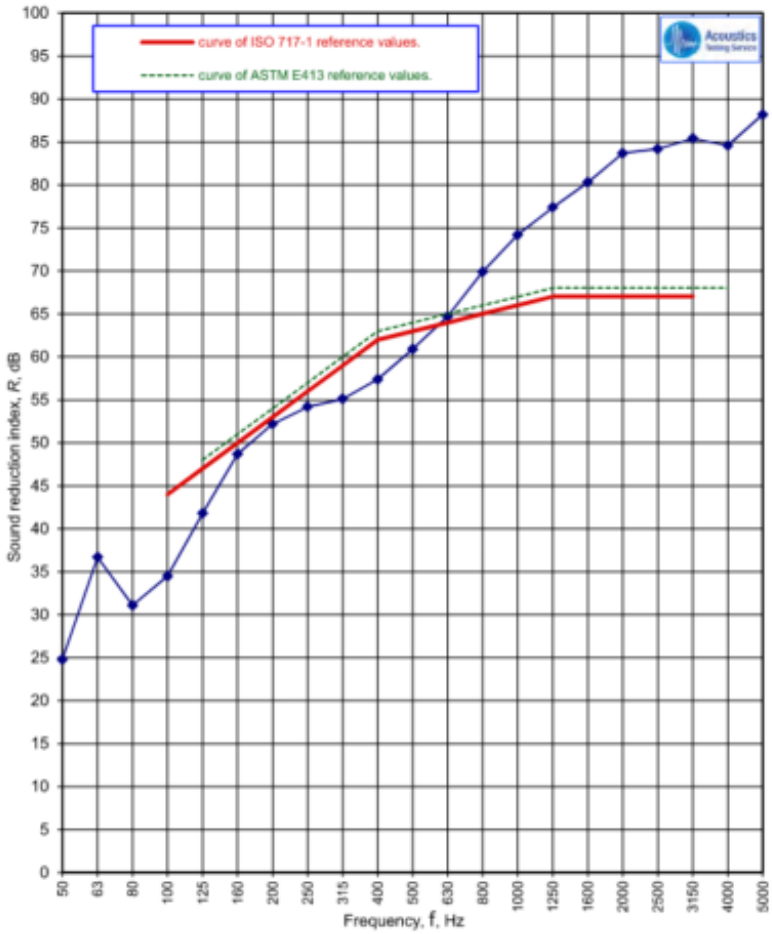
Computer files: T2321_RT.pls T2321_TL_Imp.pls Emmited noise: T2321_TL_Imp.pls: Source Received noise: T2321_TL_Imp.pls: Receiving Reverberation time:

Area *S* of test specimen: 10.24 m²

Air temp in the test rooms: 17.6 °C
Air humidity in test rooms: 72 %
Source room volume: 203 m³
Receiving room volume: 153 m³

Frequency *f* Hz	*R* One-third octave dB
50	24.8
63	36.7
80	31.1
100	**34.5**
125	**41.8**
160	**48.7**
200	**52.2**
250	**54.2**
315	**55.1**
400	**57.4**
500	**60.9**
630	**64.7**
800	**69.9**
1000	**74.2**
1250	**77.4**
1600	**80.3**
2000	**83.7**
2500	**84.2**
3150	**85.4**
4000	**84.6**
5000	88.2

Notes:1. #N/A = Value not available.
2. **Bold** values are used to calculate STC and R_w.
3. Words in ***Blue Italic*** in the description are manufacturers brand names.



Rating according to ISO 717-1 R_w $(C;C_{tr})$ = 63 (-3 ; -10) dB

$C_{50\text{-}3150}$ = -5 dB $C_{tr,\ 50\text{-}3150}$ = -17 dB
$C_{50\text{-}5000}$ = -4 dB $C_{tr,\ 50\text{-}5000}$ = -17 dB
$C_{100\text{-}5000}$ = -2 dB $C_{tr,100\text{-}5000}$ = -10 dB

Rating according to ASTM E413 -87
Sound Transmission Class = 64 dB

No. of test report: **T2321-2a** Name of test institute: University of Auckland Acoustics Testing Service.
Signature: Date: 8/11/2023

Figure 2: 2mm thick commercial sheet vinyl on two layers of PhoneStar Tri board

Sound reduction index, R, in accordance with ISO 10140-2
Laboratory measurements of airborne sound insulation of building elements

Description and identification of the test specimen and test arrangement: Date of test: 17-Oct-23

Airborne sound insulation of a floor system Client: *Woodland Lifestyle*

Floor System:

Source room:
Upper floor layers: 2 mm thick *commercial sheet vinyl* loose laid on 1 layer of 4 mm *Wolf Bavaria Entkopplungsplatte* (3.8kg/m²) loose laid on 2 layers of 15 mm thick *Wolf Bavaria PhoneStar TRI* panels (18kg/m³) loose laid on 1 layer of 1.4 mm *Wolf Bavaria Decoupling Fleece* loose laid on *Strandfloor* flooring
Flooring: 20 mm *Laminex Strandfloor* particleboard flooring screw fixed at 200 mm centres to floor joists
Floor framing: 240 mm x 45 mm *Red Stag* timber joists fixed at 600 mm centres in joist hangers to perimeter 240 mm x 45 mm joists screw fixes to timber test collar
Mid floor insulation: 1 layer of 115 mm thick *Pink Batts* R2.2 ceiling Fibreglass insulation

Receiving room:
Ceiling system: *GIB Quiet clips* fixed to joists at 1200 mm centres with *GIB Rondo 35 CB 0.55BMT* furring channels set at 600 mm centres providing a 290 mm ceiling cavity
Ceiling linings: 2 layers of 13 mm *GIB Fyreline* plasterboard lap jointed and screw fixed at 200 mm centres (outer lining lap jointed from inner lining

Perimeter and joint Sealant: *GIB Firesound® sealant*
Total thickness: 373.4 mm

Source chamber: Chamber A, Receiving chamber: Chamber B . Test specimen installed by client.

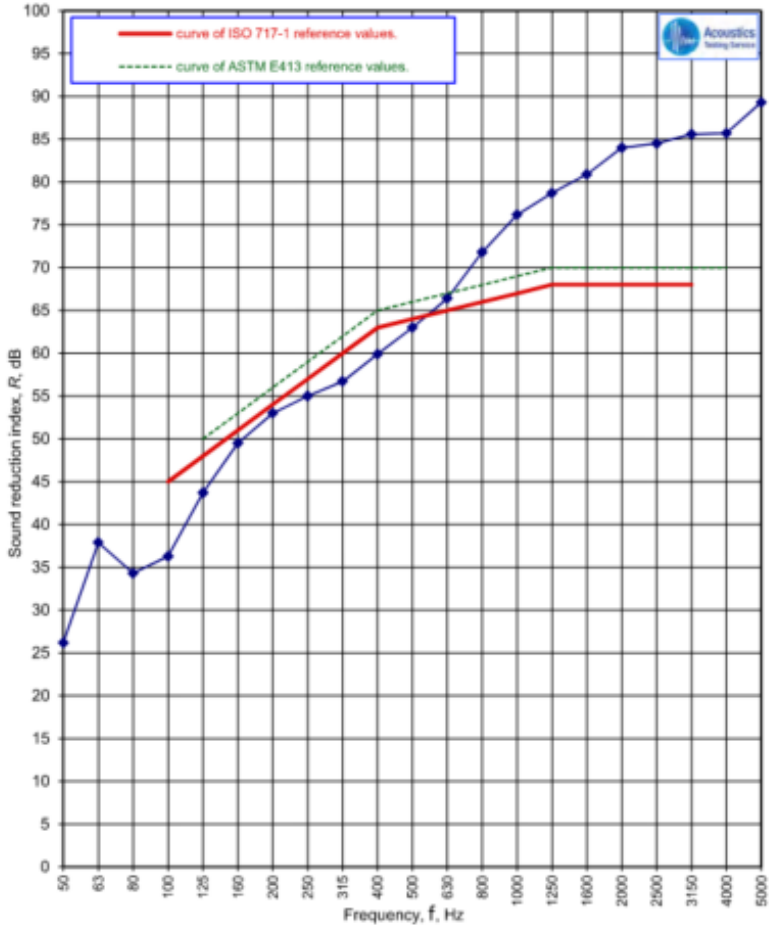
Computer files: T2321_TL_Imp.pls Emmited noise: T2321_TL_Imp.pls: Source Received noise: T2321_TL_Imp.pls: Receiving Reverberation time: T2321_RT.pls

Area *S* of test specimen: 10.24 m²

Air temp in the test rooms: 17.6 °C
Air humidity in test rooms: 72 %
Source room volume: 203 m³
Receiving room volume: 153 m³

Frequency *f* Hz	*R* One-third octave dB
50	26.2
63	37.9
80	34.3
100	**36.3**
125	**43.7**
160	**49.5**
200	**53.0**
250	**55.0**
315	**56.7**
400	**59.9**
500	**63.0**
630	**66.4**
800	**71.8**
1000	**76.2**
1250	**78.7**
1600	**80.9**
2000	**84.0**
2500	**84.5**
3150	**85.6**
4000	**85.7**
5000	89.3

Notes:1. #N/A = Value not available.
2. **Bold** values are used to calculate STC and R_w.
3. Words in ***Blue Italic*** in the description are manufacturers brand names.



Rating according to ISO 717-1 R_w $(C;C_{tr})$ = 64 (-2 ; -9) dB

Rating according to ASTM E413 -87
Sound Transmission Class = 66 dB

$C_{50\text{-}3150}$ = -4 dB $C_{tr,\ 50\text{-}3150}$ = -16 dB
$C_{50\text{-}5000}$ = -3 dB $C_{tr,\ 50\text{-}5000}$ = -16 dB
$C_{100\text{-}5000}$ = -1 dB $C_{tr,100\text{-}5000}$ = -9 dB

No. of test report: **T2321-3a**
Name of test institute: University of Auckland Acoustics Testing Service.
Signature: Date: 23/11/2023

Figure 3: 12mm thick tongue and groove flooring on single layer of PhoneStar Tri board

Sound reduction index, R, in accordance with ISO 10140-2
Laboratory measurements of airborne sound insulation of building elements

Description and identification of the test specimen and test arrangement: Date of test: 19-Oct-23

Airborne sound insulation of a floor system Client: *Woodland Lifestyle*

Floor System:

Source room:
Upper floor layers: 12 mm *thick (Including 2 mm Oak wearing surface) Forte /Loft Claremont* engineered T&G flooring adhered with *Selleys Timberflex* adhesive applied with a 6 mm V notched trowel (13 mm centre notches) to 1 layer of 4 mm *Wolf Bavaria Entkopplungsplatte* (3.8kg/m²) adhered with *Sika Nailbond Premium* applied in lines with 150 mm nominal centres to 1 layer of 15 mm thick *Wolf Bavaria PhoneStar TRI* panels (18kg/m2) loose laid 1 layer of 1.4 mm *Wolf Bavaria Decoupling Fleece* underlay loose laid on strandfloor flooring
Flooring: 20 mm *Laminex Strandfloor* particleboard flooring screw fixed at 200 mm centres to floor joists
Floor framing: 240 mm x 45 mm *Red Stag* timber joists fixed at 600 mm centres in joist hangers to perimeter 240 mm x 45 mm joists screw fixes to timber test collar
Mid floor insulation: 1 layer of 115 mm thick *Pink Batts* R2.2 ceiling Fibreglass insulation

Receiving room:
Ceiling system: *GIB Quiet clips* fixed to joists at 1200 mm centres with *GIB Rondo 35 CB 0.55BMT* furring channels set at 600 mm centres providing a 290 mm ceiling cavity
Ceiling linings: 2 layers of 13 mm *GIB Fyreline* plasterboard lap jointed and screw fixed at 200 mm centres (outer lining lap jointed from inner lining

Perimeter and joint Sealant: *GIB Firesound® sealant*
Total thickness: 368.4 mm

Source chamber: Chamber A, Receiving chamber: Chamber B . Test specimen installed by client.

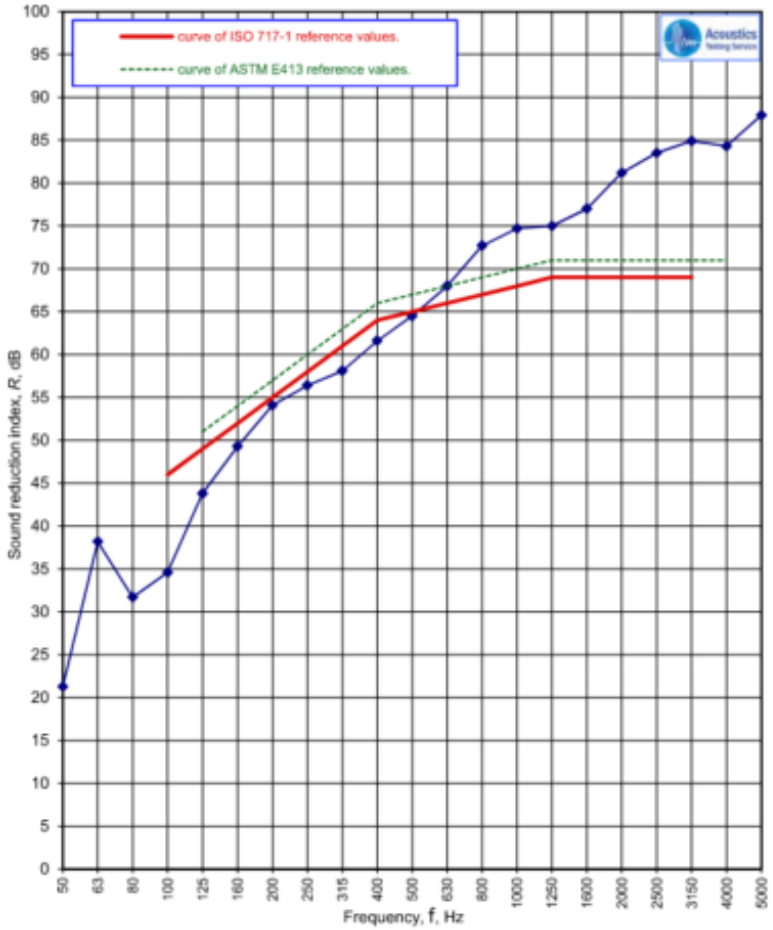
Computer files: T2321_RT.pls T2321_TL_Imp2.pls Emmited noise: T2321_TL_Imp2.pls: Source Received noise: T2321_TL_Imp2.pls: Receiving Reverberation time:

Area *S* of test specimen: 10.24 m²

Air temp in the test rooms: 17.6 °C
Air humidity in test rooms: 72 %
Source room volume: 203 m³
Receiving room volume: 153 m³

Frequency *f* Hz	*R* One-third octave dB
50	21.3
63	38.2
80	31.7
100	**34.6**
125	**43.8**
160	**49.3**
200	**54.1**
250	**56.4**
315	**58.1**
400	**61.6**
500	**64.5**
630	**68.0**
800	**72.7**
1000	**74.7**
1250	**75.0**
1600	**77.0**
2000	**81.2**
2500	**83.5**
3150	**84.9**
4000	**84.3**
5000	87.9

Notes:1. #N/A = Value not available.
2. **Bold** values are used to calculate STC and R_w.
3. Words in ***Blue Italic*** in the description are manufacturers brand names.



Rating according to ISO 717-1 R_w $(C;C_{tr})$ = 65 (-4 ; -11) dB

Rating according to ASTM E413 -87
Sound Transmission Class = 67 dB

$C_{50\text{-}3150}$ = -8 dB $C_{tr,\ 50\text{-}3150}$ = -20 dB
$C_{50\text{-}5000}$ = -7 dB $C_{tr,\ 50\text{-}5000}$ = -20 dB
$C_{100\text{-}5000}$ = -3 dB $C_{tr,100\text{-}5000}$ = -11 dB

No. of test report: **T2321-9a** Name of test institute: University of Auckland Acoustics Testing Service.
Signature: Date: 23/11/2023

Figure 4: 10mm thick ceramic tiles on single layer of PhoneStar Tri board

Sound reduction index, R, in accordance with ISO 10140-2
Laboratory measurements of airborne sound insulation of building elements

Description and identification of the test specimen and test arrangement: Date of test: 24-Oct-23

Airborne sound insulation of a floor system Client: *Woodland Lifestyle*

Floor System:

Source room:
Upper floor layers: 10 mm thick (200 mm x 600 mm) ceramic tiles adhered with *Prohesive Ecoflex* applied with a 10 mm square notched trowel on *Dribond Primebond* primer applied with a roller to 1 layer of 4 mm *Wolf Bavaria Entkopplungsplatte* (3.8kg/m²) adhered with *Sika Nailbond Premium* applied in lines with 150 mm nominal centres to 1 layer of 15 mm thick *Wolf Bavaria PhoneStar TRI* panels (18kg/m2) loose laid 1 layer of 1.4 mm *Wolf Bavaria* underlay loose laid on *Strandfloor* flooring
Flooring: 20 mm *Laminex Strandfloor* particleboard flooring screw fixed at 200 mm centres to floor joists
Floor framing: 240 mm x 45 mm *Red Stag* timber joists fixed at 600 mm centres in joist hangers to perimeter 240 mm x 45 mm joists screw fixes to timber test collar
Mid floor insulation: 1 layer of 115 mm thick *Pink Batts* R2.2 ceiling Fibreglass insulation

Receiving room:
Ceiling system: *GIB Quiet clips* fixed to joists at 1200 mm centres with *GIB Rondo 35 CB 0.55BMT* furring channels set at 600 mm centres providing a 290 mm ceiling cavity
Ceiling linings: 2 layers of 13 mm *GIB Fyreline* plasterboard lap jointed and screw fixed at 200 mm centres (outer lining lap jointed from inner lining

Perimeter and joint Sealant: *GIB Firesound® sealant*
Total thickness: 366 mm

Source chamber: Chamber A, Receiving chamber: Chamber B . Test specimen installed by client.

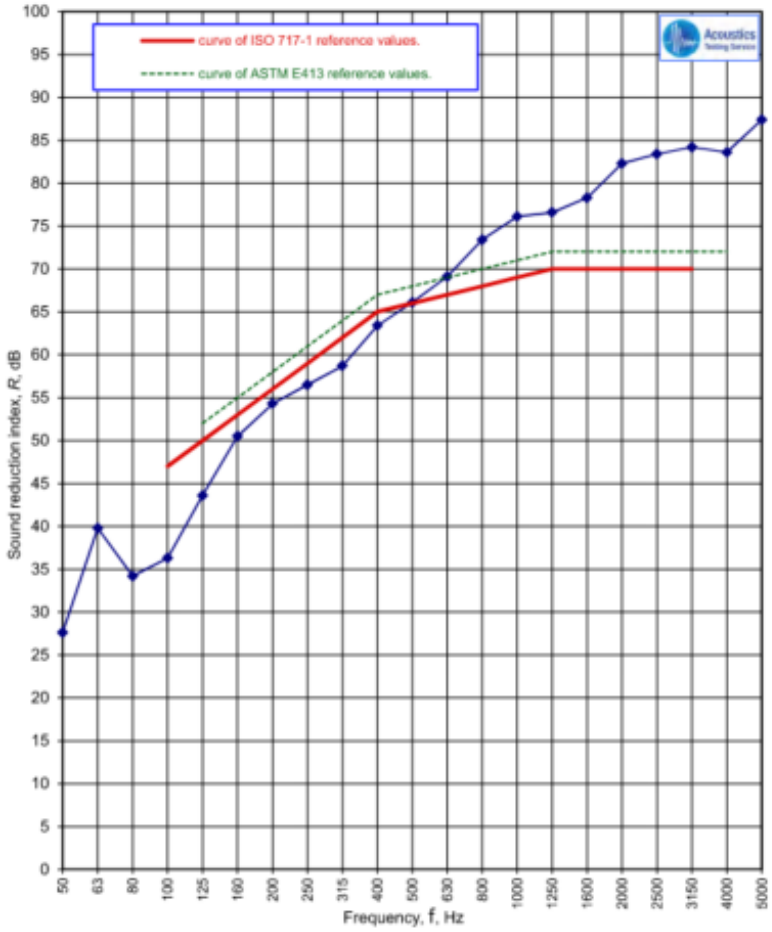
Computer files: T2321_RT.pls T2321_TL_Imp3.pls Emmited noise: T2321_TL_Imp3.pls: Source Received noise: T2321_TL_Imp3.pls: Receiving Reverberation time:

Area *S* of test specimen: 10.24 m²

Air temp in the test rooms: 18.3 °C
Air humidity in test rooms: 72 %
Source room volume: 203 m³
Receiving room volume: 153 m³

Frequency *f* Hz	*R* One-third octave dB
50	27.6
63	39.8
80	34.2
100	**36.3**
125	**43.6**
160	**50.5**
200	**54.3**
250	**56.5**
315	**58.7**
400	**63.4**
500	**66.1**
630	**69.1**
800	**73.4**
1000	**76.1**
1250	**76.6**
1600	**78.3**
2000	**82.3**
2500	**83.4**
3150	**84.2**
4000	**83.6**
5000	87.4

Notes:1. #N/A = Value not available.
2. **Bold** values are used to calculate STC and R_w.
3. Words in ***Blue Italic*** in the description are manufacturers brand names.



Rating according to ISO 717-1 R_w $(C;C_{tr})$ = 66 (-4 ; -11) dB

Rating according to ASTM E413 -87
Sound Transmission Class = 68 dB

$C_{50\text{-}3150}$ = -6 dB $C_{tr,\ 50\text{-}3150}$ = -17 dB
$C_{50\text{-}5000}$ = -5 dB $C_{tr,\ 50\text{-}5000}$ = -17 dB
$C_{100\text{-}5000}$ = -3 dB $C_{tr,100\text{-}5000}$ = -11 dB

No. of test report: **T2321-10a**
Name of test institute: University of Auckland Acoustics Testing Service.
Signature: Date: 8/11/2023

B2 Impact Sound Insulation

Figure 5: 2mm thick commercial sheet vinyl on single layer of PhoneStar Tri board

Normalized Impact sound pressure level L_n, in accordance with ISO 10140-3

Laboratory measurements of impact sound insulation of floors

Date of test: 17-Oct-23
Client: *Woodland Lifestyle*

Description and identification of the test specimen and test arrangement:

Floor System:

Source room:

Upper floor layers: 2 mm thick *commercial sheet vinyl* loose laid on 1 layer of 4 mm *Wolf Bavaria Entkopplungsplatte* (3.8kg/m²) loose laid on 1 layer of 15 mm thick *Wolf Bavaria PhoneStar TRI* panels (18kg/m²) loose laid on 1 layer of 1.4 mm *Wolf Bavaria Decoupling Fleece* loose laid on *Strandfloor* flooring
Flooring: 20 mm *Laminex Strandfloor* particleboard flooring screw fixed at 200 mm centres to floor joists
Floor framing: 240 mm x 45 mm *Red Stag* timber joists fixed at 600 mm centres in joist hangers to perimeter 240 mm x 45 mm joists screw fixes to timber test collar
Mid floor insulation: 1 layer of 115 mm thick *Pink Batts* R2.2 ceiling Fibreglass insulation

Receiving room:

Ceiling system: *GIB Quiet clips* fixed to joists at 1200 mm centres with *GIB Rondo 35 CB 0.55BMT* furring channels set at 600 mm centres providing a 290 mm ceiling cavity
Ceiling linings: 2 layers of 13 mm *GIB Fyreline* plasterboard lap jointed and screw fixed at 200 mm centres (outer lining lap jointed from inner lining

Perimeter and joint Sealant: *GIB Firesound® sealant*
Total thickness: 358.4 mm

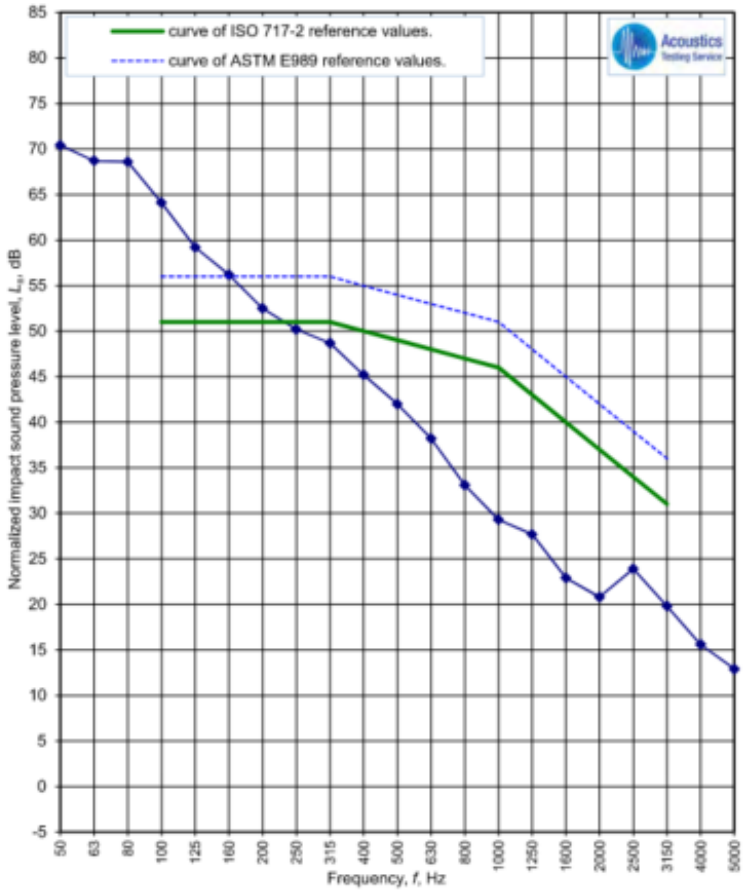
Source chamber: Chamber A. Receiving chamber: Chamber B. Test specimen installed by the client.
Computer Files: T2321_TL_Imp.pls: Source Chamber Receiving Chamber T2321_RT.pls T2321_TL_Imp.pls: T2321-2i_Bgr

Area *S* of specimen floor: 10.24 m²

Air temp. in the test rooms: 17.6 °C
Air humidity in test rooms: 72 %
Receiving room volume: 153 m³

Frequency *f* Hz	L_n One-third octave dB
50	70.4
63	68.7
80	68.6
100	**64.1**
125	**59.2**
160	**56.2**
200	**52.5**
250	**50.2**
315	**48.7**
400	**45.2**
500	**42.0**
630	**38.2**
800	**33.1**
1000	**29.3**
1250	**27.7**
1600	**22.9**
2000	**20.8**
2500	**23.9**
3150	**19.8**
4000	15.6
5000	12.9

Notes:1.#N/A = Value not available.
2. **Bold values are used to calculate IIC and Ln,w.**
3. < indicates that the true value is lower.



Rating according to ISO 717-2:

$L_{n,w}$ (C_I) = 49 (2) dB

$C_{I,50\text{-}2500}$ = 11 dB
$L_{n,w} + C_I$ = 60 dB

Rating according to ASTM E989:

Impact Insulation Class = 56 dB

No. of test report: **T2321-2i**
Name of test institute: University of Auckland Acoustics Testing Service.
Date: Wednesday, 8 November 2023
Signature:

Figure 6: 2mm thick commercial sheet vinyl on two layers of PhoneStar Tri board

Normalized Impact sound pressure level L_{n}, in accordance with ISO 10140-3

Laboratory measurements of impact sound insulation of floors

Date of test: 17-Oct-23
Client: *Woodland Lifestyle*

Description and identification of the test specimen and test arrangement:

Floor System:

Source room:

Upper floor layers: 2 mm thick *commercial sheet vinyl* loose laid on 1 layer of 4 mm *Wolf Bavaria Entkopplungsplatte* (3.8kg/m²) loose laid on 2 layers of 15 mm thick *Wolf Bavaria PhoneStar TRI* panels (18kg/m²) loose laid on 1 layer of 1.4 mm *Wolf Bavaria Decoupling Fleece* loose laid on *Strandfloor* flooring

Flooring: 20 mm *Laminex Strandfloor* particleboard flooring screw fixed at 200 mm centres to floor joists

Floor framing: 240 mm x 45 mm *Red Stag* timber joists fixed at 600 mm centres in joist hangers to perimeter 240 mm x 45 mm joists screw fixes to timber test collar

Mid floor insulation: 1 layer of 115 mm thick *Pink Batts* R2.2 ceiling Fibreglass insulation

Receiving room:

Ceiling system: *GIB Quiet clips* fixed to joists at 1200 mm centres with *GIB Rondo 35 CB 0.55BMT* furring channels set at 600 mm centres providing a 290 mm ceiling cavity

Ceiling linings: 2 layers of 13 mm *GIB Fyreline* plasterboard lap jointed and screw fixed at 200 mm centres (outer lining lap jointed from inner lining

Perimeter and joint Sealant: *GIB Firesound® sealant*

Total thickness: 373.4 mm

Source chamber: Chamber A. Receiving chamber: Chamber B. Test specimen installed by the client.

Computer Files: T2321_TL_Imp.pls: Source Chamber Receiving Chamber T2321_RT.pls T2321_TL_Imp.pls: T2321-3i_Bgr

Area *S* of specimen floor: 10.24 m²

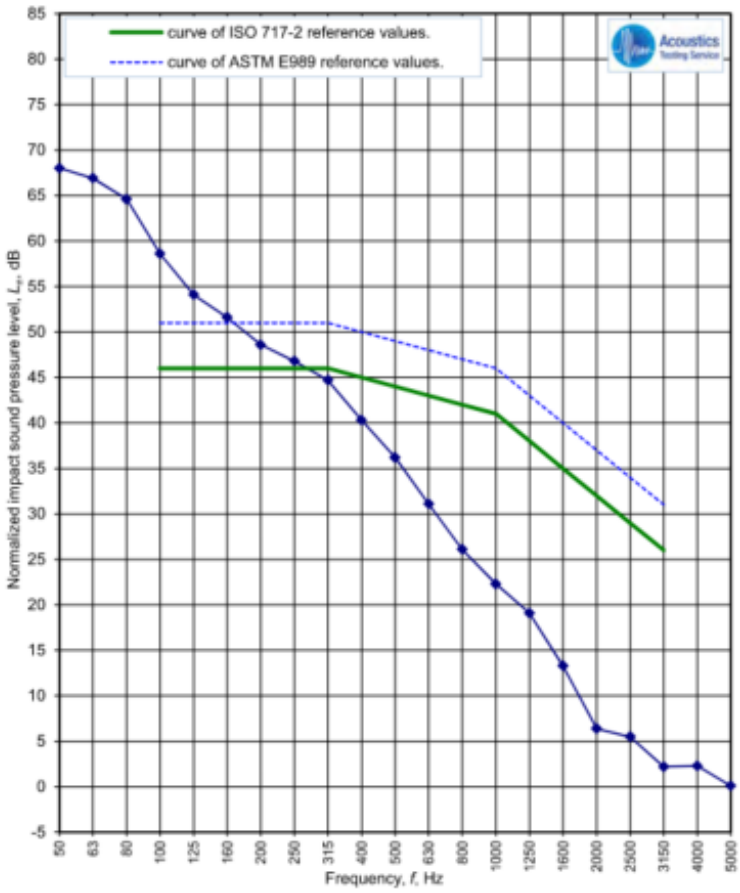
Air temp. in the test rooms: 17.6 °C

Air humidity in the test rooms: 72 %

Receiving room volume: 153 m³

Frequency *f* Hz	L_n One-third octave dB
50	68.0
63	66.9
80	64.6
100	**58.6**
125	**54.1**
160	**51.6**
200	**48.6**
250	**46.8**
315	**44.7**
400	**40.3**
500	**36.2**
630	**31.1**
800	**26.1**
1000	**22.3**
1250	**19.1**
1600	**13.3**
2000	**6.4**
2500	**5.5**
3150	**< 2.2**
4000	< 2.3
5000	< 0.1

Notes:1.#N/A = Value not available.
2. **Bold values are used to calculate IIC and Ln,w.**
3. < indicates that the true value is lower.



Rating according to ISO 717-2:

$L_{n,w}$ (C_I) = 44 (2) dB

$C_{I,50\text{-}2500}$ = 13 dB

$L_{n,w} + C_I$ = 57 dB

Rating according to ASTM E989:

Impact Insulation Class = 61 dB

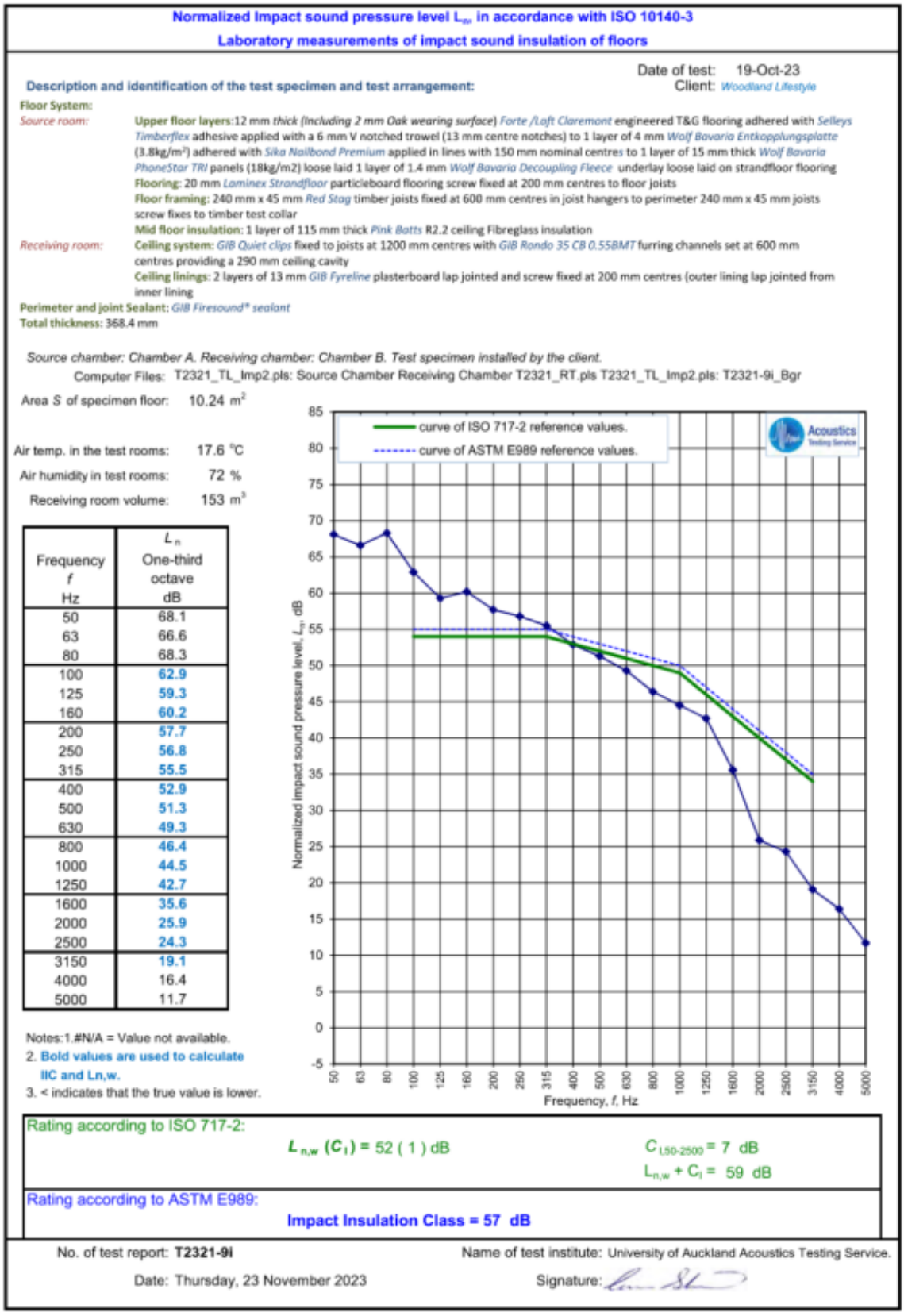
No. of test report: **T2321-3i**

Name of test institute: University of Auckland Acoustics Testing Service.

Date: Wednesday, 8 November 2023

Signature:

Figure 7: 12mm thick tongue and groove flooring on single layer of PhoneStar Tri board



Normalized Impact sound pressure level $L_{n,w}$ in accordance with ISO 10140-3

Laboratory measurements of impact sound insulation of floors

Date of test: 19-Oct-23
Client: *Woodland Lifestyle*

Description and identification of the test specimen and test arrangement:

Floor System:

Source room: **Upper floor layers:** 12 mm *thick (including 2 mm Oak wearing surface) Forte /Loft Claremont* engineered T&G flooring adhered with *Selleys Timberflex* adhesive applied with a 6 mm V notched trowel (13 mm centre notches) to 1 layer of 4 mm *Wolf Bavaria Entkopplungsplatte* (3.8kg/m²) adhered with *Sika Nailbond Premium* applied in lines with 150 mm nominal centres to 1 layer of 15 mm thick *Wolf Bavaria PhoneStar TRI* panels (18kg/m2) loose laid 1 layer of 1.4 mm *Wolf Bavaria Decoupling Fleece* underlay loose laid on strandfloor flooring
Flooring: 20 mm *Laminex Strandfloor* particleboard flooring screw fixed at 200 mm centres to floor joists
Floor framing: 240 mm x 45 mm *Red Stag* timber joists fixed at 600 mm centres in joist hangers to perimeter 240 mm x 45 mm joists screw fixes to timber test collar
Mid floor insulation: 1 layer of 115 mm thick *Pink Batts* R2.2 ceiling Fibreglass insulation

Receiving room: **Ceiling system:** *GIB Quiet clips* fixed to joists at 1200 mm centres with *GIB Rondo 35 CB 0.55BMT* furring channels set at 600 mm centres providing a 290 mm ceiling cavity
Ceiling linings: 2 layers of 13 mm *GIB Fyreline* plasterboard lap jointed and screw fixed at 200 mm centres (outer lining lap jointed from inner lining

Perimeter and joint Sealant: *GIB Firesound® sealant*
Total thickness: 368.4 mm

Source chamber: Chamber A. Receiving chamber: Chamber B. Test specimen installed by the client.
Computer Files: T2321_TL_Imp2.pls: Source Chamber Receiving Chamber T2321_RT.pls T2321_TL_Imp2.pls: T2321-9i_Bgr

Area *S* of specimen floor: 10.24 m²

Air temp. in the test rooms: 17.6 °C

Air humidity in test rooms: 72 %

Receiving room volume: 153 m³

Frequency *f* Hz	L_n One-third octave dB
50	68.1
63	66.6
80	68.3
100	**62.9**
125	**59.3**
160	**60.2**
200	**57.7**
250	**56.8**
315	**55.5**
400	**52.9**
500	**51.3**
630	**49.3**
800	**46.4**
1000	**44.5**
1250	**42.7**
1600	**35.6**
2000	**25.9**
2500	**24.3**
3150	**19.1**
4000	16.4
5000	11.7

Notes:1.#N/A = Value not available.
2. **Bold values are used to calculate IIC and Ln,w.**
3. < indicates that the true value is lower.

Rating according to ISO 717-2:
$L_{n,w}$ (C_I) = 52 (1) dB
$C_{I,50\text{-}2500}$ = 7 dB
$L_{n,w} + C_I$ = 59 dB

Rating according to ASTM E989:
Impact Insulation Class = 57 dB

No. of test report: **T2321-9i**
Name of test institute: University of Auckland Acoustics Testing Service.
Date: Thursday, 23 November 2023
Signature:

Figure 8: 10mm thick ceramic tiles on single layer of PhoneStar Tri board

Normalized Impact sound pressure level L_n, in accordance with ISO 10140-3

Laboratory measurements of impact sound insulation of floors

Date of test: 24-Oct-23

Description and identification of the test specimen and test arrangement: Client: *Woodland Lifestyle*

Floor System:

Source room:

Upper floor layers: 10 mm thick (200 mm x 600 mm) ceramic tiles adhered with *Prohesive Ecoflex* applied with a 10 mm square notched trowel on *Dribond Primebond* primer applied with a roller to 1 layer of 4 mm *Wolf Bavaria Entkopplungsplatte* (3.8kg/m²) adhered with *Sika Nailband Premium* applied in lines with 150 mm nominal centres to 1 layer of 15 mm thick *Wolf Bavaria PhoneStar TRI* panels (18kg/m2) loose laid 1 layer of 1.4 mm *Wolf Bavaria* underlay loose laid on *Strandfloor* flooring

Flooring: 20 mm *Laminex Strandfloor* particleboard flooring screw fixed at 200 mm centres to floor joists

Floor framing: 240 mm x 45 mm *Red Stag* timber joists fixed at 600 mm centres in joist hangers to perimeter 240 mm x 45 mm joists screw fixes to timber test collar

Mid floor insulation: 1 layer of 115 mm thick *Pink Batts* R2.2 ceiling Fibreglass insulation

Receiving room:

Ceiling system: *GIB Quiet clips* fixed to joists at 1200 mm centres with *GIB Rondo 35 CB 0.55BMT* furring channels set at 600 mm centres providing a 290 mm ceiling cavity

Ceiling linings: 2 layers of 13 mm *GIB Fyreline* plasterboard lap jointed and screw fixed at 200 mm centres (outer lining lap jointed from inner lining

Perimeter and joint Sealant: *GIB Firesound® sealant*

Total thickness: 366 mm

Source chamber: Chamber A. Receiving chamber: Chamber B. Test specimen installed by the client.

Computer Files: T2321_TL_Imp3.pls: Source Chamber Receiving Chamber T2321_RT.pls T2321_TL_Imp3.pls: T2321-10i_Bgr

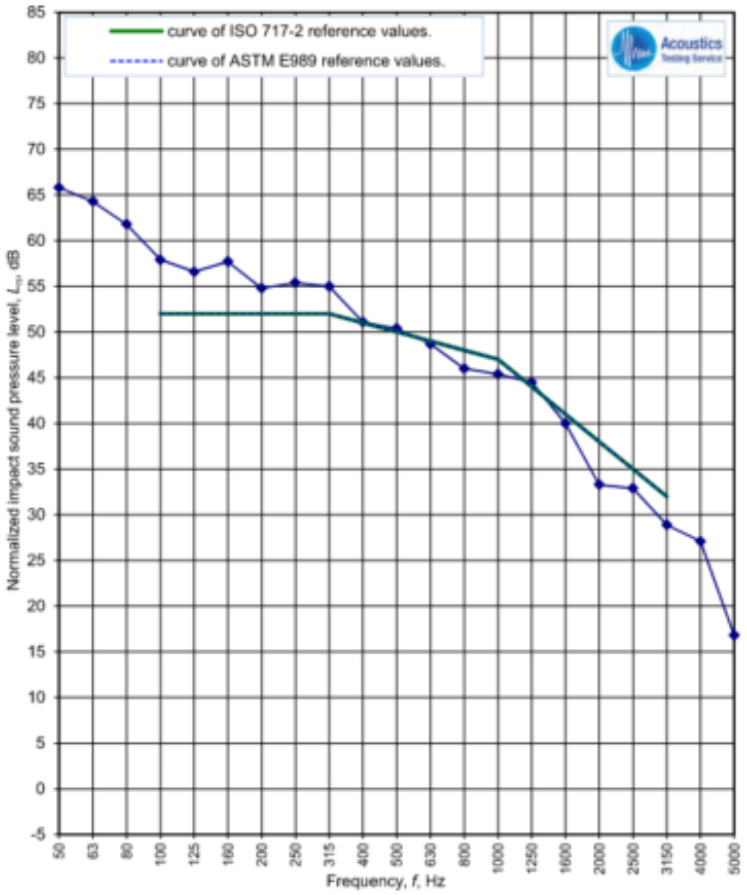
Area *S* of specimen floor: 10.24 m²

Air temp. in the test rooms: 18.3 °C

Air humidity in test rooms: 72 %

Receiving room volume: 153 m³

Frequency *f* Hz	L_n One-third octave dB
50	65.8
63	64.3
80	61.8
100	**57.9**
125	**56.6**
160	**57.7**
200	**54.8**
250	**55.4**
315	**55.0**
400	**51.1**
500	**50.4**
630	**48.7**
800	**46.0**
1000	**45.4**
1250	**44.5**
1600	**40.0**
2000	**33.3**
2500	**32.9**
3150	**28.9**
4000	27.1
5000	16.8



Notes:1.#N/A = Value not available.

2. **Bold values are used to calculate IIC and Ln,w.**

3. < indicates that the true value is lower.

Rating according to ISO 717-2:

$L_{n,w}$ (C_I) = 50 (0) dB

$C_{I,50\text{-}2500}$ = 5 dB

$L_{n,w} + C_I$ = 55 dB

Rating according to ASTM E989:

Impact Insulation Class = 60 dB

No. of test report: **T2321-10i**

Name of test institute: University of Auckland Acoustics Testing Service.

Date: Wednesday, 8 November 2023

Signature: