

# Kährs

QUALITY IN WOOD SINCE 1857

## SUBFLOOR REQUIREMENTS --- AND UNDERFLOOR HEATING

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## GENERAL REQUIREMENTS FOR SUBFLOORS

### A floor can only be as good as the subfloor allows

The substrate must fulfil a number of criteria to enable different types of wood floors to function for many years.

*The criteria are as follows:*

When installing, the materials, substrate and site must be heated to at least 18°C. The relative humidity in the premises must be lower than 60%.

- The substrate must be clean, solid and dry and provided with the necessary protection against moisture.
- The subfloor must be sufficiently level. (HusAMA98, Table 43. DC/-1 Class A and MDB.3).
- The EPS foam underlay must have sufficient compression strength (RA98Hus IBF.11, HusAMA98IBF.11 or SS-EN13163).
- The foam sheets must comply with the necessary thickness tolerance (HusAMA98 IBF.11 or SS-EN13163).
- Soft, springy subfloors must be rectified. For example, carpets with a thick pile must be removed.

### Humidity and temperature

The chapter on MD in RA states that the air's relative humidity (RH) should lie between 30–60%. If the RH is above 60% the premises must be dehumidified. If it is below 30% there is a risk of concavity. The temperature must be at least 18°C.

It is important for parquet floors that the RH of the air is maintained within the specified limits. Permanent damage can occur if the RH is too high.

HusAMA98 JSF states, for example, that if the size and number of gaps exceed those prescribed by AMA, it is often due to excessive humidity followed by drying out.

A parquet floor must always be protected against moisture from the subfloor. For protection against moisture (vapour barrier), we recommend 0.2 mm ageing-resistant PE sheeting, i.e. sheeting that meets the requirements in the current edition of SPF's Verksnorm 2000. The sheeting must be laid with an overlap of at least 200 mm. We also approve Kährs Tplex as a vapour barrier.

The underlay must always be clean and free from organic material such as wood chips, scraps of paper, etc., before the vapour barrier is installed. The organic material will otherwise cause mould when the RH under the sheeting subsequently increases.

HusAMA98 JSF.52 deals with building moisture. It specifies 60% relative humidity (RH) as the upper limit in suspended floor structures (e.g. concrete) before protection against moisture in the form of a vapour barrier normally becomes necessary.

Note that newly cast concrete floor structures are never sufficiently dry by the time a floor is installed, and a vapour barrier is therefore always needed. A few months after the concrete is cast, the RH in the structural floor is usually <95% and moisture measurement is not normally necessary.

A vapour barrier is obligatory for certain types of structural floors irrespective of age.

HusAMA98, MD states:

### When installing a floor on

- ground-supported floors
- structural floors above warm or humid areas (boiler rooms, laundry rooms)
- above a crawl space foundation
- warm floors (underfloor heating)
- lightweight concrete floor structures

the floor construction **MUST** be provided with a vapour barrier.

Lightweight concrete floor structures must be fitted with a vapour barrier because of the long drying-out time.

If the RH in the substrate is over 95%, a plastic sheeting vapour barrier does not give sufficient protection against moisture.

### Curvature

For an installed parquet floor to perform satisfactorily, the substrate must have a sufficiently smooth surface. The requirements in HusAMA98, Table 43. DC/-1, class A apply to all floors from Kährs.

The tolerance is  $\pm 3$  mm over a measured length of 2 m, and  $\pm 1.2$  mm over a measured length of 0.25 m. Kährs also approves a tolerance of  $\pm 2$  mm over a measured length of 1 m.

### Equipment

A straight edge should be used. Two lengths should be used, with pegs at 0.25 m and 2.0 m centres respectively. The contact area between the pegs and the substrate should be 100 mm<sup>2</sup>. Kährs also approves a 1.0 m straight edge for check measurements. A wedge gauge should be used. Precision levelling is an alternative to using a straight edge.

### Procedure

When measuring, the straight edge must be located in the most adverse position on the surface.

- The pegs must not be located in joints in brickwork or similarly pronounced joints.
- However, irregularities in construction joints in concrete or slab floors are also covered by the measurement requirements.
- The tolerance requirements in AMA are set as absolute values and must therefore be complied with at each measurement point. Measurements made in this way always result in a pass or fail.
- The imaginary line between the pegs' contact surfaces with the substrate is used as the reference value. All measurement points along the line must then meet the stipulated requirements wherever the straight edge is placed.

Even if the curvature requirements are met, the wood floor is not necessarily in constant contact with the substrate. However, the flexing that occurs is not harmful to the board.

**Example A**

Situation: Measurement length = 2 m, Peg height = 10 mm  
 Tool = Wedge gauge  
 If the wedge gauge measurement is 7 mm, the plus value is (+)  $10 - 7 = 3$  mm. Therefore a pass.

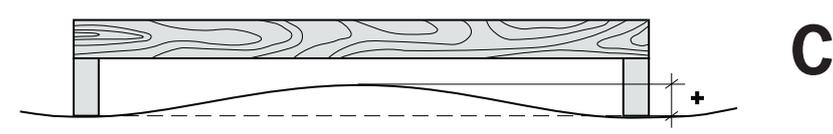
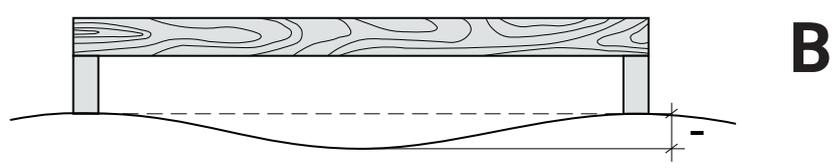
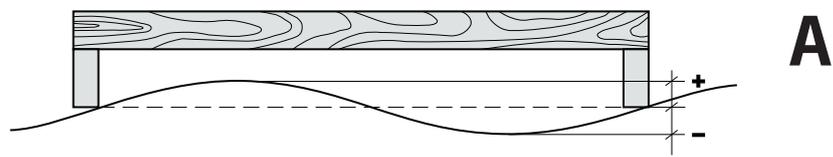
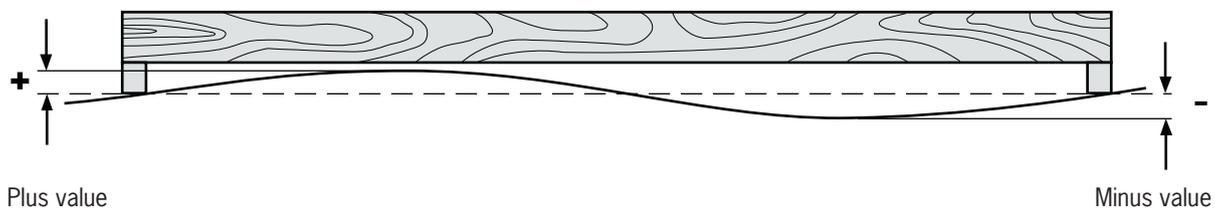
**Example C**

Situation: As in example A  
 Moving the straight edge to the left gives the plus value (+)  $16 - 10 = 6$  mm, which is also a fail.

**Example B**

Situation: As in example A  
 If the straight edge is moved to the right so that the pegs contact the elevated areas, the minus value is (-)  $16 - 10 = 6$  mm. This is a fail because all measurement points must meet the specified tolerance requirements. No value, + or -, must be greater than 3 mm.

**Example of measurement of curvature:**



## SPECIFIC REQUIREMENTS FOR FLOORS GLUED TO THE SUBSTRATE

### General

If the floor material is to be glued to a concrete substrate, the surface must be strong enough to withstand a scratch test without the concrete flaking. This also applies to floor surfaces finished with a levelling compound. If a weak surface skin remains it must be ground away, otherwise the adhesive will not bond properly.

If the substrate construction means it is not possible to glue directly to it, or if a vapour barrier is required, a sheet material must be laid under the wood floor. Even if a sheet material is not a requirement, it may still be advisable to use it, as a surface to glue the floor to. The floor can then be stripped out easily when it needs replacing.

### Suitable sheet materials for this purpose are:

- Good quality chipboard of at least class 2 SIS 234801, 19 mm thick. A minimum of 16 mm may be suitable provided the substrate is level.
- Plywood (preferably pine), at least B quality and min. 12 mm thick, driven or screwed to the substrate at 400 mm centres.

Always follow the sheet manufacturer's installation instructions.

Note the adhesive manufacturer's priming requirements for these substrates.

The surface must also be clean and free from dust, grease and dirt. Any old adhesive residues on the substrate should normally be removed (follow the adhesive manufacturer's instructions). If the sheet manufacturer has used a mould release agent in production, adhesion can be jeopardised. To ensure a good bond, the sheets should be sanded.

If the substrate requires an expansion joint, the same also applies to the parquet. Otherwise, very large continuous areas can be laid

without joints. Floors laid in patterns must usually be glued down to perform well. Whenever the floor is glued down, the end joints should be staggered because this levels out the floor and avoids bond failure when the adhesive dries. To ensure adhesion, the floor can be weighted down while the adhesive dries.

### Adhesive used for gluing

Surface-treated products to be glued to suspended concrete floor structures that do not exceed RH 65% must be glued using an adhesive that does not contain water, such as an MS polymer adhesive.

Irregularities in the substrate must never be levelled with adhesive because this results in an uneven and inadequate bond. Use a spreader that applies the correct amount of adhesive. The adhesive manufacturer's instructions must be followed.

Kährs parquet boards with Woodloc® joints can be glued to the substrate. The laying wedge with pullout string used for Woodloc® installation is designed so that it can also be used when gluing.

For gluing to suspended concrete floor structures where the RH exceeds 65% read the section above and make sure that you follow the adhesive manufacturer's instructions.

MS polymer adhesive does not give the same moisture protection as a vapour barrier.

**When a factory-finished floor that has been glued down using an MS polymer is re-lacquered, the bond between the new coat of lacquer and the factory-finished lacquer cannot be guaranteed.**



## WOOD FLOORS AND UNDERFLOOR HEATING

### General

Wood floors and underfloor heating are often combined nowadays and work well together. The heating system used – electrical or water – is of no significance to the wood floor. The underfloor heating system must deliver no more than 80 W/m<sup>2</sup>, evenly distributed. The surface temperature of the floor must never exceed 27°C. This applies even next to/above radiator pipes, above pipe runs and under carpets, furniture etc.

In a normally insulated house, with a properly functioning underfloor heating system, the temperature of the floor surface is generally 2°C higher than the room temperature. In a warm water underfloor heating system, the flow temperature is usually 7–12°C higher than the floor's surface temperature.

The installation instructions for each type of floor also apply to installation over underfloor heating. This section discusses issues particular to wood floors over underfloor heating.

### Specific requirements for wood floors over underfloor heating

- The floor construction must have a heat-distributing layer that gives a very even temperature across the entire floor area, in order to avoid excessive temperatures near the heat source.
- The entire living area must be heated. However, this does not apply to comfort heating systems, which complement the normal heating. The temperature in this case is significantly lower than the permitted 27°C at the floor surface.
- The floor covering (including intermediate layer) should have a low thermal conductivity.
- It must be possible to control and limit the surface temperature very accurately.
- The installed floor's temperature must never exceed 27°C. This also applies under carpets and furniture. If the room does not have too many textile floorcoverings or particularly thick rugs, it is reasonable to achieve 23°C in the clear floor areas, giving a room temperature of approximately 21°C. The proviso, of course, is that the room has normal heating requirements, i.e., it must have normal standards of draughtproofing, insulation, window area, ceiling height, etc. Note that the requirement for max. 27°C also applies to pipe runs from bypass groups.
- A vapour barrier must be built into the floor construction. This should be as close to the wood floor as possible. It is particularly important that the vapour barrier is close to the wood floor if the structural floor is thick or heavy. Under no circumstances must the vapour barrier be on the opposite side of the structural floor.
- The wood floor must lie tightly to the substrate, without air gaps that may cause substantial drying of the wood.
- However, Kährs Activity Floor can be installed over underfloor heating because there are no air changes to cause drying.
- Provided the conditions above are met, both warm water and electrical underfloor heating systems are suitable for use with Kährs wood floors.

**Note that thick rugs, etc., can result in damagingly high temperatures in the wood floor.**



### Choice of wood floor

All Kährs floors have Woodloc® joints, which reduces the risk of gaps occurring.

Hard Maple (Canadian Maple) and Beech multi-layer parquet expands and contracts more than other species. Underfloor heating increases drying, which causes additional contraction. In a cold and dry climate, gaps may therefore appear between strips and between boards.

### Thermal conductivity in W/(m\*K)

| Product                               | Without intermediate layer |
|---------------------------------------|----------------------------|
| Kährs wood floors<br>14, 15 and 20 mm | 0.14                       |
| Kährs Linnea 7 mm                     | 0.22                       |



Underfloor heating gives the ideal distribution of heat within a living space.

## VAPOUR BARRIER/DAMP-PROOF MEMBRANE

### Vapour barrier

A vapour barrier must be located as close to the floor as the construction permits. This usually means it is placed under the intermediate layer. We recommend 0.2 mm thick polyethene (PE) sheeting that meets the requirements in the current edition of the Swedish Plastics Federation's Verksnorm 2000 as a vapour barrier. The sheeting is laid with an overlap of min. 200 mm in accordance with RA98Hus JSF.5 and JSF.52. With this overlap the joints need not be taped.

Applying coats of so-called damp-proofing agents can never replace a vapour barrier, i.e. protect against moisture penetration. For substrates where a vapour barrier is always required, read section "Humidity and temperature".

When a vapour barrier is used with an intermediate layer, the sheeting must be placed under the intermediate layer. Kährs Tuplex is approved as a vapour barrier provided it is installed as instructed.

In accordance with HusAMA98 JSF.512, plastic sheeting must not be used for protection against moisture if the RH in the substrate is >95%.

### Damp-proof membrane

When installing on a floor surface with a RH >95%, the damp-proof membrane can sometimes be used for protection against moisture in accordance with HusAMA 98 JSF.71. Damp-proof membranes are made by a number of manufacturers, e.g. Platon and Matak, and must be installed in accordance with the manufacturer's instructions. For maximum effectiveness, the construction must be mechanically ventilated.

## IMPACT SOUND INSULATION – INTERMEDIATE LAYER

To achieve a quiet and pleasant floor to walk on, some form of intermediate layer should always be installed between the substrate and the wood floor. The most commonly used are polyethene foam, felt paper or Kährs Tuplex.

Where an impact sound insulation rating is required, the underlying construction is crucial. For this reason we cannot provide general recommendations. However, when installing a floor in a typical family house (where there are no standardised requirements), Kährs Tuplex or polyethene foam is normally sufficient.

Floors that are glued down do not improve impact sound insulation.

The intermediate layer is placed between the subfloor and the wood floor. It must be installed edge-to-edge, i.e. with no overlaps.

When an intermediate layer is used with a vapour barrier, the intermediate layer must be laid over the vapour barrier, which is then protected against abrasion and perforation.

Kährs has tested a number of intermediate layers with regard to impact noise insulation. The results of these tests, carried out at the Swedish Testing and Research Institute (SP), are given below.

If an impact sound reduction rating is required, please contact an acoustics specialist.

| Floor description                           | Impact sound $\Delta L_w$ (dB) | Impact sound class | Airborne sound $\Delta R_w$ (dB) |
|---|--------------------------------|--------------------|----------------------------------|
| 7 mm Kährs wood floor + flooring paper L400 | 16                             | 7                  | -2.0                             |
| 7 mm Kährs wood floor + Cellofloor 2 mm     | 19                             | 7                  | -2.0                             |
| 7 mm Kährs wood floor + Cellofloor 3 mm     | 19                             | 7                  | -3.0                             |
| 7 mm Kährs wood floor + Airolen® 1.8 mm     | 18                             | 7                  | -2.0                             |
| 15 mm Kährs wood floor + Cellofloor 2 mm    | 17                             | 7                  | -1.0                             |
| 15 mm Kährs wood floor + Cellofloor 3 mm    | 18                             | 7                  | -1.0                             |
| 15 mm Kährs wood floor + Airolen® 1.8 mm    | 17                             | 7                  | -1.0                             |
| 15 mm Kährs wood floor + Airolen® 3.0 mm    | 18                             | 7                  | -0.5                             |
| 15 mm Kährs wood floor + Tuplex             | 18                             | 7                  |                                  |

## CONCRETE FLOORS AND LEVELLED FLOORS

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The following applies in addition to the general requirements: A vapour barrier is obligatory on ground-supported floors, crawl space foundations and newly cast suspended floor structures.

Concrete floors that were previously not intended for parquet installation must usually be levelled because a parquet floor requires a smoother substrate.

**Floating floors:** Uneven concrete floors must be levelled using a levelling compound.

**Glued-down floors:** If the construction requires a vapour barrier, this must be covered with a sheet material. When the floor is glued to sheets and concrete subfloors, large areas can be installed without expansion joints. When gluing, MS-polymer adhesive is not an adequate vapour barrier.

## TIMBER FLOOR STRUCTURES

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The following applies in addition to the general requirements: The timber floor structure must be sufficiently dry (max 10% moisture content). To avoid creaking, make sure that battens and joists are level.

The end joints of adjoining rows of boards must be staggered by at least 500 mm, and adjoining rows of boards must not have end joints that fall within the same section of framework. It is not necessary to locate the end joints over the battens.

## CHIPBOARD

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The following applies in addition to the general requirements: Chipboard sheets must be sufficiently dry (max. 9.5% moisture content). Note that the maximum width for laying chipboard sheets may be less than for the multi-layer parquet.

**Glued-down floors:** When installing on a solid substrate, such as ground-supported floors, the chipboard sheet must be at least 16 mm thick. If the construction requires a vapour barrier, this must be placed under the chipboard sheet. The sheets must not be fixed to the substrate. If the sheet manufacturer has used a mould release agent in production, adhesion can be jeopardised. To ensure a good bond, the sheets should be sanded.

## PLYWOOD

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Plywood can be used as substrate for a glued parquet floor on concrete when a vapour barrier is required.

The following applies in addition to the general requirements: The plywood sheets must be sufficiently dry (max. 9.5% moisture content).

**Glued-down floors:** The plywood sheet must be at least 12 mm thick when installing on a level substrate such as a ground-supported floor. If the construction requires a vapour barrier, this must be placed under the plywood sheet, which must be nail-gunned or screwed to the substrate at 400 mm centres.

## EXISTING WOOD FLOORS

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The following applies in addition to the general requirements: The timber floor structure must be sufficiently dry (10% moisture content).

**Floating floors:** Multi-layer parquet is normally installed at right angles to the existing floor. Provided the old floorboards are level, the new floor can be installed in the same direction as the old floorboards.

## PVC FLOORING

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The following applies in addition to the general requirements: Floors that were previously not intended for parquet installation must usually be levelled because a parquet floor requires a smoother substrate.

**Floating floors:** PVC flooring may be considered to act as a vapour barrier provided the flooring and any joints are sealed and intact. If an underfloor heating system is to be installed, the PVC flooring must be removed, which may affect impact sound.

**Glued-down floors:** It can be difficult to achieve adhesion to PVC flooring. There is often no information about how the flooring is stuck to the subfloor or which adhesive was used. If the bond is inadequate, the PVC flooring may lift because it is pulled by the glued wood floor. It is therefore recommended that this flooring be removed.

## LINOLEUM FLOORING

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The following applies in addition to the general requirements: Floors that were previously not intended for parquet installation must usually be levelled because a parquet floor requires a smoother substrate.

**Floating floors:** Linoleum flooring is made of organic material, so it must be removed if the construction requires a vapour barrier. If an underfloor heating system is to be installed, the flooring must be removed, which may affect impact sound.

**Glued-down floors:** It can be difficult to achieve adhesion to linoleum flooring. There is often no information on how the flooring is stuck to the subfloor. If the bond is inadequate, the linoleum flooring may lift because it is pulled by the glued wood floor. It is therefore recommended that this flooring be removed.

## CERAMIC TILES

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The following applies in addition to the general requirements: Note that this type of floor was often used in the past because of the risk of moisture penetration from below. The need for a vapour barrier must therefore be checked carefully.

**Glued-down floors:** Gluing directly onto ceramic tiles is not possible. If the surface is roughened (e.g. with carborundum) a solvent-based adhesive can be used. Ceramic tiles are often used in humid premises and hygiene areas. The difficulty in removing grease, particularly from the joints, in hygiene areas means gluing onto this

substrate can be very difficult. For sheet materials suitable for use as a substrate, see section “Specific requirements for floors glued to the substrate”. Contact your adhesive supplier for more detailed information.

## NEEDLEFELT CARPET

The following applies in addition to the general requirements: Remember that carpets may contain residues of organic material that can go mouldy in the presence of moisture. Floors that were previously not intended for parquet installation must usually be levelled because a parquet floor requires a smoother substrate.

**Floating floors:** Floating installation is normally possible. However, the carpet must be removed if it lies on a construction that requires a vapour barrier. Generally, it is recommended that the carpet be removed.

Kährs Linnea can be installed on this substrate.

**Glued-down floors:** Gluing is not possible. Remove the carpet. If the floor lies on a construction that requires a vapour barrier, lay a sheet material.

## FITTED CARPET

The following applies in addition to the general requirements: Remember that carpets may contain residues of organic material that can go mouldy in the presence of moisture. Floors that were previously not intended for parquet installation must usually be levelled because a parquet floor requires a smoother substrate.

**Floating installation of 15 mm multi-layer parquet:** If the carpet's pile is short, a floating installation can be carried out on top of the carpet, otherwise the carpet must be removed. The carpet must be removed if the construction requires a vapour barrier. We generally recommend that the carpet be removed.

**Floating installation of Kährs Linnea:** The carpet must be removed.

**Glued-down floors:** Gluing is not possible. Remove the carpet. If the floor lies on a construction that requires a vapour barrier, lay a sheet material.

## LIGHTWEIGHT CONCRETE

The following applies in addition to the general requirements: We always recommend a vapour barrier on this substrate, whatever its age. Uneven lightweight concrete floors must be levelled using a levelling compound.

**Glued-down floors:** Because a vapour barrier is required, it must be covered with a sheet material to which the floor can be glued. The vapour barrier is laid under the boarding.

## EPS FOAM (EXPANDED POLYSTYRENE)

When applying supplementary insulation to concrete floor structures it is important to use EPS sheets designed for wood floor installation. To avoid undesirable flexing and long-term damage, the thickness tolerance of the sheets should be  $\pm 0.5$  mm (see HusAMA98 IBF.11). Note that EPS sheets for (e.g.) ground insulation under concrete floor structures have a much higher thickness tolerance. This makes such sheets unsuitable. For the same reason, bowed sheets should not be used. Follow the foam manufacturer's instructions.

Our instructions regarding EPS foam are:

**Floating installation of 15 mm wood floors in domestic rooms:** EPS foam with a compressive strength of at least 150 kPa (density 30 kg/m<sup>3</sup>), in accordance with SS-EN 13163. An intermediate layer is placed between the foam and boards.

**Floating installation of Kährs Linnea in domestic rooms:** EPS foam with a compressive strength of at least 150 kPa (density 30 kg/m<sup>3</sup>), in accordance with SS-EN 13163, must be covered with sheets of load-distributing chipboard at least 10 mm thick or 6 mm tongue and groove chipboard or fibreboard.

## HDPE AIR-GAP MEMBRANES

The following applies in addition to the general requirements: Air-gap membranes are significantly more impervious than vapour barriers, and additional protection against moisture is not necessary. The membrane should meet the requirements in HusAMA 98 JSF.7, JSF.71 and JSF.72. A membrane is often used in environments where there is a high risk of capillary suction in concrete or poor air. This construction is therefore often combined with mechanical ventilation for maximum effect.

**Floating floors, 15 mm:** Several options are available on the market. Follow the manufacturer's recommendations and instructions.

**Floating installation of Kährs Linnea in domestic rooms:** Kährs Linnea can be installed on Delta FM Yellow Line and Platon Multi without a load-distributing sheet. A 10 mm load-distributing chipboard sheet must be laid on Blue Platon. Otherwise, see the manufacturer's recommendations and instructions.

**Floating installation of Kährs Activity Floor 30 mm:** Blue Platon is one of the membranes that cannot be used as an underlay for Activity Floor.

**Glued-down floors:** See Kährs Installation Guide.

## AIR-GAP SUBFLOOR SYSTEM

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The following applies in addition to the general requirements:

**Floating floors:** When installing a subfloor system such as Nivell or Granab, a 22 mm chipboard sheet must be screw-glued to the battens in accordance with the manufacturer's instructions.

Remember that in many cases the wood floor must be protected with a vapour barrier. Follow the subfloor system manufacturer's instructions regarding mechanical ventilation.

## SECONDARY SPACED BOARDING

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This construction is often used in connection with underfloor heating.

The following applies in addition to the general requirements:

**Floating floors:** 15 mm multi-layer parquet can be installed on 28 x 120 mm secondary spaced boarding, ideally at 160 mm centres.

These recommendations apply to installation on secondary spaced boarding on joists at max 600 mm centres.

## SAND

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The following applies in addition to the general requirements:

**Floating floors:** 15 mm multi-layer parquet can be installed on a layer of sand. In accordance with HusAMA98. MDB.336, the sand must be covered with plastic sheeting laid with a min. overlap of 200 mm. The sheeting must also be turned up the walls.

## PLASTERBOARD SHEETS

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The following applies in addition to the general requirements:

**Floating floors:** Plasterboard sheets can be used as a substrate for floating installation.

**Glued-down floors:** Do not glue to paper-faced plasterboard sheets because it may make the paper-layer delaminate.

## GENERAL INFORMATION ABOUT MOISTURE

Moisture is a very important factor in floor installation and has a major impact on the end result. It is therefore important to know how moisture affects floors and floor installation and how to deal with the problem. Potential difficulties can be avoided with a little information and the right approach.

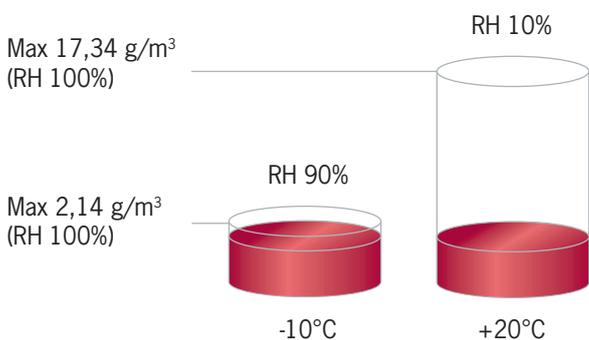
### Relative humidity (RH)

Definition: The air's capacity to absorb and hold moisture is related to the air's temperature. In winter, the outdoor temperature is normally low, resulting in a high RH. For example, if the outdoor temperature is -10°C, the air can hold a maximum of 2.14 g water/m<sup>3</sup> air. Taking this outdoor air in via ventilation and heating it to +20°C does not change the quantity of water. At +20°C the air can hold a maximum of 17.34 g water/m<sup>3</sup> air. At 20° C, 2.14 g/m<sup>3</sup> is less water than the air can hold, which means the relative humidity is low. See the figure below.

The diagram below shows how the RH varies during the year. The position and amplitude of the curve vary in different parts of the world. (This curve reflects conditions in the Nordic region.) As can be seen from the graph, wood has a lag effect, so the EMC (equilibrium moisture content) curve is somewhat flatter than for moisture in the indoor air.

All porous materials, e.g. wood, tend to achieve the same relative humidity as that of the surrounding air. Wood is a hygroscopic material, which means that it swells or shrinks depending on the ambient climate. Different species of wood move to different extents. Furthermore, wood does not move uniformly. The manufacturing method gives multi-layer parquet and Linnea a cross-ply or locked construction because the various layers are at different angles. The movements are only 25–30% of the movements of solid wood.

The greater the ventilation in winter, the drier the indoor air (and hence the floor) becomes. This also applies, of course, to mechanically ventilated buildings.



The table below shows the shrinkage when fresh wood is dried to 0% moisture content: Wood is anisotropic, i.e. it has different properties in different directions, which is particularly apparent in shrinkage and swelling, for example.

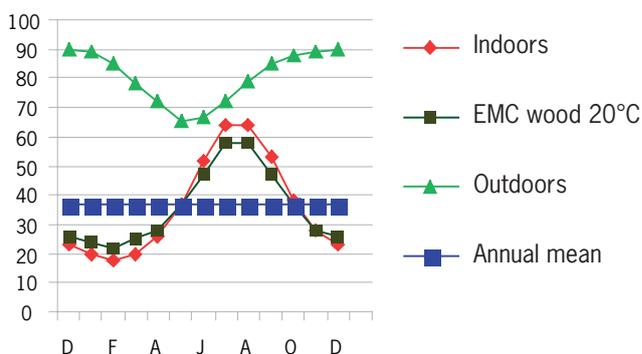
However, movement due to moisture cannot be entirely prevented. It is therefore important that there is a movement joint in between the floor and the wall and other fixed objects when a parquet floor is installed floating. To stop the floor absorbing moisture before installation, it is important not to open packaging until just before installation. The boards in an unopened package have an RH corresponding to approximately 40% at 20°C. This is the annual mean indoor value in the Nordic region.

In practice, wood's hygroscopic properties mean that the cross-section of a multi-layer floor is slightly concave in winter and slightly convex in summer. To limit concavity to an acceptable level, the relative humidity in winter should not be less than 30%.

**Important:** Moisture levels in newly built premises are often still high when parquet floors are installed. To avoid damage it is important that the relative humidity during and after installation is below 60%. The floor boards may be permanently deformed if their relative humidity exceeds 60%. This could occur if the floor is installed in newly built premises with inadequate or no ventilation, e.g. during holiday periods.

Ventilation is a simple way of keeping the relative humidity low when installing floors in newly built premises. Note that excessive airing/ventilation in winter during "normal conditions", i.e. in an occupied building, can make the RH too low.

The temperature of rooms and materials must be at least 18°C. See Hus AMA98 MD. A parquet floor must not therefore be installed until all other trades, such as painters and tilers, have finished their work and the site has the correct RH.



When drying from fresh wood to 0% moisture ratio, the shrinkage is as follows:

| Wood            | Across annual rings | Along annual rings | In fibre direction | Volume |
|-----------------|---------------------|--------------------|--------------------|--------|
| Oak and Pine    | 4%                  | 8%                 | 0.4%               | 12%    |
| Beech and Alder | 6%                  | 12%                | 0.3%               | 18%    |

### Moisture protection

Moisture protection is not normally necessary on structural floors where the relative humidity is below 60%. Note that newly cast structural floors do not meet this requirement, so moisture protection is always needed.

Moisture protection prevents the diffusion of moisture (moisture migration) between different building materials in a building, and normally consists of 0.2 mm age-resistant polyethylene. Installation instructions for vapour barriers and intermediate layers can be found in the section "Vapour barrier/Damp-proof membrane" in this brochure.

Moisture migration in constructions is determined by vapour pressure, which in turn depends on the temperature and moisture content.

- At the same RH, a material with a higher temperature has a higher vapour pressure than one that is colder.
- At the same temperature, a material with a higher RH has a higher vapour pressure than one with a lower RH. (Compare with ground-supported slab.)

The vapour pressure in a construction will tend to even out, and therefore equalise itself between areas with higher and lower vapour pressures, which is usually from warm to cold.

In certain situations the moisture migrates in the "wrong direction" (but still from the higher vapour pressure to the lower pressure). If

this occurs in a floor construction such as a crawl space foundation with a pre-finished wood floor without a vapour barrier, the floor's surface treatment will be the first impervious layer the moisture will encounter. This will cause the wood at the wood floor's surface to swell and eventually to be damaged.

Certain constructions will load the vapour pressure, due to additional moisture, with high moisture content or relatively higher temperature.

When installing on a floor surface with a RH >95%, the damp-proof membrane can sometimes be used for protection against moisture in accordance with HusAMA 98 JSF.71. Damp-proof membranes are made by a number of manufacturers, e.g. Platon and Matak, and must be installed in accordance with the manufacturer's instructions. For maximum effectiveness, the construction must be mechanically ventilated.

Moisture protection on the following subfloors, whatever their age, is obligatory for the reasons given above:

- underfloor heating
- concrete floor lying directly on the ground (ground-supported slab)
- floor above warm or humid area (e.g. boiler room or laundry room)
- structural floor above a ventilated crawl space foundation
- lightweight concrete floor structures

**Moisture is often the cause of a problem**

Complaints about wood floors arise most often from damage caused by the effects of high humidity followed by drying out. The humidity of a wood floor is directly proportional to the humidity of the surrounding air. If the air humidity is high, the wood floor's moisture content increases and the floor will expand. High air humidity can be caused by general building moisture, or more usually by building moisture in the concrete floor structure plus water vapour penetrating by diffusion through the structural floor from the ground.

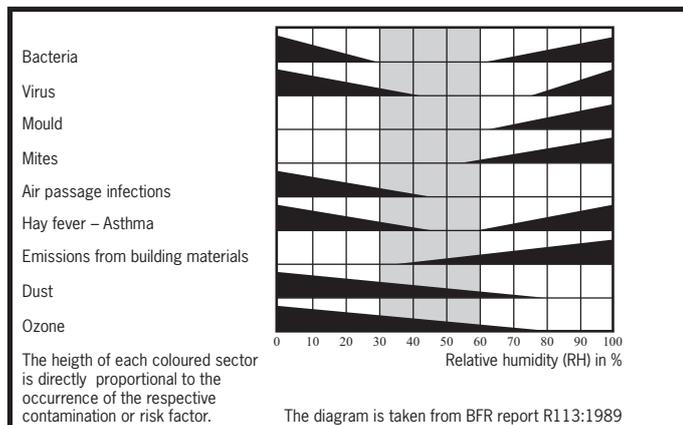
The damp wood floor contracts when it subsequently dries.

A large excess of moisture will damage the floor permanently.

Even natural seasonal variations can cause a certain amount of movement – expansion and contraction – in a wood floor as well as minor cross-sectional changes. These changes are not normally permanent. For example, during the summer and autumn multi-layer boards have a slightly convex cross-section as a result of expansion. The boards then contract in winter when the heating is on and acquire a slightly concave cross-section. Kährs Linnea can even exhibit the opposite behaviour when it gets damp. Gaps can appear between the boards, but these will disappear as the RH increases.

The ideal RH for wood is 30–60%. This is also advantageous for other reasons. The table "Sunda hus" (Healthy buildings) from BFR report R113:1989 shows that at higher or lower RH, problems such as mould, bacterial growth, asthma, etc., are created or aggravated in indoor air.

**The diagram shows the importance of air humidity indoors.**



There is therefore good reason to try to maintain the RH of indoor air at 30–60%.

Moisture compass for relating the air's relative humidity (RH) to a floor's moisture content (MC).

**Example of interpretation of moisture compass:** The levels of RH and MC on opposite sides of the diagram correspond to each other.

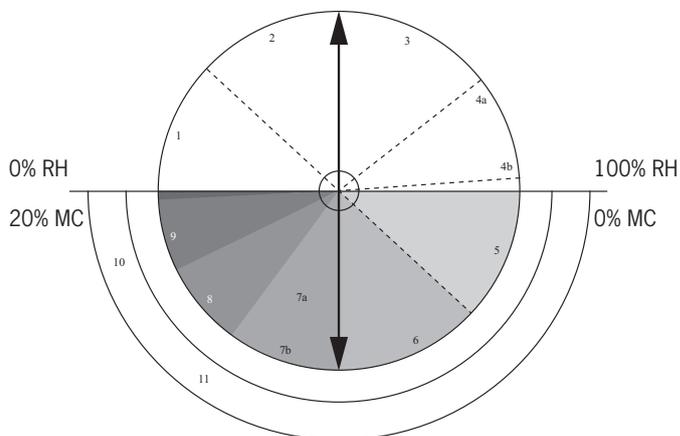
When delivered, our floors have been dried to approximately 7% MC, which corresponds to "a centrally heated room with a constant climate" at approx. 40% RH. In a new building (e.g. a timber house), the building material normally used is only air-dry, which corresponds to outdoors under cover.

If, for example, the floor battens are not sufficiently dry, the parquet floor may become damagingly damp, and gaps will form when the wood floor subsequently dries. When damp battens contract, it results in a floor that rattles or creaks.

Moisture content, %, in floor material at 20°C.

Relative humidity (RH) – Moisture content of air relative to that of saturated air.

Moisture content (MC) – Percentage of moisture by weight relative to the material in dry state.



- 1. Extremely dry climate
- 2. Centrally-heated room with constant climate
- 3. None centrally-heated room with varying climate
- 4a. Outdoors under shelter
- 4b. Outdoors not covered
- 5. Extremely dry wood
- 6. Furniture-dry
- 7a. Joinery-dry
- 7b. Planing-dry
- 8. Storage-dry
- 9. Air-dry
- 10. Danger of mould
- 11. Construction timber