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Technical bulletin

Underlay Materials under Laminate Floor Coverings
Test Standards and Performance Indicators

(English edition 02/2019)

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1. Introduction

1.1. Scope

This technical bulletin provides general advice and application-oriented recommendations for underlayments laid loose under floating laminate floor coverings.

Existing legal requirements 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. Standards/Directives

Annex A contains the standards and directives concerned, as well as texts which might be of significance in assessing suitability for use.

By following all of the minimum recommendations for the underlayment specified in this Technical bulletin, the risk of a flooring system damage will be reduced (e.g. damage to the joining system). This is based on the current level of knowledge.

Please note that the information provided by your laminate floor manufacturer or supplier regarding the requirements for the use of their underlayment is binding and overrules this document recommendations.

2. Definitions

Laminate floor covering:	Floor covering as described in EN 13329, EN 15468 and EN 14978.
Underlayment:	Resilient layer between the substrate and floor covering added to obtain specific properties. It is also possible to have combinations of the above underlays and underlay materials as underlayments, as well as combinat-ions of the above underlays with films or coatings (e.g. vapor barriers).
Flooring system:	Laid floors consisting of laminate floor covering and underlayment.
Substrate:	Structural layer onto which the floor covering is installed.
Abbreviations:	**R** .....Thermal **R**esistance **PC**.....**P**unctual **C**onformability **SD**.....Water vapor diffusion resistance ($\mathbf{s_d}$-value) $\mathbf{DL_{25}}$ .....**D**ynamic **L**oad **CS**.....**C**ompressive **S**trength **CC**.....**C**ompressive **C**reep **RLB** .....**R**esistance to **L**arge **B**all $\mathbf{IS_{Lam}}$.....**I**mpact **S**ound Reduction $\mathbf{RWS_{Lam}}$.....**R**adiated **W**alking **S**ound

3. General information

When floating laminate floor coverings are laid, an underlayment is placed between the substrate and the laminate floor covering. This underlay serves a number of purposes.

On the one hand, the underlayment provides for floating installation of a laminate floor covering system, while at the same time protecting the floor in the long term and extending its service life.

In general, the entire flooring system – in other words, the combination of laminate floor covering with underlay – has to meet the required needs of the user.

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

This Technical bulletin highlights existing application-oriented requirements and the technical performance indicators for assessing the extent to which an underlayment meets these requirements.

In the past, values such as density and thickness were generalized and used for quality assessment, for example as in *"High density = Excellent mechanical properties"* and *"Good thickness = Excellent sound impact behavior"*. However, scientific investigations have shown that these generalizations do not always apply. For example, an underlayment made from material A that is less dense may be considerably more pressure-resistant than an underlayment made from material B that is considerably denser.

As a result, test methods were drawn up in technical specification EN 16354 which are able to demonstrate the application-specific properties of an underlayment. These performance indicators are described - and in some cases rated - below.

The test methods are described in EN 16354 "Laminate floor coverings - Underlays - Specifications, requirements and test methods".

The indicators mentioned in this technical bulletin describe the performance and durability of underlayments, as well as the requirements for the various areas of application and use (e.g. living room, hall, kitchen, etc.). They help to identify and determine suitable laminate/underlay combinations. For floor coverings with a use class (acc. EN 13329, EN 14978 or EN 15468) of 31 or higher underlays are recommended which fulfill the higher requirements.

In general, underlayments have a thickness of ≥ 2 mm. With high floor-mounted super-structures, it is essential that any doors or other structural elements are accommodated accordingly. In most cases, the thicker the underlayment, the softer it is. This therefore calls for sufficient mechanical stability and an appropriate CS value (see abbreviations above).

4. Requirements

The requirements of an underlayment are clustered into the three areas (4.1.-4.3.) below, in which the structural condition of the site and the existing substrate are just as important as the application to which the flooring is designated, and the acoustic requirements. In the general overview, recommendations are given for each of these requirements in order to make it easier for consumers to choose the underlay for their specific area of application.

4.1. Requirements based on the substrate/structure

R: Thermal resistance requirement

Case 1: Underfloor heating

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

With this underfloor heating systems, the flooring system must not affect the heating function, i.e. the transfer of heat from the floor heating into the room must not be excessively impeded by a heat insulating floor layer. 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 flooring system** must not exceed **0.15 m²K/W**.

Case 1b: Heating is 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 resistance R of the **underlay alone** is **higher than the heat resistance of the laminate floor covering**.

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

Case 2: Underfloor cooling

With underfloor cooling systems, the cooling system needs to be fitted with an automatic control for regulating the dew point in order to prevent condensation. This requires metering sensors (i.e. probes) to be fitted to the floor covering which will switch off the cooling system in good time before condensation appears. Any condensation arising on the floor covering will result in damage to the laminate. This could potentially lead to deformation, swelling and the formation of cracks. The recommended thermal resistance $R_{\lambda,B}$ for **the entire flooring system** for underfloor cooling systems must not exceed **0.10 m²K/W**.

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

Heating on top of the underlay:
The higher the R value of the underlay, the better suited the flooring system will be for use below a heating system.

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

Example of a suitable floor-mounted superstructure:

Laminate floor covering	0.07 $\frac{m^2 \times K}{W}$
Underlayment	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, suitable for below-heated floors)

Case 3: Unheated floors

Cold, unheated floor coverings (e.g. those installed close to the ground or over unheated passages, etc.) cause uncomfortable feeling to live on. Underlays with good thermal insulation will avoid too cold flooring surface and increase user's comfort. Based on practical experience, this is achieved when the thermal resistance R of the **underlay alone** is at least 0.075m²K/W.

The higher the R value of the underlay and/or the $R_{\lambda,B}$ of the flooring system, the more characteristic will be the rise in temperature and comfort.

PC: Requirements relating to unevenness

It is frequently the case that existing substrates (particularly floorboards, tiles, etc.) do not meet the requirements for evenness stipulated in DIN 18202 (see also EPLF Technical bulletin "Installation of Laminate Floor Covering").

Smaller localized uneven areas can be leveled out by using appropriate underlayments. These are able to accommodate small grains of screed, for example, and thus create a flat surface for laying the laminate floor covering.

The capacity to level out localized uneven areas is expressed using the PC value. This is always given in mm and indicates an underlayment's capacity to level out an uneven surface.

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

Screeds which are newly laid and conform to the standard always have localized uneven areas of < 1 mm. Therefore, the underlayment in this instance should preferably have a PC value of ≥ 0.5 mm.

IMPORTANT:
It is essential that large-scale uneven areas are leveled out using appropriate measures (e.g. with a filler or similar) so that the laminate floor will lie evenly on the substrate across the entire surface and no hollow spaces will occur, which might, for example, worsen the room acoustics, or put too much stress on the locking systems.

SD: Floor moisture resistance requirements

With **mineral substrates** (e.g. concrete, screed, etc.), a certain amount of residual moisture in the substrate has to be expected which might damage the laminate floor covering. Therefore, a water vapor control layer in the form of a film is recommended for use on mineral substrates as a general principle. Water vapor control layers can be either integrated into the underlayment or laid separately. The thickness of the water vapor control layer on its own is not significant in this case, but the type and quality of the water vapor control layer are important.

In German-speaking countries, these kinds of water vapor control layers are sometimes described as "vapor retarders" or "vapor barriers" and the threshold values are not precisely

defined - which often leads to uncertainties in the planning of floors and buildings. In English-speaking countries, it is properly described as a “water vapor control layer”.

The capacity to impede the diffusion of vapor is expressed using the s_d value (SD). Based on practical experience, this value should be at least 75 m.

The higher the SD value, the better the film will protect the laminate floor covering against damage caused by rising damp.

For example, PE films with a thickness of 150 µm or more and of high quality (transparent) or metalized PET films with a thickness of 10 µm or more and of high quality achieve s_d values of > 75 m.

Where the substrate has a higher level of residual moisture (see also EPLF technical bulletin “Installation of Laminate Floor Covering”), appropriate measures must be taken to desiccate the floor before laying the laminate floor covering.

With **wood substrates** (e.g. floorboards, chipboard, etc.) it has to be taken care not to disturb the substrate’s equilibrium moisture content at any time of the year, i.e. the transfer of moisture through the floor must not be impeded. As a result, in this case as a general principle no water vapor control layer should be used between the wood floor structure and the floating laminate floor covering.

Requirements for old industrial floor coverings

Information concerning the general requirements for the substrate is provided in the EPLF technical bulletin “Installation of Laminate Floor Covering”.

4.2. Requirements based on use

Floors are subject to different loads with different uses. Protecting the flooring system against these different loads requires underlayments to have different properties.

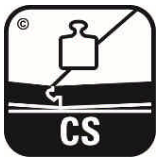
DL_{25}: Requirements with dynamic loads

A typical load for a flooring system is the dynamic load which is generated when walking over the flooring (e.g. hallways, offices, shop floors, etc.) or when chairs are used (e.g. office chairs rolling on castors, dining room chairs scraping back from the table, etc.). Here, the underlayment needs to be able to withstand repeated loads of short duration without undergoing a change to its properties in the long term.

This capacity is expressed using the DL_{25} value. It involves applying a defined dynamic load to the underlay (as is usually generated when walking or moving an office chair over the floor) and calculating the number of cycles until a change is recorded in the properties of the underlayment.

The higher the DL_{25} value, the longer the underlayment will withstand these dynamic loads.

A minimum value of 10.000 cycles is recommended. For higher requirements, the DL_{25} value must be at least 100.000 cycles.



CS and CC: Requirements with static loads

Another typical kind of load is the sustained static load generated by the laminate floor covering itself or by heavy furniture standing on it (e.g. cupboard, piano, aquarium base, etc.). In this case, the underlay needs to resist very heavy loads at rest without undergoing a change in its properties.

Case 1 – CS

In order to maximize the service life of the joining system connecting the laminate boards, the underlayment must not yield too much or become deformed when a load is applied. Severe deformations could cause irreparable damage to the joining system and/or the HDF core layer.

The capacity of the joining system to support these types of loads is expressed using the CS value. Based on practical experience, the system needs to have a compressive strength of at least 10 kPa (0.5 mm).

The higher the CS value, the better the underlayment will protect the joining system and counteract the formation and opening-up of any cracks.

For higher requirements, the CS value must be at least 60 kPa.

Case 2 – CC

The behavior of the underlayment when subjected to a sustained load - under heavy furniture, for example - is expressed using the CC value. This rates how an underlayment reacts when subjected to a sustained load for ten years. In this case, the recommended compression strength is at least 2 kPa (0.5 mm).

The higher the CC value, the heavier the furniture can be that are placed on the laminate floor covering for a sustained period of time.

For higher requirements, the CC value must be at least 20 kPa.

RLB: Requirements for impact resistance

Flooring systems are also subject to stress when objects are dropped onto them (e.g. toys, pans, etc.). In this case, the flooring system needs to be able to absorb extreme forces of short duration, as otherwise this might damage the laminate floor surface. This capacity is expressed using the RLB value and should be a falling height of at least 500 mm.

The higher this value, the better the underlayment will minimize the damage to the laminate floor covering caused by falling objects.

For higher requirements, the RLB value must be at least 1200 mm.

4.3. Requirements based on acoustics

As a rule, underlayments have an impact on the acoustic properties of a flooring system. These acoustic properties are divided into two basic types with different requirements in each case:

IS_{Lam}: Requirements relating to impact sound reduction

Impact sound is understood as the noise, which is heard in the room below or next door as the structure-borne noise, generated when a laminate floor covering is used. The capacity of an underlayment to reduce impact sound is expressed using the IS_{Lam} (noise impact reduction) value. The IS_{Lam} value of an underlayment for footstep soundproofing should be at least 14 dB.

Underlays with lower IS_{Lam} values are to be considered as a separation layer.

The greater the IS_{Lam} value, the better the underlayment will reduce the transmission of footstep noise.

For higher requirements, the IS_{Lam} value must be at least 18 dB.

To express the IS_{LAM} value the reference floor covering described in EN16354:2018 (clause 3.5) has to be used for tests.

RWS_{Lam}: Requirements for radiated walking sound

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

Reference-value under development

The lower the RWS_{Lam} value, the better the underlayment will reduce the emission of walking noise.

To express the RWS_{LAM} value the reference floor covering described in EN16354:2018 (clause 3.5) has to be used for tests.

4.4. Overview of requirements and their key performance indicators

	Property	KPI	Description	Benefits for users	Minimum requirements	Higher requirements
Substrate/ Structure	Thermal resistance	R_λ	Heat insulation / Suitable for underfloor heating on top of the underlay	Higher floor temperature and comfort, energy saving	0.075m²K/W/ Higher R-value than the R-value of the floor covering	
		$R_{\lambda,B}$*	Suitable for underfloor heating (H) or cooling (C) below the underlay	Less time required for heating up/cooling down; energy savings	H: ≤ 0.15 C: ≤ 0.10 m²K/W	
	Uneven areas	PC	Leveling out of localized uneven areas	Mechanical protection; prevention of sound bridges	≥ 0.5 mm	
	Moisture	SD	Protection against residual moisture in substrate	Prevention of moisture damage	≥ 75 m	
Use	Dynamic load	DL_{25}	Sustained load generated by walking on floor, etc.	Mechanical protection; sustained retention of essential properties	≥ 10.000 cycles	≥ 100.000 cycles
	Static load	CS	Compressive stress at a defined compression strength	Protection of locking system and against cracking	≥ 10 kPa	≥ 60 kPa
	Sustained static load	CC	Sustained load generated by furniture, etc.	Sustained retention of essential properties	≥ 2 kPa	≥ 20 kPa
	Impact resistance	RLB*	Load generated by force of impact	Protection of surface	≥ 500 mm	≥ 1250 mm
Acoustics	Impact sound reduction	IS_{Lam}*	Reduction of structure-borne noise transmission	Noise reduction inside neighboring rooms when walking on the flooring	≥ 14 dB	≥ 18 dB
	Radiated walking sound emission	RWS_{LAM}*	Radiated walking sound emitted	Noise emissions generated inside the room itself when walking on the flooring	Value under develop-ment	Value under develop-ment

* The entire flooring system is tested

Test methods acc. EN16354

5. Environment and safety

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

For example, in Germany a “bauaufsichtliche Zulassung (abZ)” or general building regulations approval is currently required for underlayments (VOC and flammability), and in France underlays have to be labeled according to specific VOC categories.

Other environmental and safety-related properties:

- Pollutant emission
- Odor emission
- Fire classification
- Disposal
- Recycling

These factors are currently under development as part of a European standardization project (Construction Products Directive).

Annex A: Bibliography

EN 16354	Laminate floor coverings — Underlays — Specification, requirements and test methods
DIN EN 823	Thermal insulating products for building applications – Determination of thickness
DIN EN 822	Thermal insulating products for building applications – Determination of length and width
DIN EN 824	Thermal insulating products for building applications – Determination of squareness
DIN EN 825	Thermal insulating products for building applications – Determination of flatness
DIN EN ISO 868	Determination of indentation hardness by means of a durometer (Shore hardness)
DIN EN 826	Thermal insulating products for building applications – Determination of compression behavior
DIN EN 1606	Thermal insulating products for building applications – Determination of compressive creep
DIN EN 13793	Thermal insulating products for building applications – Determination of behavior under cyclic loading
DIN EN 12667	Thermal performance of building materials and products – Determination of thermal resistance by means of guarded hot plate and heat flow meter methods
DIN EN 12086	Thermal insulating products for building applications - Determination of water vapor transmission properties
DIN EN ISO 10140-1	Acoustics – Laboratory measurement of sound insulation of building elements – Part 1: Application rules for specific products
DIN EN ISO 10140-3	Acoustics – Laboratory measurement of sound insulation of building elements – Part 3: Measurement of impact sound insulation
DIN EN ISO 10140-4	Acoustics – Laboratory measurement of sound insulation of building elements – Part 4: Measurement procedures and requirements
DIN EN ISO 10140-5	Acoustics – Laboratory measurement of sound insulation of building elements – Part 5: Requirements for test facilities and equipment
EN 16205	Laboratory measurement of walking noise on floors
DIN EN ISO 717-1	Rating of sound insulation in buildings and of building elements – Part 1: Airborne sound insulation
DIN EN ISO 717-2	Rating of sound insulation in buildings and of building elements – Part 2: Impact sound insulation
CEN WI 00134207	Acoustics – Measurement of reflected walking sound on laminate floor coverings using an automatic impulse hammer
DIN EN ISO 11925-2	Reaction to fire tests – Part 2: Ignitability of products subjected to direct impingement of flame

DIN EN 13501-1	Fire classification of construction products and building elements – Part 1: Classification using test data from reaction to fire tests
DIN EN 13329	Laminate floor coverings – Elements with a surface layer based on aminoplastic thermosetting resins – Specifications, requirements and test methods
DIN EN 438-2	Decorative high pressure laminates (HPL) – Sheets based on thermosetting resins – Part 2: Determination of properties
DIN EN 1815	Resilient and textile floor coverings – Assessment of static electrical propensity
DIN EN 14909	Flexible sheets for waterproofing – Plastic and rubber damp proof courses – Definitions and characteristics
DIN EN 717-1	Wood-based panels – Determination of formaldehyde release – Part 1: Formaldehyde emission by the chamber method
DIN EN ISO 16000-9	Indoor air – Part 9: Determination of the emission of volatile organic compounds from building products and furnishing – Emission test chamber method
DIN EN 1264-3	Water-based surface embedded heating and cooling systems – Part 3: Dimensioning

Note:

The provisions and figures contained in this technical bulletin do not in any way lay claim to completeness. They reflect as far as reasonably possible the current state of the art. They are meant to serve as nonbinding guidelines in conjunction with the installation instructions which apply specifically to the product in question. Warranty claims cannot be derived from the provisions of this text. If any doubt exists as to any of the provisions contained herein, the manufacturer/supplier of the respective MMF product should be consulted.

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