Fidbox®

Electronic Monitoring System

WOOD MOISTURE BALANCE - THE CHARACTERISTICS OF WOOD

… Forward

This article has been compiled as general as possible but with strict consideration for indoor living conditions in geographical areas with seasonal weather fluctuations and fluctuations in outdoor temperature and relative humidity. It does not consider those geographical regions of the world where only mild fluctuations are expected and where due to persisting warm climate conditions indoor room climate controls (air-conditioning) can be expected. Though most information is general it is intended to be directed at the use of hardwood parquet flooring and the effects of relative humidity plus temperature in an enclosed environment. The technical information contained herein corresponds with recognized rules of technology at the time of printing. Despite most careful preparation and correction, liability cannot be accepted. It has been gathered from diverse sources and there is no claim to originality or ownership.

Wood is a hygroscopic material, i.e. wood can absorb water and wood can give off water. Through this characteristic there is a relationship between the humidity of the environment, in which the wood is finished and the wood moisture. This relationship is called wood moisture balance. Further technical terms: balanced dampness, wood moisture equilibrium, and dampness absorption.

… Water in the wood

After a tree has been cut down the cellular cavities (free water) and cellular walls (captured water) are filled completely with water. During the storage phase the tree releases constantly water as the wood dries from the inside outwardly (even if it is stored in the open air). The free water of the cellular cavities is first to be released. If these cellular cavities are free of water and have dried and the cellular walls are still soaked with water, one speaks of a fibre saturation point (corresponds to about 30 % wood moisture). With continued drying the cellular wall subsequently releases likewise the confined water, until wood moisture corresponding to the local environmental climate is reached. With the release of the captured water, the cell walls become thinner, the wood becomes smaller: it reduces itself in volume and shrinks, until the water is completely removed (Dry, 0 % wood moisture). Wood changes its size partially, thus between fibre saturation point (maximum wood volume) and Dry (minimum wood volume) substantially dependent upon wood type. Because wood is hygroscopic, it must always adapt its own dampness to the currently dominant air humidity. During this process it constantly changes its volume. When air humidity increases, also the moisture content of wood rises: the wood expands. If air humidity decreases, also the moisture content of wood decreases: the wood shrinks. These constant adjustments are defined as the working of the wood.

… Joints

Wood thus adapts itself with its own humidity to the air humidity of its immediate environment. Because the air humidity constantly changes, also the moisture content of wood changes constantly. Because wood changes its volume with the changes of dampness also, wood is always in movement, it expands or it shrinks.
Therefore, greater or lesser sized joints will appear seasonally between the parquet elements.
During winter, with dry room climate conditions, creating low air humidity and warm air, a somewhat larger joint will occur and in summer with higher air humidity they will be smaller in size.
Parquet is supplied and installed with “middle wood moisture” of approx. 9% residual moisture, which corresponds to the wood moisture, in a room climate approx. 20° to 22°C with approx. 50% of relative humidity. In summer the relative humidity lies usually over this value, in the winter usually much lower.

Accordingly, wood moisture changes and therefore deformation of parquet is inevitable. In the summer the parquet will slightly expand, in the winter it will shrink, so that joints or bowing/cupping of the parquet elements can occur. These joints and bowing are a natural characteristic and not a defect. The formation of joints and bowing can be reduced if in the winter sufficient ventilation and the implementation of an air moisturizer which provides higher room humidity. A hygrometer is relatively inexpensive and gives security about the correct adherence to room climate conditions. Each room in a building from cellar to attic should have one!

…an example

Parquet flooring is dispatched from the warehouse with a wood moisture content of approx. 9 %. That corresponds to a room climate of approx. 20° C temperature and approx. 50 % air humidity. The parquet lies stabile, joint-free and without bowing. In a dry winter period, the air humidity can decrease below approximately 30% or lower. If we maintain the 20° C room temperature, the moisture content of wood reduces to approx. 6 %. The parquet gets wide joints and bowing or cupping becomes visible on the surface. Damage can occur.

Dependence of room climate conditions wood moisture, air temperature and air moisture							
relative air humidity	**Values of the wood equilibrium humidity in %**						
90%	21,1	21,0	21,0	20,8	20,0	19,8	19,3
85%	18,1	18,0	18,0	17,9	17,5	17,1	16,9
80%	16,2	16,0	16,0	15,8	15,5	15,1	14,9
75%	14,7	14,5	14,3	14,0	13,9	13,5	13,2
70%	13,2	13,1	13,0	12,8	12,4	12,1	11,8
65%	12,0	12,0	11,8	11,5	11,2	11,0	10,7
60%	11,0	10,9	10,8	10,5	10,3	10,0	9,7
55%	10,1	10,0	9,9	9,7	9,4	9,1	8,8
50%	9,4	9,2	9,0	8,9	8,6	8,4	8,0
45%	8,6	8,4	8,3	8,1	7,9	7,5	7,1
40%	7,8	7,7	7,5	7,3	7,0	6,6	6,3
35%	7,0	6,9	6,7	6,4	6,2	5,8	5,5
30%	6,2	6,1	5,9	5,6	5,3	5,0	4,7
25%	5,4	5,3	5,0	4,8	4,5	4,2	3,8
Temperature in °C	10	15	20	25	30	35	40

…Dampness behaviour/deformation

With this dampness balance, dimensional changes occur. With moisture collection the wood expands and with the release of moisture it shrinks. The form changes caused by moisture are “anisotropic” i.e. moisture caused variations in length in direction of the wood fibres are negligibly small, while in the radial direction (transverse to the annual rings) 10 to 20 times in tangential direction (parallel to the annual rings) 20 to 40 times larger than parallel to the fibre.

In the table above, indicative numbers for deformations are given for each 1 % change of wood moisture content. The shrinking of the wood affects the joint formation of parquet during the heating season. For example a parquet plank of solid red beech with a width of 50 mm shrinks by a wood moisture change of 12 % to 8 % maximum 4 x 0,44% x 50 mm = 0,88 mm in the width.

The moisture adjustment occurs by the individual wood at different speeds: this “adapting speed“ is likewise indicated in the table.

… Effects on the parquet

Damage caused by inappropriate cleaning or care and other such activities can create different effects. Too high moisture caused e.g. by damp wiping leads the parquet to very strongly expansion. The parquet sometimes tears from the underground and forms randomly noticeable bulging. A too low air humidity, dryness or heat influence causes the wood to dry and under circumstances shrinks very intensively causing larger joints to appear. Apparent uplifting or bowing/cupping of the edges of individual parquet elements can be seen and in the worst case, tension occurs and creates tears in the wood and the parquet top layer separates from the carrier layer respectively from the sub-floor. This is irreversible damage.

… Humidity and the effects of dry air:

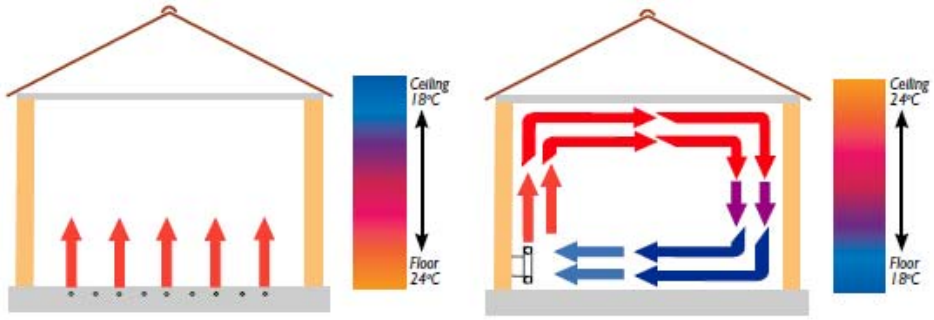
Apart from temperature and air purity, the third important factor in the maintenance of an ideal room climate is the moisture content of the air. Whilst the danger of excessive humidity in our latitudes (Europe) is comparatively low, often, during winter months when rooms are heated, we experience excessively dry air indoors. The consequences of dry air are severe.
Opening the windows will not help to avoid dry room air during the cold season. Instead, it is necessary to actively add moisture to the air, as just like people, the air becomes thirsty too. The art lies in giving the air just enough water to drink so that it reaches the ideal moisture content level. If moisture is not added to the air artificially, it will try to quench its thirst by taking the moisture from our skin, mucous membranes, plants, wooden furniture, etc.
Medical experts recommend a relative air humidity of between 40 and 60 per cent. At these levels, our senses tell us that the air in the room is ideally humidified. Then it is also ideal for our health, for the animals and plants in the room, for furniture, instruments and much more besides.

…Dry air has many nasty effects:

- Discomfort, tiredness, sickness - **Breathing in dry air makes the uptake of oxygen and its subsequent transfer to the blood system more difficult. Fatigue, tiredness and reduced concentration levels are symptoms of a reduced oxygen supply.**
- Increased susceptibility to colds - **The self-cleansing function of the windpipe is affected by dry air. The consequences: increased susceptibility to infections and respiratory tract complaints.**
- Dry skin - **Low relative humidity results in greater loss of moisture from the skin's outer layers. It becomes dry, rough and flaky, and has a tendency to become inflamed.**
- Dry hair - **A contributing factor to dull lifeless hair with split ends is dry air.**
- Increased levels of dust -**Humidity binds dust. Dry room air causes dust to rise. This is made worse by the thermal currents created by the radiators.**
- Increased static electricity -**Particularly in textiles.**
- Damage to wooden objects -**Furniture and other wooden objects have a dull surface in dry room air. They dry out and eventually cracks will appear.**
- Out of tune musical instruments - **Low moisture content in room air will cause musical instruments to go out of tune.**

…Understanding Indoor Heat Distribution:

In the table below you will find the two most common methods of heating a home today. A simple rule for the direction of transfer of heat is this: *Heat follows cold.*
Heat always follows the path of least resistance: whichever direction is cooler is the direction the heat will move.
What this means is that if there are two objects with different temperatures, the hotter object will always transfer heat to the colder object. The belief that heat rises is only true in one circumstance: heated air will rise as it forms convection currents. Heat energy itself normally moves in the path with the least energy (the coldest surface), whether it be up, down, or sideways.



Radiant Heat (underfloor heating) **Common wall radiator**

…Recommended Relative Humidity Level:

Generally, the “right” moisture level— the **relative humidity**—in your house is less than 50-55 per cent.
At less than 50 per cent **relative humidity** it is unlikely that mould will grow indoors. There are cases when 50 per cent **relative humidity** is still too high. For instance, if there is condensation on your windows in cold weather, it's a good idea to lower your **relative humidity**.
Another instance: if you, or someone in your family, is asthmatic, you should consider keeping the humidity level in the bedroom at around 40 per cent. Dust mites prefer **relative humidity** of 50 per cent and higher. Dust mites leave debris in bedding, and the debris aggravates asthma.
Sometimes, reducing **relative humidity** won't solve moisture problems. Defects in insulation or the air barrier in walls and ceilings can cause cold spots in your house. They show up as areas where there is always condensation, even if **relative humidity** is 50 per cent or less. A **dehumidifier** won't solve the problem. You will need help from a qualified builder, renovator or insulation specialist.

… Prevention

Everyone can contribute to the lasting value preservation of a parquet floor.
- Parquet production
For our modern and central heated dwellings this means that parquet floor coverings are stabilized in the production processes (in dry chambers) already so dried out, that it correlates with the expected local conditions. These conditions which can be considered an average annual expectation are the directives for parquet production. It provides the stability of wood humidity. Only with this procedure can the consumer be guaranteed that a parquet surface retains its exclusive appearance and value several years after installation.
This procedure for stabilization of the single species of wood and the carrier material requires a considerable amount of time and is quite cost intensive!

- Installation of parquet

Every qualified parquet installer or craftsman wants to ensure a good parquet installation with cautious controls of all circumstances in the process, before, during and after the completion of the parquet installation.
Especially important is the substrate control for stability and residual moisture.
Disastrous consequences can be expected should parquet be installed on a substrate that is not properly dry or wrong adhesives are used. This would have a lasting effect on quality and appearance. For this reason the builder should always listen to the advice of the installer. The responsibility of the parquet installer ends with the meeting & hand-over of the cleaning and maintenance instructions to the building owner or user.

- Building Owner and User

With the handing over of the cleaning and maintenance instructions passes the responsibility for the lasting value preservation to building owner or the end-user.
It is very important that the development of the room climatic conditions should be observed with technical support of a hygrometer.
People feel most comfortable in a healthy room climate. Should the air humidity be permanently too low during the winter months, you should implement a humidifier using the vaporization or ionization principle. You can get these devices in normal DIY sheds or other shops where household maintenance materials are sold. Always pay attention to the application of the right maintenance and preventive measures to ensure that your humidifier always stays clean and functional.
It is important that the user of a house takes the time to better understand the effects of indoor air humidity and its effect on the quality of healthy living.
Air Humidity has a maximum storage capacity for water vapor which depends on temperature. Warm air can store lots of moisture, while cold air can store very little. Please consider the average outdoor temperature and humidity statistics as given below for London in summer and winter which were provided by the UK Met Office as an example:

- Winter: average outdoor temperature = 4° C, average relative humidity = 80%
- Summer: average outdoor temperature = 17° C, average relative humidity = 60%

Also consider that relative humidity does not vary much outdoors.
The problems occur when air from outside comes into the house (through open doors or windows) and is either warmed or cooled without any change in hydration, making the air's relative humidity either fall or rise sharply.
For example:

Winter

If the relative humidity of air outside at 0° C is 50%, and that air is drawn into a house and warmed to 20° C without any additional moisture added, its relative humidity falls to about 10%.

Summer

If outside air at 20° C and 50% relative humidity passes inside into a cooled room at 15° C, the relative humidity shoots up to over 80%.

Indoor air in winter often feels very dry; it has been taken in from the outside and then heated up without any additional moisture being added. And of course the reverse is true in sweltering summers.
A room held at 20° all year would swing from 30% relative humidity in winter to 50% relative humidity in summer. Such changes play havoc on the wood in floors!
Daily ventilation by window opening during the heating period is good for fresh air but should be limited to 10 to 15 minutes and maximum twice a day!
Another possible option would be to add a few special plants which are suitable for improving the room humidity in the rooms with low air humidity (ask your florist).

End