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A GUIDE

FLOOR IMPACT INSULATION

GOING BEYOND THE NCC "DEEMED TO SATISFY"

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1.0 INTRODUCTION

The Building Code of Australia (BCA) adopted requirements, specifying floor impact noise limits. This was further amended in 2016 with the following requirement:

"An L'nT,w not more than 62 for floors separating dwellings and for floors separating dwellings from a plant room, lift shaft, stairway, public corridor, public lobby or the like, or parts of a different classification."

LnTw is a corrected room noise level resulting from a tapping machine on a slab and as measured in a lower receiving room.

The BCA was changed to the National Construction Code (NCC) in 2018. In 2009, the NCC specifies three options for *"Deemed-to-Satisfy" solutions*.

a) Evidence that the system meets the Performance Requirements or *Deemed-to-Satisfy* provisions – such as a lab test and certificate.

b) Comparison with the *Deemed-to-Satisfy* provisions – test certificate conducted from another building.

c) Expert Judgment – it worked in other buildings so it should work in this one.

Palmer Acoustics do not believe that any single option can be taken directly as a *"Deemed-to-Satisfy"* solution as these "solutions" many times do not meet *L'nT,w* 62 level due to the difference in building and differences between laboratory tests and buildings.

Body Corporate By-Laws

In Queensland, high rise buildings are governed by a Body Corporate under the Community Management Act 1997 and the Body Corporate Commission. The By-Laws are legal documents that can be enforced. By-laws often include the statement:

Noise

The occupier of a lot must not create noise likely to interfere with the peaceful enjoyment of a person lawfully on another lot or the common property.

The result of the NCC criterion limit (LnTw 62) is that in a building that just meets this level, everyday impact events (eg a vacuum cleaner or chair moving across a floor an upper-level area can generate noise levels of around 50 to 60 dB(A) in the apartment below. This level of noise is very intrusive, particularly in very quiet locations or buildings that are built to block out external intrusive noise. We never recommend buildings be constructed to the NCC minimum standard.

1.1 Hard Flooring

Hard flooring cannot meet the same level of reduction as carpet. It is common that once a carpet has been removed lower occupants will be impacted by noise. We become involved with occupants to find solutions to mitigate this noise as much as possible. In doing this we deal with the following terms

$L'_{nT,w}$ – Weighted Standardised impact sound pressure level; a measurement of impact sound transmission between rooms. Lower values denote better performance. The single figure measure is derived by adapting a standard response curve to measured 1/3 octave band sound pressure levels. Measured results are adjusted based upon a reverberation time of 0.5 sec in receiving room. Normally derived from a field test. These terms are in accordance with ISO 717 -2 2020 Part 2 and inline with the NCC.

$L'_{n,w}$ – Same as above but tested in a lab environment (created simulation) not relevant to individual building. A key difference is that a laboratory test is on a 140mm slab, where and many high rise residential building have slabs 180 to 250mm thick.

("L" means level, "n" means normalized "T" means time and "w" means weighted)

Note Regarding FIIC
Field impact Isolation class (FIIC) is the ASTM (American Society for Testing and Materials) standard descriptor used to define floor impact performance ratings. In Australia this term was never adopted by the NCC and has now been superseded by the ISO standard terms. For the purpose of this guide we will only be referring to L'nT,w.

Ln,w
Under the NCC, there is also an option to show compliance from laboratory testing to ISO 140 Part 6 *(Acoustics - Measurements of sound insulation in buildings and of building elements - Part 6 Laboratory measurements of impact sound insulation of floors).*

It is our advice that an approved system can only apply if the ISO 140 Part 6 tested system was installed in a physically and dynamically identical building to the conditions under which the laboratory tests were conducted.

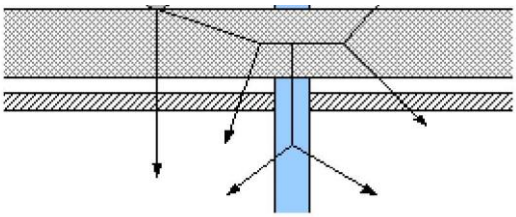


Figure 2: Floor impact transmission paths

When assessing an apartment there are 5 factors to consider:

1. The thickness and type of the concrete slab (prestressed, post stressed, not stressed or ribbed type floor slab)
2. Details of any lower plasterboard ceiling with an air gap.
3. The By-law – Is it reasonable or unreasonable
4. The size of the room (smaller rooms perform worse results)
5. Type of floor surface - hard or soft (carpet)

These all contribute to the overall result, and what makes lab testing certificates often irrelevant.

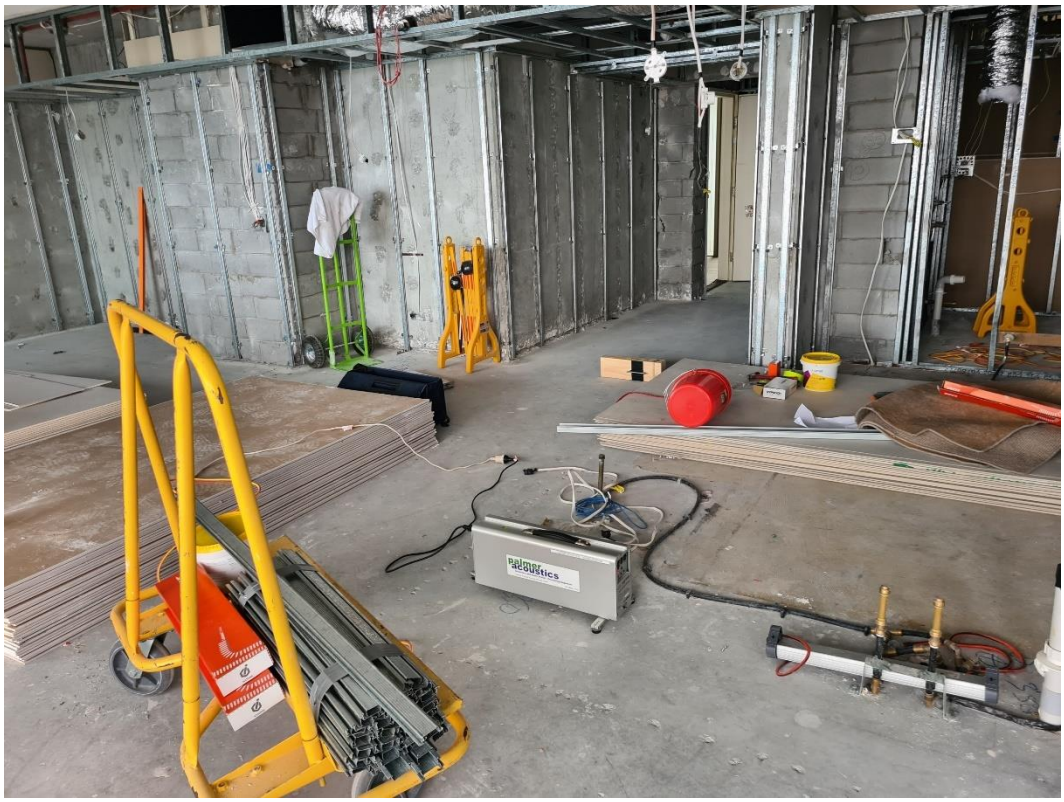
Quotes from National Construction Code

> *The NCC is Australia's primary set of technical design and construction provisions for buildings. As a performance-based code, it sets the minimum required level for the safety, health, amenity, accessibility and sustainability of certain buildings. It primarily applies to the design and construction of new buildings and plumbing and drainage systems in new and existing buildings. In some cases it may also apply to structures associated with buildings and new building work or new plumbing and drainage work in existing buildings.*
>
> *This Part is intended to reduce the likelihood of illness or loss of amenity as result of undue noise transmission between different parts of a building or adjoining buildings. This Part contains minimum requirements for sound insulation for walls, floors and penetrations through walls and floors for services such as pipework.*
>
> *Amenity: An attribute which contributes to health, physical independence, comfort and well-being of people.*

"Deemed to Satisfy" does not equal Amenity. As a collective working within the industry, we all have firsthand experience of this.

The market is a strong force that can push up building standards. Starting with high levels of floor impact insulation are essential in maintaining good amenity. Our experience is that in high-rise building, noise disputes are the biggest issue for occupants and a problem for Body Corporate's.

These matters are ideally resolved through Body Corporate intervention with education and pre sample and post laid floor testing. Palmer Acoustics works alongside flooring contractors and suppliers to find workable and effective solutions.



2.0 FIELD IMPACT TESTING

Floor impact insulation is tested using an ISO standards and a standard tapping machine. The floor surface in question is "tapped" with the resulting noise levels measured in the lower rooms.

The field requirements to carry out floor impact insulation tests are as per the requirements of ***ISO 717 – 2 Acoustics – Rating of sound insulation in building and of building elements – Part 2: Impact sound insulation*** and testing standard ***ISO 16283.2 Acoustics – Field measurements of sound insulation in buildings and of building elements - Part 2 Impact sound insulation*** This test uses a standardised tapping machine (see Figure 1 below) which limits the minimum size of sample that can be tested.

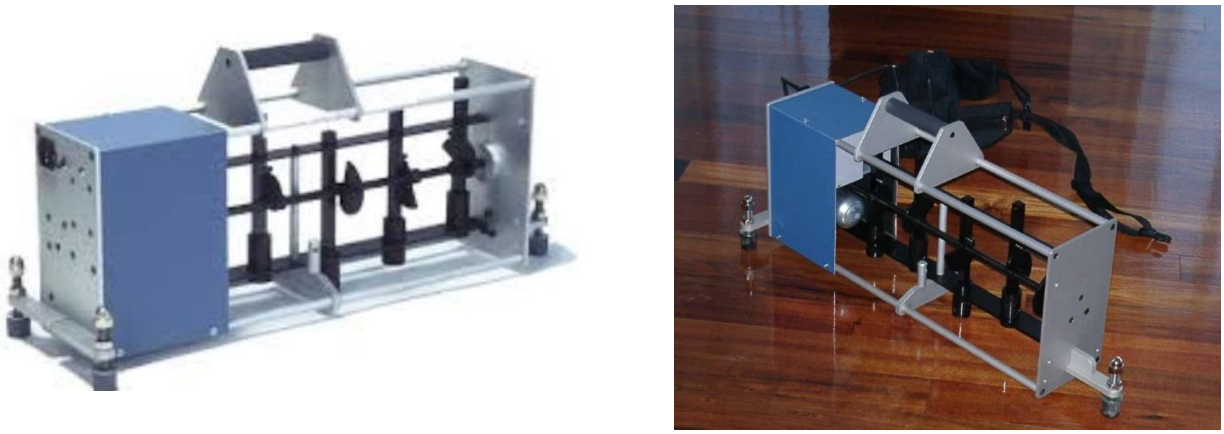


Figure 1. Typical Impact Insulation Testing equipment ***ISO 16283.2***

The test is conducted by applying impact loads from the 5 falling weights from the tapping machine to the surface being tested with the resulting sound pressure levels measured in the lower receiving room. The measured 1/3 octave band noise levels are then applied to standardized calculations to arrive at the single figure insulation rating.

To ensure compliance with the standards the following considerations apply:

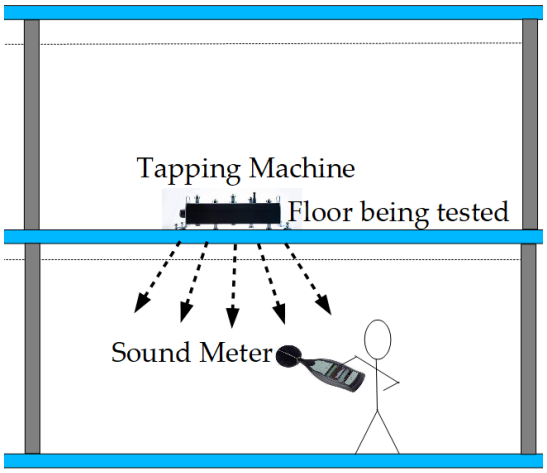


Figure 2: Testing Procedure

2.1 Body Corporate By-Laws

A By-Laws can be worded:

"Once the floor has been installed/completed an impact test is to be conducted by a suitable qualified or AAAC member to ensure that the floor meets the required L'nT,w level".

If the test passes the owner has saved some money, if the test fails the chance to rectify it has passed. The options include lifting the floor and starting again with a different floor, creating significant cost, laying carpet across the floor or restoring the floor to its original condition.

Prevention is cheaper than a cure – Test before installation

1. **To test we need access to downstairs apartments for 1.0 hours, and there should no disturbing noises during that time (e.g., typing/mouse-clicking, TV, A/C, vacuuming etc.),**
2. During this test, the doors and windows of both apartments should be fully closed.
3. The size of any test sample should be at least **1.2m× 1.2m**, separated from any walls or structure by a minimum of **1.2m**
4. **The sample must not be installed on top of a wall for a lower unit.**
5. The samples must be laid in the same way that the **finished Floor** would be laid, with any adhesives given sufficient time to dry (usually minimum 48 hrs)
6. We take "floor" to mean an installed flooring type, e.g. tile, timber, ceramic etc., laid within a single space, e.g. open plan living & dining room.

3.0 IMPACT INSULATION CRITERION

To simplify the process for Body Corporates and to promote reasonable minimum standards, The Association of Australasian Acoustical Consultants (AAAC) created a Star rating system for residential building. This is in the document *AAAC Guideline for Apartment and Townhouse Acoustic Rating 2010* (re www.aaac.org.au). The guideline address floor impact noise to the following levels

3. Intertenancy Activities		2 Star	3 Star	4 Star	5 Star	6 Star
(c) Impact Insulation of Floors						
between tenancies	L'nT,w ≤	65	55	50	45	40
between all other spaces & tenancies	L'nT,w ≤	65	55	50	45	40

These levels of insulation can be considered as follows:

ISO Rating	Star Rating	Approx. ASTM	Perception
L'nT,w 70	No rating	FIIC ≤40	All floor impacts clearly audible (e.g. dropping comb on floor)
L nT,w 65	2 Star	FIIC 40-45	Footsteps on floors clearly audible below
L nT,w 60	2 Star	FIIC 45-50	Footsteps on floors audible below;
L nT,w 55	3 Star	FIIC 50-55	Footsteps on floors audible below
L nT,w 50	4 Star	FIIC 55-60	Footsteps on floors barely audible below
L nT,w 45	5 Star	FIIC 60-65	Footsteps on floors normally inaudible below
L'nT.w 40	6 Star	FIIC ≥65	Footsteps on floors near inaudible below

Note: Field Impact Insulation Class (FIIC) is the ASTM standard descriptor used to define floor impact performance ratings. In Australia, this term has now been superseded by the ISO standard terms currently being adopted across Australia. It is advisable to now think only in terms of the ISO terms L'nT,w, and L'n,w (see above and enclosed glossary of terms).

L'_{nTw} (dB)	Noise generated in adjoining room			
	Normal Walking with normal footwear or house footwear	Elevated running children or walking barefoot	Extreme moving furniture and boisterous children	
	Perception of resulting noise			
63	Audible - intrusive	Very intrusive	Unbearable	Unhappy
58	Audible	Intrusive	Very intrusive	
53	Barely audible	Audible	Intrusive	Neutral
48	Inaudible	Barely audible	Intrusive	Happy
43	Inaudible	Inaudible	audible	

Bruel & Kjaer

Another reference (B&K) suggests impacts as above.

The achievement of impact insulation of less than L'nT,w, 60, is not an easy and requires consideration of all the building elements (concrete types, density and thickness, reinforcing, stressing of the concrete, location of structure, ceiling underneath and even the room volume of the lower area)

The star system has had a side effect that sometimes Body Corporates hold unachievable ratings, to the point where hard floor impact ratings simply cannot be met. In effect they create a by-Law which eliminates the use of all hard floors. Carpet becomes the only alternative.

With no understanding of the building and the thickness of the slab – bridging the gap between a bare slab of 160mm (LnTw 80) and a L'nT,w, of 45 can be very difficult. Differences in impact insulation rating between a bare slab and a slab with an impact insulation product (called ΔL) are typically between 10 and 20. A difference of 35 is normally not achievable.

This results in unreasonable expectations that cannot be met.

4.0 FLOOR IMPACT INSULATION REALITIES AND OPTIONS

It is currently not possible by using empirical means to predict floor impact insulation levels 100% accurately. There are suppliers of floor impact insulation systems who quote that their product will provide a specific insulation level. This data must be seen with skepticism, as the reality is that levels of impact insulation are both unpredictable and inconsistent.

The data used is often from the result of tests on floor-ceiling systems, of which the highlighted product is only one component. A high-performance system is frequently used for tests, such as a 250mm thick slab with a lower suspended ceiling (LnTw approx. 55).

The following factors all come into the final levels of overall performance:

- Slab thickness. It has the effect of reducing noise by approximately 9 dB per doubling of mass.
- Whether the slab is pre or post-tensioned. This can significantly affect the ability of a slab to re-radiate impact noise to lower areas.
- The density and composition of the concrete floor.
- The location of beams, columns and shear walls.
- The locations and types of interior wall and structural supports.
- The use of curtain wall systems. These can create flanking paths that can significantly reduce acoustic insulation's overall level (both airborne and structure-borne).
- Any floor leveling topping systems applied. These can be aerated concrete, which in some cases are in themselves a reasonably effective impact insulation treatment.
- The absence of gaps between tiles and adjacent building structures. Where tiles directly above adjacent structures impact noise can easily by-pass the impact insulation layer with a significant reduction in overall performance. It is recommended that a minimum 5mm gap occurs between the tiles and adjacent walls or structures. This gap is filled with a resilient sealant.

Generally, impact insulation systems are applied to concrete floor slabs. Where structural timber floors are used, the issues become more complex, with there being more difficulty in achieving medium to high impact insulation. This is due to the higher deflections of the base floor slab and hence the ease through which floor vibrations can be excited and sound transmitted.

It is generally accepted that the noise level in the apartment relates directly to the noise transmission to the apartment below, meaning "the Nosier in the apartment, the quieter in the apartment below.

This has merit due to the reflective surfaces some products have. This can be noted on timber floating floors where the floor sounds "tinny" or "rattily" when impacted. Such floors generally transmit lower levels of noise and have high levels of impact insulation.

4.1 More (thicker) underlay does not always give better impact insulation.

From our experience with floor impact insulation, we find that prediction is not easy. When a test result does not pass, the first instinct would be to add more underlay. This in turn sounds like a logical step. Unfortunately, this is not a simple answer. Many products have what is called a bell curve. The product weight and its ridged properties all play part in how it interacts with the impact.

A loose laid/ floating will almost always outperform glued systems due to its rigidness (by about 4 dB)

Hybrid 6-8mm will lift, reducing the contact with the slab, reducing the transmission. Adding a 3-4.5mm rubber may only improve the result by one as the product will no longer lift, leaving it with more contact with the rubber and slab. More energy is transferred.

14mm engineered timber often requires a little more help. A 2-3mm moisture guard may be enough as a floating system. Glued may require a combination of high density and mid density rubber/cork combination to address the sound character of the product in the hope of reducing it.

There are many options/systems that can be selected to provide floor impact insulation treatments depending upon the performance levels required.

4.2 Bare Concrete Slab

Extensive field testing has shown that a 200mm concrete slab will provide insulation of close to L'n,Tw 68 to 74, representing a high level of sound transmission and low acoustic amenity level. The characteristics of the floor and locations of structural supports and walls will define the final level of performance.

4.3 Suspended Ceiling Under Slab

It is our experience that a suspended 64mm channel with a 13mm plasterboard ceiling under a slab will add close to 5 dB extra performance to floor/ceiling impact performance. Fiberglass in the void (close to 18 kg/m^3), could add a further 3 dB . With a resiliently supported ceiling (3mm static deflection) from 2 layers of 13mm plasterboard with a 100mm air gap and 75mm fiberglass in the void, the overall improvements is around 10 dB.

4.4 Floor Impact Insulation Products

For concrete slab floors an impact insulation layer under a hard floor is a cost effective way to reduce floor impact noise.

A wide range of proprietary floor impact insulation systems are available (see Appendix B for some details).

These are generally a proprietary product located under tiles, stone, or timber floor systems. On tiled floors, such products should provide at-least a 15 unit improvement in insulation with insulation of up to 25 units possible. The impact systems can be a rolled out resilient element (1mm to 15mm thick), a screeded wet system (typically 5 to 10mm), or a solid board system laid out across the floor (approx. 10mm thick).

4.5 Impact insulation layer plus ceiling tiles

The combination of a proprietary impact insulation system under tiles and a resiliently supported insulated ceiling can give overall insulation levels in the range L'nT,w 45 to 55. The heavier the ceiling and the greater the ceiling insulation hanger's static deflection, the greater the acoustic insulation.

4.6 Full-floating floor systems

The highest levels of impact insulation are achieved by creating a fully floating concrete slab on top of the building concrete slab floor. Such a floating slab would be 100mm concrete supported on spring insulation mounts (typically 25mm deflection) or neoprene pads provide close to 6mm static deflection. These floors can provide a level of impact insulation down to L'nT,w 35.

4.7 Carpet (a soft floor surface)

Carpet provides the highest levels of impact insulation, but is often not a preferred product in high rise buildings.

Installing hard flooring is complex and logistically challenging. To assist in this process a group of flooring specialists and product suppliers are listed together for ease of use and reference.

Generally, any impact insulation assessment will consider all of the issues 4.1 to 4.7 raised above with the most suitable systems and treatments selected for the application.

5.0 FLOOR IMPACT INSLATION SUPPLIERS AND CONTRACTORS

For information a list of contractors specializing in the application and installation of floor impact insulation systems, details of available products are as listed below.

Contractor	Phone	Website/Email	Address
A1 Rubber	(07) 3807 3666	https://a1rubber.com/	32-34 Binary St, Yatala, QLD 4207
Airstep Australia		www.airstep.com.au	20 South Gippsland Highway Dandenong South, Melbourne Victoria 3175, Australia
ABA Building Products (wet screed system)	1300 788 780	https://www.abaaustralia.com.au/	2 Buda Way, Kemps Creek NSW 2178
Acoustica Australia	1300 722 825	https://www.acoustica.com.au/	25 Plasser Crescent, North St Marys NSW 2760, Australia
Acoustical Surfaces	1-800-854-2948	https://www.acousticalsurfaces.com/	123 Columbia Court North • Suite 201 • Chaska, MN 55318
Batten and Cradle	0800 849 138	https://www.battenandcradle.co.nz/	26 Queen Street New Plymouth 4310
Cork Imports Australia	+61 (07) 3399 1493	www.corkimports.com.au	Unit 1, 225 Queensport Road Nth Murarrie QLD 4172
Construction Chemicals (wet screed system) Dribond	(07) 3271 2944	https://constructionchemicals.com.au/	45 Coulson Street, Wacol Queensland 4076
Damtec Australasia, direct stick system Costa Varsos	0411 116 114 1800 326 832	https://www.damtec.com.au/ enquiries@damtec.com.au	30 Chaffey Street, Thomastown, VIC, 3074
Dunlop Flooring	180 622 293	https://www.dunlopflooring.com.au/	380 Dohertys Road, Truganina Victoria 3029, Australia
Embelton (rolled out ImpactaMat) Glen Fuller	0411 751 900	https://www.embelton.com/	2/10 Blue Rock Drive Luscombe QLD 4207
Pliteq	(03) 9018 7696	https://pliteq.com/	72 York St, South Melbourne VIC 3205
Getzner Hayagreev Raman	+61 451 217 080	hayagreev.raman@getzner.com	
Quick-Step Floor Designers	(07) 3273 3111	https://www.quick-step.com.au/en-au	4/14 harper street 4214 ashmore
Regupol Australia (roll out sheet systems) Nick Anasson	(02) 4624 0050	https://www.regupol.com.au	155 Smeaton Grange Road Smeaton Grange NSW 2567
Sika Australia (timber flooring system)	(07) 3633 9222	https://aus.sika.com/en/home.html	30 Parker Court, Pinkenba, QLD 4008
Soundproffing solutions Australia	1300 064 701	info@soundproofingproducts.com.au	51 Yarraman Place Virginia, Brisbane

Contractors who specialize in the supply and installation of impact insulation flooring systems are:

Suppliers	Phone	Website/Email	Address
689 PTY Ltd	459387621	https://689.com.au/contact-us/	Southport, Gold Coast, QLD, 4215
All Flooring Solutions	07 3865 8643	https://www.allflooringsolutions.com.au/	2/420 Newman Rd Geebung Qld 4034
Andersons flooring	1800 016 016	https://andersens.com.au/	29 Western Drive, Gatton QLD 4343
Beare Flooring	1300 023 273	https://bearefloring.com.au/	2/604 Pine Ridge Road, Coombabah QLD 4216
Brisbane's Finest Floors	4711220488	https://www.brisbanesfinestfloors.com.au/	486 Waterworks Rd, Ashgrove QLD 4060
Carpet Court	(07) 3809 4433	https://www.carpetcourt.com.au/stores/brisbane/browns-plains	133 Browns Plains Rd, Browns Plains Queensland 4118
Choices Timber Flooring	07 3257 3377	https://www.choicesflooring.com.au/	167 Robertson St Fortitude Valley, QLD 4006
Contemporary Flooring	0406 649 877/ 0400 228 930	https://www.cflooring.com.au/contact	18 Tombo Street, Capalaba Queensland 4157
Decoline	0433 777 360	https://www.decoline.com.au/	3/55 Musgrave Rd, Coopers Plains QLD 4108
dunlopunderlay	1800 622 293	https://www.dunlopunderlay.com.au/commercial-underlay	380 Dohertys Road, Truganina Victoria 3029, Australia
E-Flooring	3855 8107	https://www.e-flooring.au/	40 Pickering St, Enoggera QLD 4051

Embelton	3359 7100	https://www.embelton.com/	5 Hurricane St, Banyo QLD 4014
First Response	0410 625 526	https://www.firstresponsems.com.au	2/16 Crockford Street,Northgate QLD 4013
Floor Trader	0412 862 060	https://www.floortrader.com.au/	20 Dulwich St, Loganholme QLD 4129
Flooring Focus	0431 011 583	https://flooringfocus.com.au/	Unit 1/38 Kendor St, Arundel QLD 4214
Flooring Xtra	0438 647 425	tatters@flooringxtra.com.au	6/8 Leopold Street, Newstead Queensland 4006
Gold Coast Hardwood Floors	0430 209 761	https://www.goldcoasthardwoodfloors.com.au/	89 Hansford Road Coombabah, QLD,4216
HEPH Pty Ltd		www.heph.com.au	66 Voyager Dr, Kuraby QLD 4112
LKV Flooring	(07) 3890 5173	https://lkvflooring.com/	1631 Wynnum Road, Brisbane Queensland 4173
Main Beach Design	0418 726 292	https://destinationmainbeach.com.au/retail/main-beach-design/	13 Tedder Avenue, Main Beach
MJS Floor Coverings	3347 7300	http://www.mjsfloorcoverings.com.au/	35 Dividend St, Mansfield QLD 4122
Mobile Floor	732007888	https://www.mobilefloors.au/gold-coast/	2/3363 Pacific Highway, Slacks Creek Queensland 4127
Mobile Flooring Services	0434 677 262	bryce@mobileflooringservices.com.au	30a golden wattle avenue, mount cotton Queensland 4165
Nerang Tiles	07 5536 1916	www.nerangtiles.com.au	83 Lawrence Drive, Nerang QLD 4211
NFD - National Flooring Distributors	(07) 3806 2666	https://nationalflooringdistributors.com.au/	58 Blanck Street Ormeau QLD 4208.
Platinum Timber and Ply	07 3803 7488	https://platinumtimber.com.au/	5 Aliciajay Cct, Luscombe QLD 4207
Quality Floors by Max Francis	411883249	https://www.qualityfloors.com.au	20 Ryhill Rd, Sunnybank Hills QLD 4109
Reality Flooring	402753	https://realityflooring.com/	Pallara, Brisbane, Australia 4110
Simply Flooring	3161 4867	https://simplyflooring.com.au/	94 Boniface St, Archerfield QLD 4108
SkyLine Renovations	0421 131 186	Allan@skylinerenos.au	
The Flooring Pros Brisbane	0432 596 893	·theflooringpros.com.au	21 Middle Road, Hillcrest Queensland 4118
Tile it	0438 237 449	tile-it.com.au	9/1378 Lytton Rd, Hemmant QLD 4174
Tiles International	1300733000	customerservice@nationaltiles.com.au	3503 Pacific Hwy, Slacks Creek Queensland 4127 ·
Trojan Timber	3861 4422	trojantimbers.com.au	4/67 Araluen St, Kedron QLD 4031
vibrantflooring	(07) 5529 3399	https://vibrantflooring.com.au/	3/6 Ereton Drive Arundel QLD 4214

Generally the higher the impact insulation of a product the higher the cost.

6.0 DISCUSSION

From our work over at least 33 years in high-rise buildings, we are increasingly aware of the reality that noise is a function of living in high-rise building. To expect to live in a high rise building and not experience noise is not realistic. However, the issue is the level of noise. There are ways by which noise can be significantly reduced, but these have limitations concerning:

- Cost - many developers/builders do not wish to pay the cost to upgrade floor and ceiling systems to achieve a reasonable impact insulation level. Often they will had the building over meeting the NCC minimum standards.

- Height - impact insulation systems can raise floor heights from 1mm to 150 mm depending upon the performance required. Many typical systems will be close to 10mm thick. This can create issues with floor levels and the relative heights where tiled floors meet carpeted floors.

- Weight. For buildings that are structurally limited.

On many projects we have worked on, it is argued that floor impact insulation systems need not be applied since the only hard areas are entries, bathrooms, and kitchens, which have close to a 400mm deep lower bulkhead ceiling. Whist this argument partially applies to bathrooms; the problem arises for kitchen and entry areas where impact noises in these areas easily travel across the slab into the ceiling of adjacent living or bedroom areas. For this reason, impact insulation treatments must be considered for entry, kitchen, and bathroom areas.

In Queensland, to maximize building and floor to ceiling heights, many projects do not have ceilings in living areas. The lack of a ceiling is a significant factor in reducing the level of acoustic insulation. Where medium to high levels of impact insulation are required, solid plasterboard ceilings should be installed to in occupied areas.

An important factor in floor impact noise is the ambient noise in the receiving room. In many apartments background levels can drop down to levels close to 30-34 dB(A) at night, however there are apartments where the levels can be closer to 20-25 dB(A). When the background levels are particularly low the levels of audibility and intrusiveness from impact noise is much greater.

7.0 CONCLUSION

The management of floor impact insulation is a complex issue requiring extensive consideration, particularly at the design stage. Without such consideration, impact noise can be a serious issue affecting occupants' amenity and the building's perceived quality. We recommend that any residential development be constructed with a minimum L'nT,w insulation of 55 (ie 3 Star re www.aaac.org.au) to provide a reasonable acoustic amenity level. Such a floor would likely include a minimum 190mm slab, an impact insulation layer under a tiled area, and a suspended ceiling for lower areas. For quality developments, a higher level of acoustic insulation is appropriate.

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APPENDIX A **FLOOR IMPACT INSULATION PRODUCTS**

Regupol Sonus curve 6, 8, 17 & 25

Designed to reduce the transmission of impact sound generated by footfall noise, REGUPOL Sonus curve is commonly used under bonded and unbonded screed beds as a complete system with stone, marble, tiles or selected floor coverings.

Regupol Sonus multi 3 & 4.5

Suitable for a wide range of floor coverings, REGUPOL Sonus multi 4.5 is a lightweight and high-performance impact sound insulation underlayment. The unique material composition makes it versatile sustainable products within a range of acoustic underlays.

MJS - MG320

Moisture Guard MG320 is a Double-Sided Laminate PE Film 3mm thick underlay designed exclusively for use under all Laminate & Timber Floating Floors. It is a closed cell polyolefin foam structure with a 200UM polyethylene plastic sheet as per the ATFA's Engineered Flooring Industry Standard 2018.

Dunlop Aquacoustic

Dunlop Aquacoustic is a specialist hard flooring underlay that provides unsurpassed acoustic performance. Incorporating a 200-micron moisture-resistant barrier and cross-linked polyethylene foam, Aquacoustic offers superior moisture protection.

Dunlop Advantage 3

Advantage 3 Underlay enhances flooring with superior cushioning and provides a soft feel underfoot. This acoustic underlay, crafted from recycled rubber and natural cork, is an eco-friendly option that helps reduce your environmental footprint.

Cork Imports 6mm low density

6mm cork, often used for flooring or underlay, is a natural, eco-friendly material known for its sound insulation, thermal comfort, and resilience, making it suitable for various applications. The cellular structure of cork effectively absorbs and reduces noise transmission, making it ideal for soundproofing walls, floors, and ceilings.

Embelton

Embelton is a company specializing in noise and vibration isolation solutions, offering products and services for both commercial and residential sectors, including floating floor isolation, acoustic underlays, and equipment vibration control. Floating Floor Isolation:

Embelton provides solutions for isolating floors from structural vibrations, reducing airborne and impact noise transmission.

Acoustic Underlays, Embelton ImpactaMat underlay, made from recycled rubber, is designed to reduce both structure-borne and airborne noise.

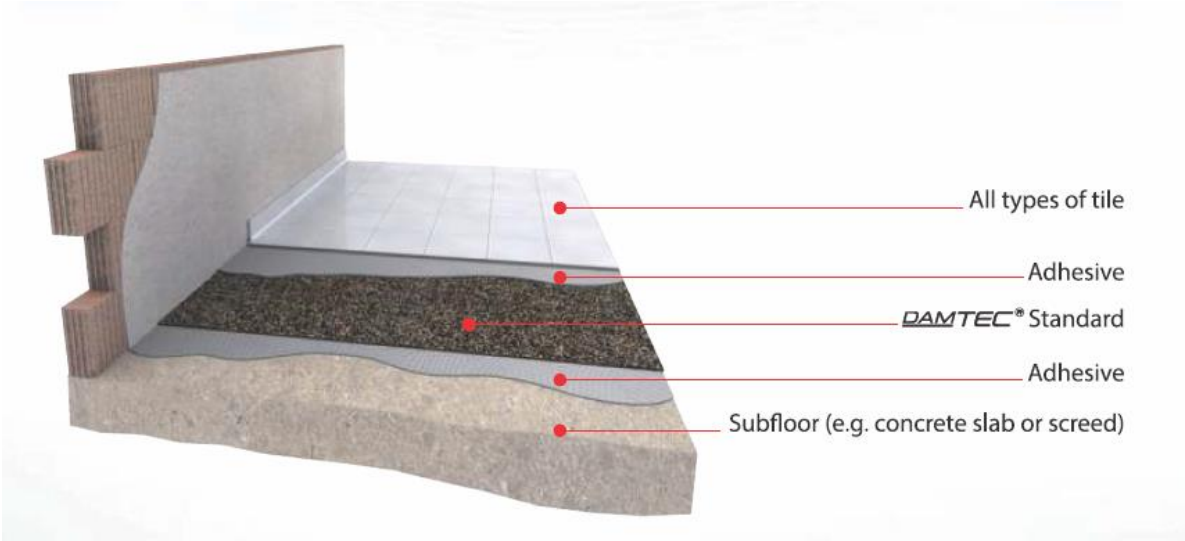
Equipment Vibration Control: Embelton offers various products for isolating vibration at the source, including spring mounts, pad mounts, and rubber mounts, for machinery, plantrooms, and auxiliary equipment)

Wall and Ceiling Isolation, Embelton provide solutions for reducing noise transmission through walls and ceilings, addressing both airborne and impact noise.

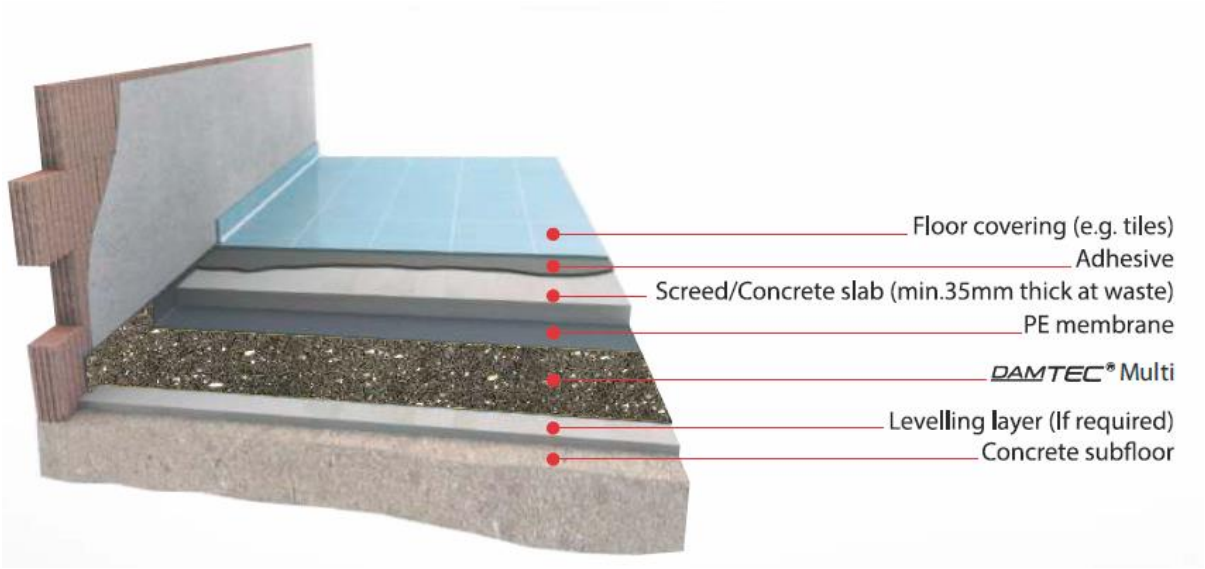
DAMTEC

Damtec is a manufacturer of acoustic underlay products, specifically designed for impact sound reduction in various flooring applications, specializes in creating acoustic underlays to minimize impact sound, such as footfall noise, in homes and commercial spaces, engineered and manufactured in a U.S. Green Building Council certified plant in Germany.

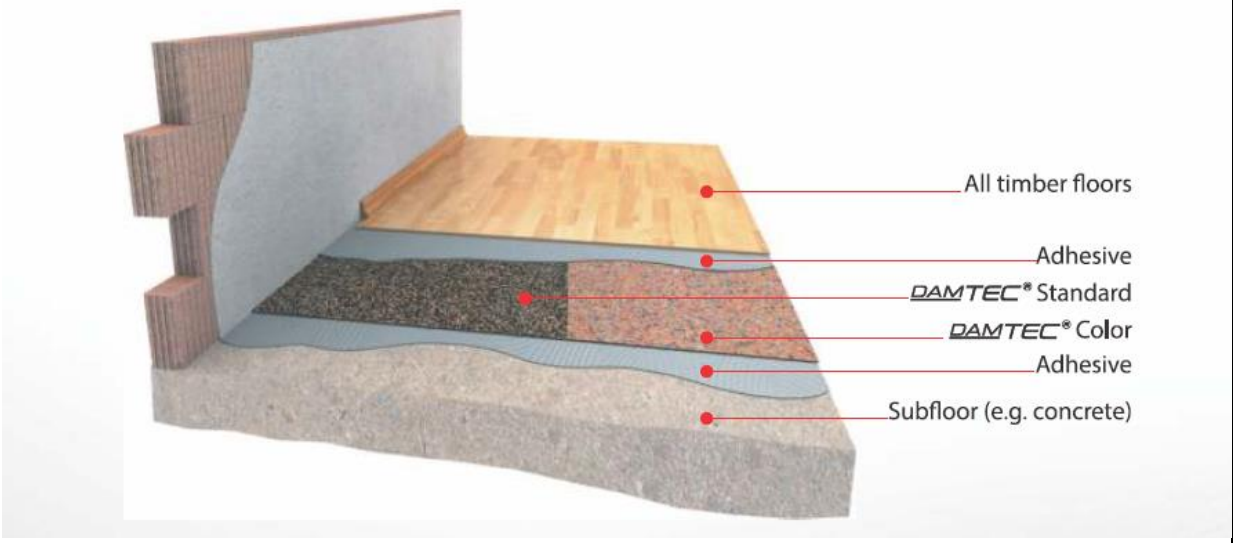
1. **Installing Damtec Standard (Premium cork and rubber composite underlay) providing a high level of impact sound reduction as well as a significant increase in adhesion/bond strength for Direct Stick tiling applications in both dry and wet areas:**

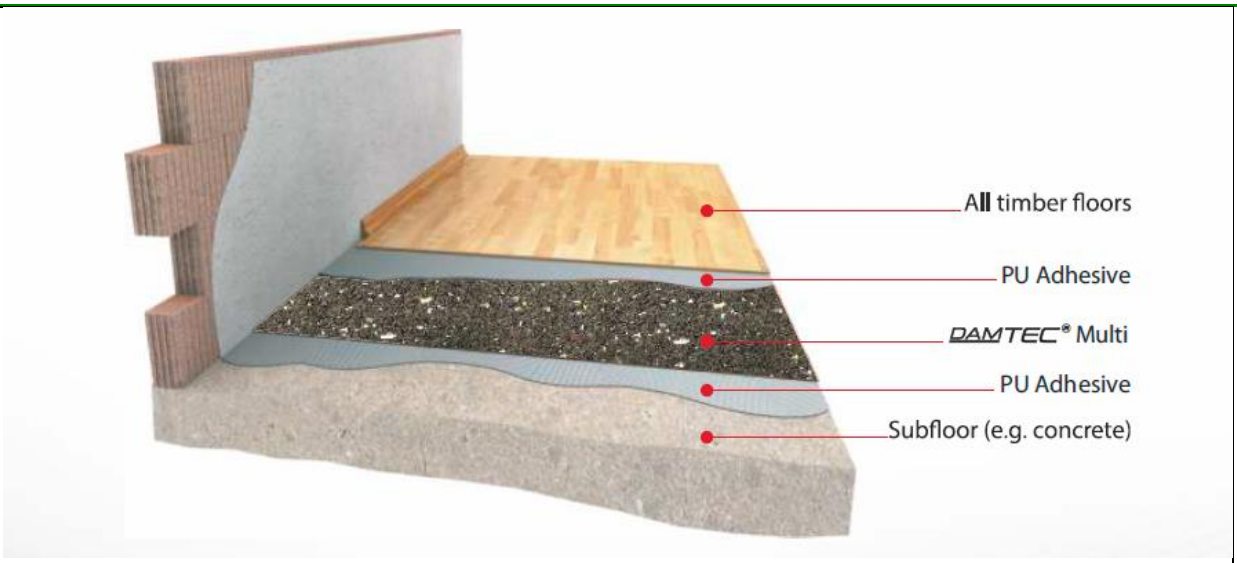


2. **Installing DAMTEC Multi for under screed applications (>than 35mm at waste) in both wet and dry area flooring application:**

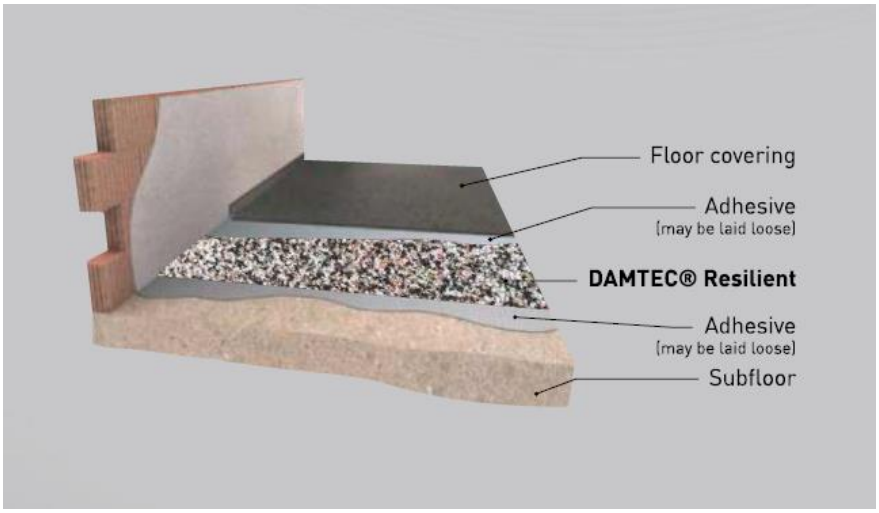


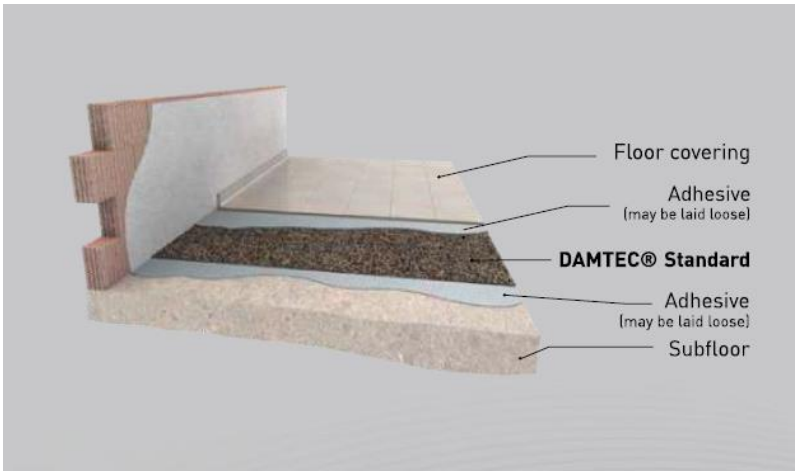
3. **Installing Damtec Standard (Premium cork and rubber composite) acoustic underlay, DAMTEC Rubber and DAMTEC Multi acoustic underlay options providing a high level of impact sound reduction for Direct - Stick Timber flooring applications:**

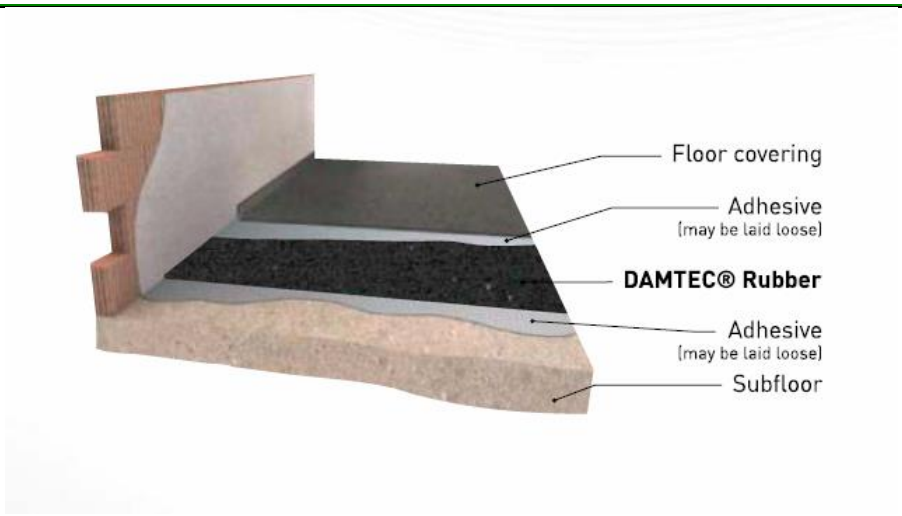




4. **<u>Installing Damtec Resilient (High - grade PU foam and cork composite) acoustic underlay under Sheet Vinyl flooring applications and DAMTEC Standard (Premium cork and rubber composite) acoustic underlay or DAMTEC Rubber acoustic underlay options providing a high level of impact sound reduction for LVT flooring applications:</u>**







** It is important to note that with Sheet vinyl applications it is recommended to always use a 100% inert acoustic underlay like the specifically engineered – DAMTEC Resilient acoustic underlay which contains no recycled tyre rubber in order to eliminate the risk of migration/plasticization ocurring on the surface of the sheet vinyl.

Please note that all Damtec acoustic products are German engineered and manufactured using the highest quality raw material and PU binders which has been tested in accordance with the relevant standards compliant with Part F5 of the BCA for Impact Noise.

In addition, DAMTEC products have also been tested with all the major adhesives manufacturers like MAPEI, Ardex, Kerakoll, Uzin, Keisal, Bostik, RLA Polymers, Davco etc..who can all provide warranties with their respective products with a variety of DAMTEC acoustic underlay products covering all the floor covering options highlighted above.

We place a significant focus on talking to consultants, builders and flooring contractors about the importance of incorporating suitable adhesives and waterproofing membranes when designing or installing a floor system as these components play a pivotal and complimentary role in ensuring;

a) the performance of the entire floor system from an “impact sound” performance perspective is not compromised and;

b) the floor system proposed is structurally sound and all products making up the floor system from top to bottom is compatible and fully warranted.

DAMTEC Australasia also has a philosophy to try and assist its clients by assessing the Impact Sound compliance requirements nominated by Palmer Acoustics on each and every project where possible, as every construction site varies and a lot of factors need to be taken into consideration when assessing and proposing the most appropriate Damtec acoustic underlay to be used.

A1 Products

A1 acoustic products, like those offered by Acustica Integral and A1 Rubber, focus on noise reduction and vibration control, often using materials like felt and recycled rubber underlays for applications such as floating floors, insulated enclosures, and under various flooring types. Product such as A1 Felt (Acustica Integral) , AcoustaMat™ (A1 Rubber): A1 Acoustic Wall Panel.

Construction chemicals

Construction Chemicals provide the Acoustibond (tile adhesive), Acoustiflor (membrane), and Acoustiscreed (screed). These are products designed to reduce noise transmission through floors. They are a wet screeded system.

APPENDIX B GLOSSARY

IMPACT MEASUREMENT AND ASSESSMENT DESCRIPTORS

- L_{Aeq} – Equivalent Continuous Noise Level. The noise level in dB(A) which if present for the entire measurement period, would produce the same sound energy to be received as was actually received as a result of a signal which varied with time. Normally abbreviated to "L_{eq}" or "L_{Aeq}", often followed by a specification of the time period (such as 1 hour or 8 hours) indicating the period of time to which the measured value has been normalized;

- $L'_{nT,w}$ – Weighted Standardised impact sound pressure level; a measurement of impact sound transmission between rooms. Lower values denote better performance. The single figure measure is derived by adapting a standard response curve to measure 1/3 octave band sound pressure levels. Measured results are adjusted based upon a reverberation time of 0.5 sec in the receiving room. Normally derived from a field test.

- $L'_{n,w}$ – Weighted Normalized impact sound pressure level; a laboratory measurement of impact sound transmission between rooms. Lower values denote better performance. The single figure measure is derived by adapting a standard response curve to measure 1/3 octave band sound pressure level measurements. Measured results are adjusted based on the absorption of 10m^2 in the receiving room. Normally derived from a laboratory test.

- C_I – A spectrum adaptation term compensating for the effect of floor coverings when applied to bare floors under test. The usually negative value, in decibels, is added to the single-number quantity, L'_{nw} or L'_{nTw}.

- ***Field Impact Insulation Class (FIIC)*** – a single-number rating derived from measured values of normalized one-third octave band impact sound pressure levels in accordance with Eq 4 and the reference contours in Classification E 989. It provides an estimate of the sound insulating performance of a floor-ceiling assembly and associated support structures under tapping machine excitation.

- ***Impact Insulation Class (IIC)*** – This classification covers the determination of a single-figure rating that can be used for comparing floor-ceiling assemblies for general building design purposes.

- ***Impact Sound Pressure Level (L)*** – the average sound pressure level in a specified frequency band produced in the receiving room by the operation of the standard tapping machine on the floor assembly, averaged over each of the specified machine positions.

- L'_{nT} – ***Standardised Impact Sound Pressure Level*** – the impact sound pressure level standardised to a room with a reference reverberation time of 0.5 seconds.

- L'_n – ***Normalized Impact Sound Pressure Level*** – the impact sound pressure level normalized to reference absorption area of 10 metric sabins (108 sabins).

- ***Receiving Room*** – a room below or adjacent to the floor specimen under test in which the impact sound pressure levels are measured.

- ***Source Room*** – the room containing the tapping machine.

ACOUSTIC STANDARDS

- ***ISO 140 – 6***
  Acoustics – Measurement of sound insulation in buildings and of building elements – Part 6: Laboratory measurements of impact sound insulation of floors

- ***ISO 140 – 7***
  Acoustics – Measurement of sound insulation in buildings and of building elements – Part 7: Field measurements of impact sound insulation of floors

- ***ISO 717 – 2***
  Acoustics – Rating of sound insulation in buildings and of building elements – Part 2: Impact sound insulation

- **ISO 16283 - 2 : 2020** Acoustics — Field measurement of sound insulation in buildings and of building elements — Part 2: Impact sound insulation

- ***ASTM Classification E 1007 – 97***
  Standard Test Method for Field Measurement of Tapping Machine Impact Sound Transmission Through Floor-Ceiling Assemblies and Associated Support Structure

- ***ASTM Classification E 989 – 89***
  Standard Classification for Determination of Impact Insulation Class (IIC)