EUROPEAN PRODUCERS OF LAMINATE FLOORING
FEDERATION EUROPEENNE DES FARBICANTS DE REVERTEMENTS DE SOL STRATIFIES
VERBAND DER EUROPÄISCHEN LAMINATFUSSBODENHERSTELLER E.V.

Technical bulletin

Underlay Materials under Laminate Floor Coverings - Test Standards and Performance Indicators

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Contents

1. Introduction

1.1. Scope

This technical bulletin provides general advice and application-based 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 the latest state of 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 the minimum recommendations for the underlayment specified in this Technical bulletin, you will reduce the risk of product damage (e.g. damage to the click system) based on the current level of knowledge and minimize potential complaints within the warranty period for the flooring system.

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

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.

As underlayments, it is also possible to have combinations of the above underlays and underlay materials, as well as combinations 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 (**Sd**-value)
DL..... **D**ynamic **L**oad
CS ..... **C**ompressive **S**trength
CC ..... **C**ompressive **C**reep
RLB ... **R**esistance to **L**arge **B**all
IS ..... **I**mpact **S**ound Reduction
RWS .. **R**eflected **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 it protects the floor in the long term and extends its service life.

In general, the entire flooring system – in other words, the combination of laminate floor covering and underlayment – must 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-based 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 CEN/TS 16354:2012 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 CEN/TS 16354:2012 "Laminate floor coverings — Underlays — Specifications, requirements and test methods".

The indicators 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.

In general, underlayments have a thickness of ≥ 2 mm. With high floor-mounted superstructures, 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 grouped into the three areas (4.1.-4.3.) below, whereby the structural condition of the site and the existing substrate are just as important as the use to which the floor is put 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 underlayment for their specific area of use.

4.1. Requirements based on the substrate/structure

R: Thermal resistance requirement

Case 1: Heated floors

With heated floors, the flooring system must not affect the heating function, i.e. the transfer of heat from the floor heating in 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 Surface Heating and Surface Cooling) and the European standard for floor 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 2: Cooled floors

For cooled floors, 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 switch off the cooling system in good time before condensation forms. Any condensation arising in 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 floor cooling systems must not exceed **0.10 m²K/W**.

The smaller 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.

The $R_{\lambda,B}$ value for the entire flooring system must 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 $\frac{m^2 \times K}{W}$
Total $R_{\lambda,B}$:	0.115 $\frac{m^2 \times K}{W}$ (≤ 0.15 and therefore suitable for heated floors)

Case 3: Unheated floors

With cool, unheated floors (e.g. those installed close to the ground or over unheated passages, etc.), the surface temperature of the laminate floor - and therefore users' comfort underfoot - can be increased by means of a good heat insulation underlayment. Based on practical experience, this is achieved when the thermal resistant R of the **underlay alone** is at least 0.075 m²K/W.

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

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 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 on upper side of the underlayment.

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 greater the PC value, the better the underlay 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 lies evenly on the substrate across the entire surface and no hollows occur which might, for example, make the room acoustics worse or put too much stress on the connection systems.

SD: Floor moisture resistance requirements

With **mineral substrates** (e.g. concrete, screed, etc.), a certain amount of residual moisture in the substrate is 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 do play an important role.

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 greater 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 dry the floor out before laying the laminate floor covering.

With **wood substrates** (e.g. floorboards, chipboard, etc.), care must be taken not to disturb the substrate’s equilibrium moisture content at any time of year, i.e. the transfer of moisture through the floor must not be impeded. As a result, as a general principle no water vapor control layer should be used in this case 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 subjected to different loads with different uses. Protecting the flooring system against these different loads requires underlayments to have different properties.

DL: 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 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 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 greater the DL value, the longer the underlayment will withstand these dynamic loads.

A minimum value of 10,000 cycles is recommended. For higher requirements, the DL 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 click 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 click system and/or the HDF core layer.

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

The greater the CS value, the better the underlayment will protect the connection 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 behaves 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 greater the CC value, the heavier the furniture that can be placed on the laminate floor covering for a sustained period.

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 height of fall of at least 500 mm.

The greater 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: Requirements for impact sound reduction

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

Underlays with lower IS values are to be considered as a separation layer.

The greater the IS value, the better the underlayment will reduce the transmission of footstep noise.

For higher requirements, the IS value must be at least 18 dB.

RWS: Requirements for reflected walking sound reduction

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.). Currently on basis of EN 16205 especially for laminate floor coverings a test method is developed that can reflect the "perceived loudness" of a laminate floor covering by the RWS-value. It is planned an appendix or a part 2 of the standard that describes the evaluation of the perceived loudness of a laminate floor covering.

Hints:

The value of $L_{n,\ walk,\ A}$ described in the current state of EN 16205 is only partially correlating with the perceived loudness.

The description in CEN / TS 16354 for RWS will be changed in the next revision.

Reference-value under development

4.4. Overview of requirements and their key performance indicators

	Requirement	KPI	Description	Benefits for users	Recommendation
Substrate/ Structure	Thermal resistance	R_λ	Heat insulation	Higher floor temperature and comfort underfoot	≥ 0.75 m²K/W
		$R_{\lambda,B}$*	Suitable for heated floors (H) or cooled floors (C)	Less time required for heating up/cooling off; energy savings	H: ≤ 0.15 C: ≤ 0.10 m²K/W
	Uneven areas	LC	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 loads	DL	Sustained load generated by walking on floor, etc.	Mechanical protection; sustained retention of essential properties	≥ 10,000 cycles
	Static load	CS	Compressive stress at a defined compression strength	Protection of connection system and against cracking	≥ 10 kPa
	Sustained static load	CC	Sustained load generated by furniture, etc.	Sustained retention of essential properties	≥ 2 kPa
	Impact resistance	RLB*	Load generated by force of impact	Protection of surface	≥ 500 mm
Acoustics	Impact sound reduction	IS*	Reduction of structure-borne noise transmission	Noise reduction in neighboring rooms when floor is walked on	≥ 14 dB
	Reflected walking sound emission	RWS*	Reflected walking sound emitted	Noise emissions generated in the room itself when walking on flooring	Value under develop-ment

* The entire flooring system is tested

5. Environment and safety

The following properties may be of significance with respect to environmental and safety factors. 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 underlayments 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:

CEN/TS 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