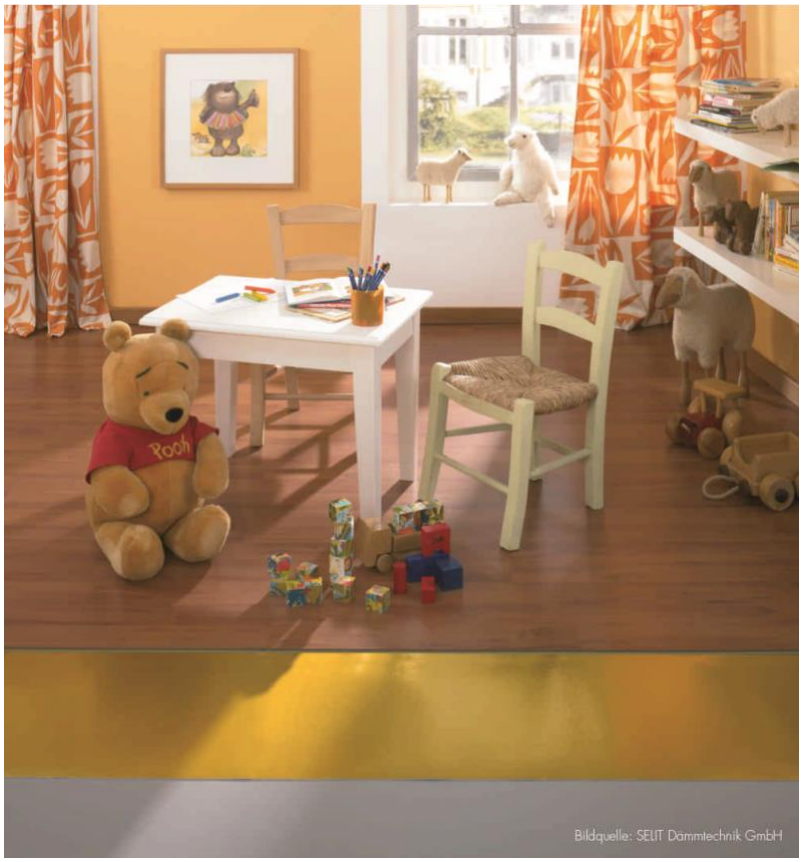
MULTILAYER MODULAR FLOORING ASSOCIATION
VERBAND DER MEHRSCHICHTIG MODULAREN FUSSBODENBELÄGE E.V.

Technical Bulletin

TB 1

Underlay Materials under Multilayer Modular Floor Coverings (MMF)
Test Standards and Performance Indicators

(English Edition 10/2022)



Disclaimer

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1. Introduction

1.1. Scope

This technical bulletin provides general advice and application-oriented recommendations for underlays laid loose under floating multilayer modular floor coverings with a minimum thickness of 4 mm. It does not refer to products with “pre-attached underlays” and also not to areas with special requirements and specifications for use.

The legal requirements in the country or area of purchase are to be observed at all times.

The explanations and data provided in this technical bulletin conform to state-of-the-art technology and the relevant recognized regulations at the time of publication.

1.2. References

All relevant references are mentioned in Annex B of this document.

2. Definitions

Multilayer modular floor covering:	Floor covering as described in EN 16511, as well as other semi-rigid multilayer modular floor coverings for floating installation (e. g. “LVT, design flooring” etc.).
Modular:	Elements supplied in single planks or tiles with worked edges that allow the product to be joined together to form an integral floor covering unit.
Underlay:	Resilient layer between subfloor and floor covering, added to obtain specific properties. As underlays, it is also possible to have combinations of the above-mentioned underlays with films or coatings (e.g. vapor barriers).
Floor covering system:	Combination of multilayer modular floor covering element and the underlay.
Substrate / Core:	Core layer providing thickness, stability and other properties needed.
Subfloor:	Structural layer of the building construction which supports the floor covering system installed above.
Abbreviations:	**PC**..... **P**unctual **C**onformability **SD** …… Water vapor diffusion resistance ($\mathbf{S_d}$-value) **R**..... Thermal **R**esistance **DL**..... **D**ynamic **L**oad **CS** ..... **C**ompressive **S**trength **CC** ..... **C**ompressive **C**reep **IS** ..... **I**mpact **S**ound Reduction **RWS**.... **R**adiated **W**alking **S**ound

3. General information

This technical bulletin highlights application-oriented requirements and the technical performance indicators for assessing if the underlay meets the intended purpose of the floorcovering system.

In general, the entire flooring system – in other words, the combination of multilayer modular floor covering with underlay – has to be chosen to meet the required needs of the use application.

By following the minimum recommendations for the underlays as specified in this technical bulletin, you will reduce the risk of product damage (e.g. damage to the joining system) of the floorcovering. These recommendations are based on the current level of knowledge. They will enable you to minimize potential complaints within the warranty period.

3.1. Background information

When floating multilayer modular floor coverings are installed, an underlay may be placed between the subfloor and the floor covering. This underlay offers various additional benefits to the floorcovering system. The underlay not only reduces the need for extensive subfloor preparations, it also offers protection for the floorcovering, resulting in a satisfactory long-lasting service life.

Any country-specific legal requirements are binding and are to be observed at all times.

Please note that the information provided by your floor manufacturer or supplier regarding the requirements for the use of their underlay is binding.

All minimum requirements were developed for assumed normal domestic use over a period of 20 years, covering 95 % of this type of floor coverings.

3.2. Test methods

The test methods described in this document demonstrate the application-specific properties of an underlay.

The test methods are described in Annex A of this technical bulletin.

3.3. Underlay groups

Multilayer modular floor coverings for floating installation are categorized by MMFA as:

- **"Wood":** All products with wood-based substrates (≥ 65 % content of wood particles/fibres in the core) with polymer or cork surface layer (cork thickness less than 2.5 mm).
- **"Polymer":** Polymer or polymer-composite substrate with polymer surface layer and/or lacquer.
- ***"Mixed":*** All products not covered by categories "Wood" and "Polymer".

These different categories need specific underlays (depending e.g. on rigidity, elasticity, etc. of the floor covering).

There are 2 underlay groups. Typically, underlay group 1 can be used under floor coverings category "Wood", and underlay group 2 can be used under floor coverings category "Polymer" or "Mixed"

The underlay group required shall be specified by the floor covering supplier. If no underlay group is specified by the supplier, group 2 is recommended.

4. Performance characteristics of underlays

In chapter 5, minimum and higher requirements are given for each of the below mentioned performance characteristics in order to guarantee the durability of the technical performance, in respectively light and heavier areas of use (e.g. living rooms, halls, kitchens, etc.) during the whole lifetime of the flooring. They are meant as a rough indication to make it easier for consumers to choose the underlay for their specific area of application and to identify and determine the suitable floor covering/underlay combinations. For floor coverings with a use class of 31 or higher (acc. to EN 16511, EN ISO 20326, EN 17142 or EN ISO 10582) underlays are recommended which fulfill the higher requirements.

4.1. Performance in relation to the substrate/construction

PC: (punctual conformability)

The subfloor must conform to MMFA Technical Bulletin TB2.

Smaller local imperfections like grains of screed can be leveled out by using appropriate underlays. It is essential that large-scale unevenness is leveled out by using appropriate measures (e.g. with a levelling compound or similar). MMF floor coverings will be critical in respect to imperfections of the subfloor. For example, larger gaps between tiles or cracks may show on the surface after some time. Unevenness may also put too much stress on the connection systems.

The capacity to level out the above-mentioned smaller local imperfections is expressed using the PC value. This value is always given in mm.

The higher the PC value, the better the underlay will be suited for leveling out localized uneven areas.

SD: (water vapor diffusion resistance)

Moisture-sensitive flooring systems (such as floor coverings with MDF/HDF core) require a permanently dry subfloor. In case of mineral subfloors (e.g. concrete, screed, etc.), a water vapor diffusion control layer in the form of a moisture-proofing film is recommended for use on mineral subfloors as a general principle in order to protect the floor covering from damages caused by rising residual moisture from the substrate.

Water vapor diffusion control layers can be either integrated into the underlay or be installed separately. The thickness of the water vapor diffusion control layer on its own is not significant in this respect, but the type and quality of the water vapor diffusion control layer are important.

The capacity to hold back the diffusion of water vapor is expressed using the sd value (SD).

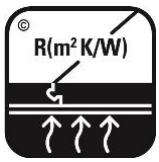
The higher the SD value, the better the film or underlay will protect the floor covering against damage caused by rising dampness.

Based on practical experience, this value should be at least 75 m.

Transparent polyethylene (PE) films with a thickness of 150 µm will most probably achieve sd values of > 75 m. The same applies for metalized plastic films with a thickness of > 10 µm.

The requirement of 75 m is valid for subfloors in equilibrium moisture content. When the subfloor has a higher level of residual moisture, appropriate measures must be taken to dry the subfloor prior to the installation of the floor covering. It is absolutely necessary to consult and respect the relevant requirements of the floorcovering supplier.

Permanent or longtime moist conditions under the floor covering system must be avoided. This could cause mold or other problems.



R: (thermal resistance)

Case 1: Underfloor heating

Case 1a: Heating below the underlay (e. g. water/electric in screed/concrete)

With underfloor heating systems, the floorcovering system must not affect the heating function. The floor covering system must not be an excessive barrier to the effective transfer of heat into the room. According to the BVF (Bundesverband Flächenheizungen und Flächenkühlungen or: German Association of underfloor heating and cooling) and the European standard for underfloor-heating dimensioning (EN 1264-3), the level of thermal resistance $R_{\lambda,B}$ for **the entire floor covering system** should not exceed **0.15 m²K/W**.

Case 1b: Heating on top of the underlay (e. g. electric films direct on top of the underlay)

In this case the energy shall pass through the floor covering in the room and as little energy as possible shall be lost in the subfloor. So the underlay should be able to avoid the loss of energy. Based on practical experience, this is achieved when the thermal resistant R of the **underlay alone** is **higher than the thermal resistance of the floor covering**.

Note: It has to be checked if the MMF floor covering is suitable for this type of heating.

Case 2: Underfloor cooling

In case of installation where cold water can be pumped through the underfloor heating system to provide cooling during the summer, additional requirements are needed. An automatic control system for dew point (condensation) detection should be installed. This requires dew point sensors (i.e. probes) to be fitted under the floor covering, which will switch off the cooling system before condensation appears. Any condensation might result in damage to the flooring system. This could potentially lead to deformation, swelling, bubbles, formation of cracks, etc. The recommended thermal resistance $R_{\lambda,B}$ for **the entire flooring system** for underfloor cooling systems should not exceed **0.15 m²K/W**.

Heating/Cooling below the underlay: The lower the $R_{\lambda,B}$ value of the floor covering system, the better suited the floor covering system will be for use on a heated/cooled substrate.

Heating above the underlay: The lower the $R_{\lambda,B}$ value of the floor covering in comparison to the $R_{\lambda,B}$ value of the underlay, the better suits the floor covering system the use of a heating system above an underlay.

The $R_{\lambda,B}$ value for the entire flooring system has to be calculated as the sum of the thermal resistances of all layers (typically: moisture barrier + underlay + floor covering).

Example of a suitable floor-mounted superstructure:

MMF floor covering	0.07 $\frac{m^2 \times K}{W}$
Underlay	0.04 $\frac{m^2 \times K}{W}$ (= **R**)
Moisture barrier	0.005 $\frac{m^2 \times K}{W}$
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Total $R_{\lambda,B}$:	0.115 $\frac{m^2 \times K}{W}$ (≤ 0.15 and therefore suitable for below-heated floors)

Case 3: Unisolated subfloor

In case of installation on uninsulated subfloors on ground floor or basement level, or above unheated areas like garages, a better living comfort can be achieved with a good thermal insulation of the floor covering system. This can help provide higher floor temperatures and a more comfortable feeling when walking barefoot on the floor covering.

The higher the $R_{\lambda,B}$ value of the floor covering system, the better the flooring system will be suited for use on an uninsulated subfloor.

4.2. Performance in relation to the use of the floor covering

Floors are subject to different loads in different classes of use. The underlay must guarantee the integrity of the floor covering. On the other hand, the underlay itself must be able to withstand these loads without losing technical performance in the long term.

It is a general misconception that thicker underlays perform better in this respect. This is absolutely NOT the case. Instead the absolute deformation under load is important. It is generally assumed that a maximum deformation of 0.5 mm for “Wood” floor coverings, or less than that for “Polymer” or “Mixed”, are allowed in order to protect the connection between the panels. Thicker underlays may behave negatively in this respect. Therefore, the following characteristics are important.

The technical characteristics that influence the integrity of the floorcovering are listed below.

DL: (dynamic load)

Dynamic load is the pressure generated on the floor covering system by foot traffic, castor chairs, trolleys, etc.. The underlay needs to be able to “absorb” these repeated loads of short duration without losing its absorbing performance over time.

This capacity is expressed using the DL value. A defined load is applied on the underlay for a short time and then released. This cycle is repeated with a defined frequency. The DL value is the number of cycles to obtain a reduction of underlay thickness of 0.5mm.

The higher the DL value, the longer the underlay will withstand these dynamic loads.

Depending on the underlay group (see 3.3), different loads are applied and recorded as DL_{25} or DL_{75}.

The floor covering has a significant effect on the load distribution. Depending on the floor covering, the underlay will be subject to different loads. Therefore, DL tests for group 1 underlays will be carried out applying a maximum pressure of 25 kPa and for group 2 underlays with a maximum pressure of 75 kPa.

CS and CC: (compressive strength and compressive creep)

Sustained static loads on the floorcovering such as the weight of the floorcovering itself or heavy furniture standing on the floor (e.g. cabinet, piano, aquarium, etc.) may cause the underlay to be reduced in thickness over time. Compressive strength (CS) is the force needed to compress the underlay 0.5mm in thickness. Compressive creep (CC) evaluates which load can be put on the floor covering system over a reference period of 10 years until 0.5 mm compression is reached.

Case 1 – CS

Severe deformations may cause irreparable damage to the joining system and/or the core layer. This test determines the load necessary to put on the joint between the floorcovering elements, so that the floor covering will be pressed down 0.5 mm.

The higher the CS value, the better the underlay will protect the joining system and prevent gaps, height differences, squeaking, etc.

Case 2 – CC

When an underlay is compressed by the static load over time, all beneficial technical characteristics, such as acoustical and thermal insulation, levelling capacity, etc., might disappear.

The higher the CC value, the more static load – e.g. heavier furniture – can be placed on the flooring system for a long period of time without losing technical characteristics.

4.3. Performance based on acoustics

As a rule, underlays have an impact on the acoustic properties of the floor covering system.

IS: (impact sound reduction):

Impact sound is defined as the noise which is perceived in the room below or next to the floor covering system. The noise can be generated by footsteps, falling objects etc. The IS value is the reduction of noise generated on the same subfloor with and without the floor covering system. The underlay must be tested in combination with the reference floor covering as simple extrapolation of underlay and floor covering is impossible.

The higher the IS value, the better the underlay – in combination with the floor covering – will reduce the transmission noise.

The floor covering has a significant influence on the IS value of the floor covering system. It has to be declared if testing the system was done with reference to a group 1 floor, based on a HDF core (see A.2.1), and/or if it was done with reference to a group 2 floor, using an LVT core (see A.2.2). Therefore IS_{HDF} and/or IS_{LVT} has to be declared.

RWS: (radiated walking sound emission)

Walking sound is understood as the noise that is heard when the MMF floor covering inside the room itself is used (e.g. when walking over it, playing on it, etc.). In EN 16205 a test method is described that can express the "perceived loudness" of a MMF floor covering with the RWS-value (EN16205/Annex E).

The RWS value is the emission of noise of the flooring system. The underlay must be tested in combination with the floorcovering as simple extrapolation of underlay and floorcovering is impossible.

The lower the RWS value, the better the underlayment will reduce the emission of walking noise.

The floor covering has a significant influence on the RWS value of the flooring system. It has to be declared if testing the system was done with reference to a group 1 floor, based on a HDF core (see A.2.1), and/or if it was done with reference to a group 2 floor, using an LVT core (see A.2.2). Therefore RWS_{HDF} and/or RWS_{LVT} have to be declared.

5. Requirements for underlays

5.1. Overview of requirements for underlay group 1

(e.g. under floor coverings MMFA-category “Wood” – with HDF core)

Property	Description	Minimum requirements	Higher requirements
PC	Levelling out of localized uneven areas	≥ 0.5 mm	
SD	Protection of floor coverings against residual moisture in substrate	≥ 75 m	
$R_{\lambda, B}$*	Suitable for underfloor heating (H) or cooling (C) below the underlay	H: ≤ 0.15 m²K/W C: ≤ 0.15 m²K/W	
R_{λ}	Thermal insulation Heating on top of the underlay	≥ 0.075 m²K/W Higher R-value than the R-value of the floor covering	
DL_{25}	Sustained load generated by walking etc.	≥ 10,000 Cycles	≥ 100,000 Cycles
CS	Compressive strength at a defined compression stress	≥ 10 kPa	≥ 60 kPa
CC	Sustained load generated by furniture etc.	≥ 2 kPa	≥ 20 kPa
IS_{HDF}*	Reduction of noise transmission	≥ 14 dB	≥ 18 dB

* The entire flooring system is tested.

Test methods acc. Annex A

5.2. Overview of requirements for underlay group 2

(e.g. under floor coverings MMFA-categories “Polymer” or “Mixed” – without HDF-core)

Property	Description	Minimum requirements	Higher requirements
PC	Levelling out of localized uneven areas	≥ 0.5 mm[a)]	
SD	Protection of floor coverings against residual moisture in substrate	≥ 75 m (only for moisture sensitive flooring)	
$R_{\lambda, B}$*	Suitable for underfloor heating (H) or cooling (C)	H: ≤ 0.15 m²K/W C: ≤ 0.15 m²K/W	
R_{λ}	Thermal insulation Heating on top of the underlay	≥ 0.03 m²K/W Higher R-value than the R-value of the floor covering	
DL_{75}	Sustained load generated by walking etc.	≥ 10,000 Cycles	≥ 100,000 Cycles
CS	Compressive strength at a defined compression stress	≥ 200 kPa	≥ 400 kPa
CC	Sustained load generated by furniture etc.	≥ 10 kPa	≥ 35 kPa
IS_{LVT}*	Reduction of noise transmission	≥ 10 dB	≥ 18 dB

* The entire flooring system is tested

[a)] Note: For PC values < 0,5 mm a very good leveling of the subfloor is necessary

Test methods acc. Annex A

6. Environment and safety

The following aspects may be of significance with respect to environmental and safety concerns. A number of these aspects are governed by national or EU legislation/building regulations.

For example, in Germany the “allgemeine bauaufsichtliche Zulassung (abZ)” (general building regulations approval) is currently required for underlays dealing with VOC emissions and reaction to fire and in France underlays have to be labeled according to specific volatile emission categories.

Relevant environmental and safety-related aspects are:

- Emission of dangerous substances, content of dangerous substances
- Odor emission
- Reaction to fire class
- Waste management

Annex A: Test methods and reference floor coverings

A.1. Test methods

The performance values must be tested according to the following test methods. The test methods are described in detail in EN 16354 and some are adapted to multilayer modular floor coverings as described below.

A.1.1. Determination of PC - Punctual Conformability

Described in EN 16354

A.1.2. Determination of SD - Water vapor diffusion resistance (Sd-value)

Described in EN 16354

A.1.3. Determination of R - Thermal Resistance

Described in EN 16354

A.1.4. Determination of DL - Dynamic Load

A.1.4.1. DL_{25} for underlays group 1

Described in EN 16354

A.1.4.2. DL_{75} for underlays group 2

Described in EN 16354. For tests of underlays group 2 the applied sinusoidal load must vary between σ_{min} = 100 Pa and σ_{max} = 75 kPa.

A.1.5. Determination of CS - Compressive Strength

Described in EN 16354

A.1.6. Determination of CC - Compressive Creep

Described in EN 16354

A.1.7. Determination of IS - Impact Sound Reduction

A.1.7.1. IS_{HDF} or RWS_{HDF} for underlays group 1

Described in EN 16354. For underlays group 1 the reference floor covering described in A2.1 must be used as floor covering. Only 1 slab shall be used as specimen.

A.1.7.2. IS_{LVT} or RWS_{LVT} for underlays group 2

Described in EN 16354. For underlays group 2 the reference floor covering described in A2.2 must be used as floor covering. Only 1 slab shall be used as specimen.

A.2. Reference floor coverings for system tests

Particular properties have to be tested as a system test. In this case the entire flooring system has to be investigated. In order to be able to compare the performance of the underlay as such a reference floorcovering of the respective type of flooring should be used.

A.2.1. Reference floor covering for group 1

When determining performance of an underlay of group 1 the system tests have to be executed with the following reference floor covering:

7.3 mm monolithic seamless panel (LVT-covering: 1.8 mm, core layer HDF: 5.5 mm, no stabilizing layer), Area weight: 8 kg/m², size: 92 ± 3 cm x 120 ± 3 cm.

This reference floor covering can be provided at MMFA (http://www.mmfa.eu)

A.2.2. Reference floor covering for group 2

When determining performance of an underlay of group 2 the system tests have to be executed with the following reference floor covering:

5 mm monolithic seamless LVT-slab (PU-Coating: 10 µm, wear layer: 300 µm, decor film: 70 µm, core layer PVC with glass fibre reinforced: 3.2 mm, stabilizing layer: 1.5 mm), Area weight: 8.5 kg/m², size 98 ± 3 cm x 120 ± 3 cm.

This reference floor covering can be provided at MMFA (http://www.mmfa.eu)

Annex B: Bibliography

EN 16354	Laminate floor coverings - Underlays - Specification, requirements and test methods
EN 16511	Loose-laid panels - Semi-rigid multilayer floor covering (MMF) panels with wear resistant top layer
EN 16205	Laboratory measurement of walking noise on floors
EN ISO 20326	Resilient floor coverings - Specification for floor panels/assembly for loose laying
EN 17142	Modular multilayer floor coverings - Elements with a wood powder based surface layer - Specifications, requirements and test methods
EN ISO 10582	Resilient floor coverings - Heterogeneous poly(vinyl chloride) floor covering - Specifications
EN 1264-3	Water based surface embedded heating and cooling systems - Part 3: Dimensioning
TB 2	Installation of Multilayer Modular Floor Coverings (MMF)

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