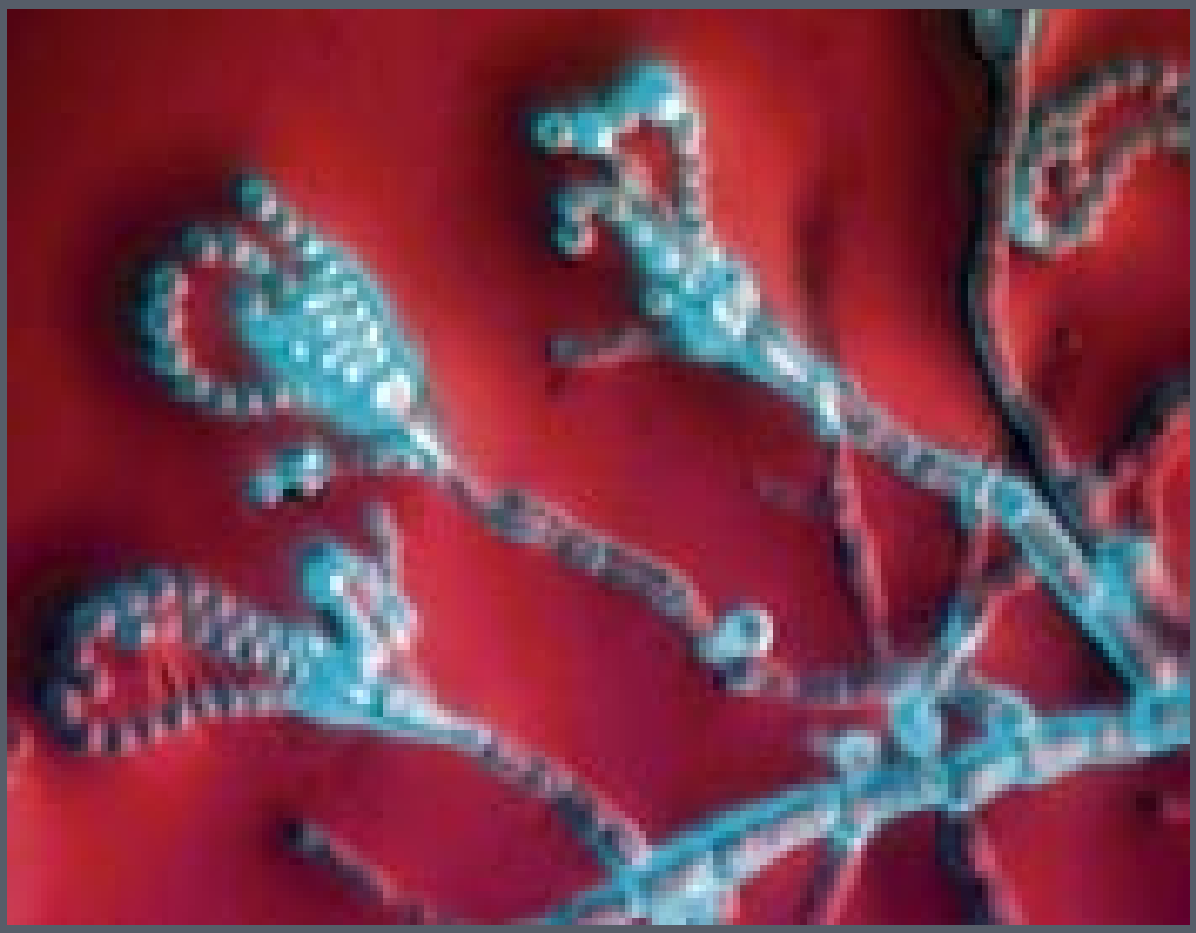
Mould:

A Comprehensive Guide



DampGuard®

Everything you need to know about mould and how to avoid it ...

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1. Moulds – a health hazard

The media are constantly telling us about health hazards which are caused by chemical pollutants in the air inside our houses, from formaldehyde, for example, or plasticizers. It is less well known that biological pollutants in the air in our homes caused by moulds, for example, can also make us ill. Moulds form tiny spores that are emitted into the air in enormous quantities and which can be breathed in. Because of their surface characteristics, these spores can, amongst other things, trigger allergies like those caused by pollen from plants.

There are around 25 million people suffering from allergies in Germany alone, and about half of these are thought to react to air pollution inside homes, with moulds being involved in around a third of all allergic illnesses. Children are particularly at risk, since their immune system is not yet fully developed. It has been proved that children who live in damp rooms where there is mould run a higher risk of suffering from respiratory tract disorders.

Large areas of mould and algae in a stairwell

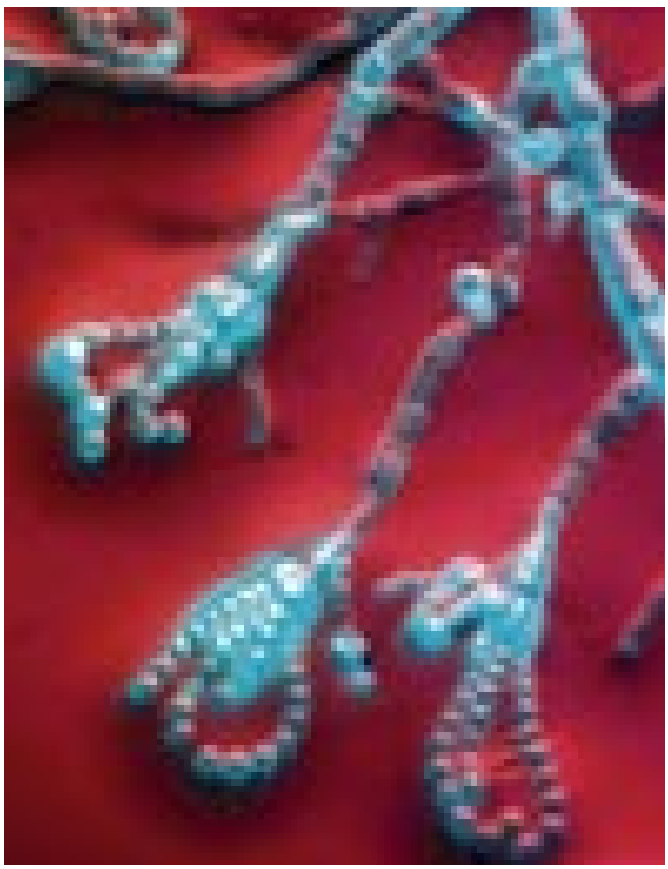
Older and sick people with weakened immune systems are also frequently affected. Vague health disorders, such as susceptibility to infections, pains in the head and limbs and irritations of the mucous membranes are often ascribed to toxins from moulds.

2. What you should know about moulds

Moulds – an important component of nature

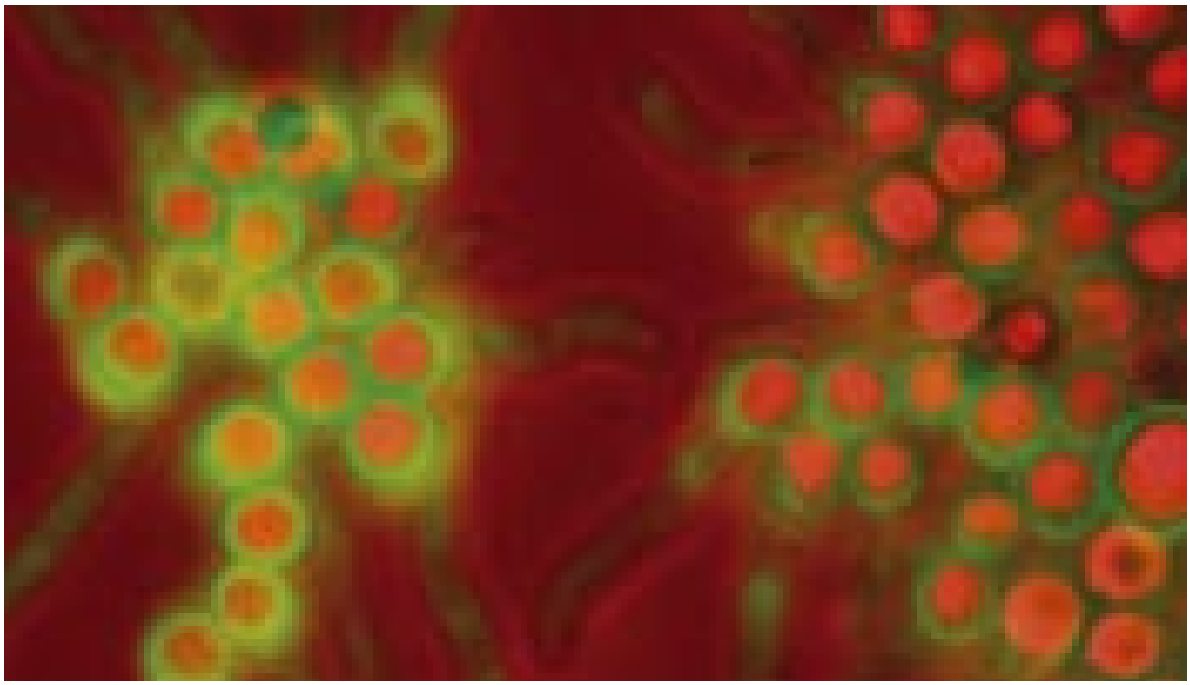
Like bacteria and viruses, moulds are micro-organisms. Micro-organisms are present everywhere, and our bodies are constantly exposed to them. The digestive tract and skin, for example, are densely populated with bacteria. This film of bacteria keeps out pathogens and, consequently, the infections that these can cause.

Aspergillus mould (enlarged approx. 400 times)



Conidia carriers (spore carriers) from a penicillin mould (enlarged approx. 500 times)

Moulds thrive in a moist environment. They break down organic materials and help maintain nature's metabolic cycles. One gram of soil in a field can contain up to 2.5 billion moulds and bacteria. Moulds are characterised by a network (mycelium), which can only be detected by a microscope, and which is made up of branched cellular threads, known as hyphae. The apparent tissue formed from the hyphae, however, can be seen with the naked eye. Moulds reproduce with microscopically small spores that are formed on particular structures of the mycelium – the conidia carriers. The spores are dispersed through the air; they are well protected against UV radiation and drying and float extremely well.



Germinating mould spores (enlarged approx. 1000 times)

The outside air always contains moulds, but the concentrations vary considerably. In the late summer and autumn, when the plants or plant organs are dying off, the supply of nutrients for moulds is at its highest. With the onset of spore formation, the concentration in the outside air can reach levels of between 1,000 and 10,000 spores/m^3.

2.1 What health hazards do moulds actually represent?

We are therefore constantly confronted with micro-organisms, in our homes, where we work and in the open air. If our immune defences are intact, most of the micro-organisms contained in the air do not represent any health hazard for humans.

At "normal" stress levels, people breathe in around 7.5 l of air a minute. Over a day, this corresponds to a volume of air breathed in of just under 10 m^3. With an average concentration of 1'000 spores/m^3, the tissue in the lungs is "burdened" with 10'000 spores a day. However, a healthy immune system can render these spore impurities harmless without any problem.

In the case of constantly high concentrations in the air or for individuals with reduced immunity, however, even micro-organisms which are normally classed as non-hazardous – including fragments of these – can have an adverse effect on health. Rotting organic material, such as leaves, paper waste or biological waste is highly polluted with moulds. Collecting leaves with vacuum devices, emptying waste containers into refuse containers, handling soil on an agricultural basis, and even working in a library or living in flats with mould can cause very problematic levels, reaching values of 100'000 spores/m^3 and more. People working in waste treatment plants can be subjected to mould concentrations of several million spores per cubic metre of air breathed.

2.2 Illnesses caused by moulds

With illnesses caused by moulds, a distinction is made between infectious diseases, allergenic reactions and inflammatory reactions. The diseases in question cannot always be assigned clearly to one category – it may be that they occur in combination.

2.3 Infections

With an infection, a pathogen enters into the human body, reproduces and harms bodily functions. Infections are generally caused by viruses or bacteria. Infections caused by moulds are generally found in people with weaker immune systems. Amongst the moulds, species of the commonly found genuses Aspergillus and Mucor are considered to be infectious. Infections of the bronchi generally affect asthmatics and, almost always, those suffering from allergies (atopic allergies). Through the formation of mucous plugs, the spores that are breathed in can germinate and form a mould network (mycelium). The moulds live in the segment bronchi without penetrating the cells. The mycelium causes allergy-triggering substances to be released all the time. The antibody reaction leads to the inflammation and destruction of the tissue, thus encouraging mould growth.

2.4 Type I allergy:

Allergic reactions with immediate effect:
Allergic reactions in the form of sniffing or bronchial asthma are widespread. Children are increasingly affected, since their immune systems have not yet matured. In children, exposure over a long period to internal air polluted by mould can lead to a general tendency to develop allergies.

Sensitivity to moulds can build up as a result of both short-term contact with very high concentrations and continuous exposure with low concentrations. The threshold value for the triggering of allergic reactions amongst people who have already been sensitised is in the range of 100 to 1'000 spores/m^3, which is very low. The fact that the natural background exposure to spores, however, is almost always in this range explains why people who are allergic to moulds often have to fight with allergy problems all year round.

The symptoms of type I allergies are rashes, swelling of the mucous membranes, connective tissue inflammations, allergic sneezing, circulatory disorders, shortness of breath and allergic asthma. This type of allergy is characterised by the immediate occurrence of the allergic symptoms on contact with the allergen (substance that can trigger allergies); these then disappear if the allergen is avoided.

2.5 Type III allergy:

Allergic reactions with a delayed effect

With a type III allergy, enzymes which damage the tissue are released as a result of repeated contact with very high mould concentrations. If a person is sensitised, the reaction will be triggered some three to eight hours after renewed contact, with symptoms such as coughing, shivering, shortness of breath, nausea, fever and abnormal fatigue. If contact is avoided, the symptoms disappear again, but repeated and lasting contact can lead to irreversible damage to the lungs.

2.6 Type IV allergies

With type IV allergies, a cellular defence reaction is triggered, which, if it lasts any length of time, can turn against the body's own structures. The symptoms are many and varied, ranging from tiredness through aching head and limbs to neurological and psychological symptoms. The type IV reaction is possibly a cause of chronic mental conditions.

Organic Dust Toxic Syndrome [ODTS]

The symptoms of ODTS are characterised by flue-like symptoms, which arise, as with the type III allergy, a few hours after contact without any need for susceptibility or sensitivity. The main triggers are thought to be the toxins produced by moulds, known as Mycotoxine, which, amongst other things, affect the immune system and have an adverse effect on the respiratory organs.

2.7 Irritations of the mucous membrane

Irritations appear in the form of inflammations of the eyes and upper respiratory tracts. A susceptibility to this probably develops after several weeks of exposure to low concentrations of mould.

3. What conditions do moulds need to grow?

Moisture is an absolutely essential precondition for mould growth. There are always plenty of sources of moisture inside our homes and offices, for example:

- people give off 30 -50 g of water per hour during light exertion, and 300 - 500 g during increased physical exertion
- cooking, showering, washing and when drying washing
- plants release water
- in new buildings, the materials may still contain moisture

In a three-person household, 6-8 litres of water per day are accumulated in this way. This moisture, which is in vapour form, must be completely removed from the rooms to prevent moisture problems and the formation of mould.

You should therefore always avoid excessive relative humidity in the air. Values of 55…60 %rh should not be exceeded; mould can start to grow at 70 %rh. In addition, excessive air humidity also prevents evaporation of sweat from the body and thus affects our heat-regulating system.

However, moisture can also condense on cold surfaces. Mould spores, whether they have come from the outside or been released in living areas (e.g. from the soil in pot plants, straw in pet cages or rotting foods), can germinate within a day if there is sufficient moisture and can then start to grow. There are plenty of the necessary carbon and nitrogen compounds in wall coverings, adhesives, paints and even house dust.

3.1 How does mould occur in living areas?

There are various reasons why mould forms in living areas, such as:

- insufficient ventilation
- living areas being shut off with tightly jointed windows
- reduced or incorrect ventilation combined with an above-average production of moisture
- reduction in the ambient or surface temperature
- incorrect surface finishing of walls and ceilings
- real structural defects such as thermal bridges

In addition, spore formation depends on

- the general climatic and seasonal conditions
- light intensity and spectrum

Structural defects include, for example, thermal bridges, leaks, open cracks and insufficiently sealed joints, capillary effects caused by lack of moisture barriers, the use of unsuitable building materials and incorrect insulation measures. The increasing of moisture levels in building materials inside as a result of condensation depends solely on the ***surface temperature*** *and* ***not*** *on the type of building material.*

Mould caused by thermal bridges in a flat in an old building

Mould on an external wall behind a sofa

3.2 What must I look for when removing mould?

Discolourations on surfaces inside rooms indicate the presence of mould. Mould must be removed immediately.

1. With fresh infestations, the moulds are generally still only growing on the surface. Small surface infestations can often be removed by disinfecting the mould. Porous areas should be wiped with a damp cloth beforehand. If vacuum cleaners are used, the exhaust air must be cleaned with HEPA filters. Otherwise, the room can be massively polluted with spores due to those contained in the air blown out by the vacuum cleaner.

2. Smaller, more recent infestations can also be treated with alcohol (70-80 %). The solutions should be applied generously and repeatedly with a cloth or brush onto the areas affected. Do not use spray bottles, in order to avoid the formation of aerosols. Remember that dead spores have generally not lost any of their ability to cause illness and can still trigger allergies.

3. Larger, older infestations must be fully removed, and any wallpaper affected must be removed. If the infestation is deep, the layers of plaster must also be removed.

4. After removing the mould, clean the surfaces of the rooms affected thoroughly with a damp cloth.

5. Structural defects must be removed.

6. The causes of the atmosphere that promotes the mould must be removed. Check how much living habits can be changed so that a high humidity level is avoided.

4. Facts worth knowing about measuring moisture

The air always contains moisture in the form of water vapour. In measurements, the air humidity is either given as absolute humidity or relative humidity. These two terms are defined as follows (in simplified form):

4.1 Absolute humidity of a gas mixture (air)

This term is used to describe the quantity of water vapour which is contained per volume unit of the gas mixture. The absolute humidity is not related to the temperature.

4.2 Relative humidity of a gas mixture (air)

The relative humidity describes the quantity of water vapour in the air in proportion to the maximum possible quantity at a particular temperature (in % RH). Warm air can absorb considerably more moisture than cold air, i.e. the relative humidity is very dependent on temperature.

The relative humidity increases when the temperature falls and vice versa.

In the immediate vicinity of a cold wall, i.e. at a distance of just a few millimetres, there is a boundary layer of cold air, which has almost the same temperature as the wall. The cold air can, however, absorb less moisture than that contained in the warm air in the room. The relative humidity therefore rises at the cold wall surface, which encourages or facilitates the growth of mould.

The DampGuard® mould monitor is fitted with a ROTRONIC HYGROMER® humidity sensor – one of the most highly developed capacitive sensors for measuring relative humidity. This sensor measures the relative humidity directly on the wall, i.e. where there is a risk of condensation. The unique design of the sensor ensures that no separate micro-climate can form between the wall and the sensor.

5. DampGuard® – operating instructions

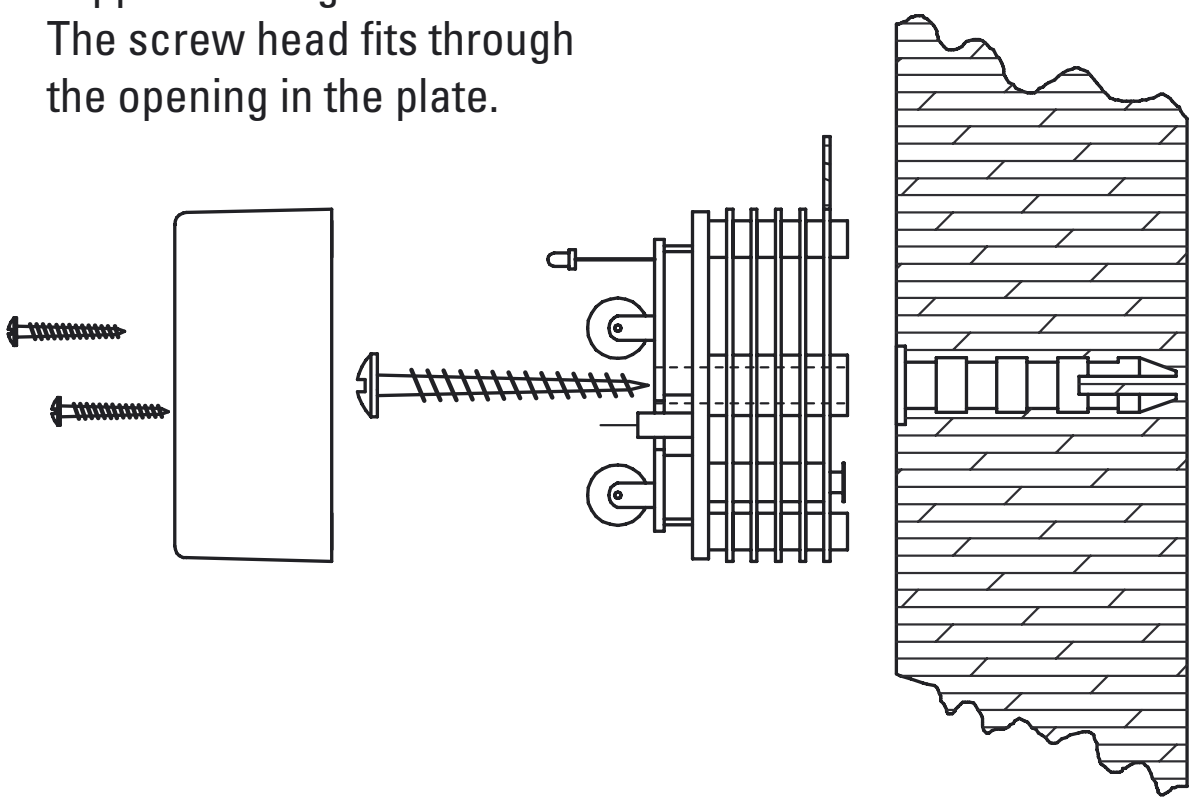
The DampGuard® mould monitor is an extremely reliable appliance, and the only task the user has to perform is to insert the batteries (supplied) and mount the device on the wall. It measures the surface temperature and moisture wherever it is mounted.

5.1 Mounting:

Warning:
Only remove the protective covering when the monitor is ready for use. The guarantee is not valid if the sensor is damaged. Do not touch the white sensor element.

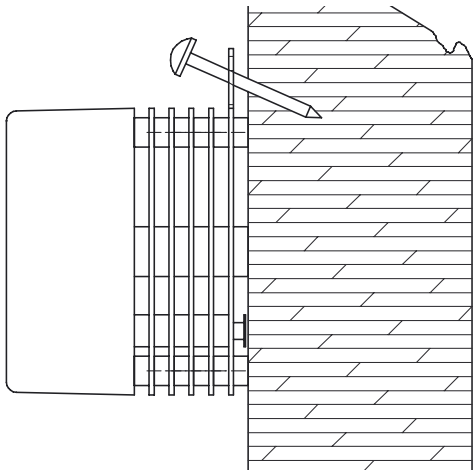
Option 1:

- Loosen the 2 cover screws with a Philips screwdriver and remove the housing cover.
- Position the DampGuard® at measurement point and mark the position of the drill hole with a pencil or bradawl.
- Drill a 5 mm hole and insert 5 mm wall plug provided. Screw the DampGuard® mould monitor using the screw supplied through the hole in the middle. The screw head fits through the opening in the plate.



Option 2:

•The lowest intermediate plate has a suspension eyelet. The appliance can also be suspended from this eyelet using a nail (not supplied).



5.2 Inserting the batteries

Only insert the batteries after the device has been mounted on the wall.

- Remove the housing cover.
- Insert the batteries supplied into the battery holder, with the correct polarity.
- Screw housing cover back on again.
- The DampGuard® monitor is now ready for use.

5.3 Display

Depending on the level of moisture, the LEDs will flash every 5 seconds as shown in the table below.

If no LED is flashing, the batteries are empty and must be replaced.

LEDs	Moisture	Mould formation	Action
🟢	< 70 %rh	Not possible	None
🟡	70…80 %rh	Critical range	Ventilation
🔴	80…100 %rh	Possible	Ventilation
🔴 🔴	90…100 %rh	Highly probable	Ventilation

Important:

The moisture sensor must be directly on the surface, over the largest possible area. Any major unevenness, such as highly textured wall paper or structured plasterwork, must be removed beforehand.

5.4 Important information for the prevention of mould problems

Our DampGuard® mould monitor helps you to check moisture levels every day.

Position the DampGuard® in the most appropriate place in your home, i.e. where mould problems are expected to occur, or where you have already noticed the first signs of mould (mildew). Mould generally occurs most frequently on cold external walls, but the problems actually *start* as a rule in the corners of rooms, window sills or particularly badly ventilated areas of the room (e.g. behind hangings or curtains). The room in which the DampGuard® is mounted should also be in everyday use, i.e. the production of moisture must roughly reflect the situation in the rest of the house.

If mould growth can be prevented on the worst surface, you will have no problems elsewhere!

Moisture produced inside must be removed to the outside. If the recommendations below are followed, the risk of mould growth and possible health hazards in the property can be minimised and the well being of individuals improved. The DampGuard mould monitor is the simplest way of showing and monitoring the moisture on surfaces at any given time.

Cold air can absorb far less moisture than warm air. At 0 °C, air can contain a maximum of 4.8 g water per cubic metre. This corresponds to a relative humidity of 100 %rh. At a room temperature of 23 °C, however, 100 %rh corresponds to 20.5 g/m^3.

It is important to understand these correlations, since it can clearly be seen that ventilation in the winter is **always** effective, even if it is raining (external moisture ~100 %rh). The cold outside air brought into the house by ventilation contains less water than the inside air. It warms up and absorbs water vapour, which is then given off to the outside air when the room is ventilated again.

Moisture exchange under different conditions:

Outside		Inside		Moisture transport
Temp/moisture	g/m³	Temp/moisture	g/m³	outside
-20 °C / 100 %rh	1.1	20 °C / 70 %rh	12.1	11.0 g/m3
-10 °C / 100 %rh	2.4	20 °C / 50 %rh	8.6	6.3 g/m3
0 °C / 100 %rh	4.8	23 °C / 70 %rh	14.4	9.5 g/m3
10 °C /100 %rh	9.4	23 °C / 50 %rh	10.3	0.9 g/m3

Even in less than favourable external conditions, moisture is still transported outside.

The following simple procedures have proved useful in preventing mould problems:

1. Depending on use, living rooms must be ventilated 3 to 5 times a day for about 5 minutes (known as "ventilation in bursts"). Ventilating several rooms at a time will give an effective change of air throughout the house (cross-ventilation). Ventilation in bursts can exchange the air in the room without major loss of heating. The continuous ventilation of a room does not have any lasting effect unless the adjoining rooms are ventilated at the same time. After the windows have been closed, air full of moisture is transported back from the other rooms in a very short time.

2. Ventilating through windows in the part-open position is completely inefficient and leads to unnecessary heat losses! Lintels can cool down considerably in winter, which promotes the unwanted formation of condensation in this area. This type of ventilation is therefore counter-productive.

3. If possible, do not place large items of furniture next to cold external walls in older buildings. If this is unavoidable, move the furniture 5-10 cm from the walls in order to allow the air to circulate. It is important that your landlord / building manager is consulted about this.

4. Keep the doors to rooms with a particularly high moisture level or a low temperature closed. Ventilate these rooms with the doors shut until the humidity in the rooms has reduced.

5. In basements, in contrast to rooms above ground, mould may also form in summer, if warm, moist air hits the cold walls. In summer, particular consideration should therefore be paid to the ventilation of basement rooms.

6. What is the best way to use the DampGuard® moisture monitor?

Mount the DampGuard® in the coldest part of the room. This is where there is the greatest risk of mould formation. The DampGuard®helps you to find a heating and ventilation regime that is tailored to your property and the way you live, so that harmful surface moisture which promotes mould is avoided. After installing for the first time, you should check the display on the monitor **several times a day** until you have found the best ventilation regime, i.e. the one that suits your personal habits the best, and the yellow warning light does not come on any more. More frequent checks only become necessary if the moisture production in living areas exceeds what is normal, or the outside walls can cool off due to falling external temperatures or changes in the heating regime.

The recommendations on the length and frequency of ventilation are only a **guide**. Please remember that moisture that condenses on the surface of the wall must be removed **completely** time and again. Individual living habits may make it necessary to ventilate more than 3-5 times a day and longer than the recommended 5 minutes. If, for example, you cook and shower before going to bed and sleep with the windows closed, ventilation of the water vapour absorbed by the wall covering the next morning must naturally be carried out for a much longer time than if you sleep with the window open.

The removal of moisture from wall coverings can be increased if the room is heated more and ventilated particularly frequently.
Warm inside air can absorb much more water vapour from moist surfaces than cold air can.

At transitional times of year – early spring and early autumn – the outside air may be able to absorb more moisture because of the increased daytime temperatures. During these periods, the outside moisture levels can be above the values of inside rooms which are only occasionally heated and which cool down at night. If the mould monitor indicates a higher surface moisture level in these transitional periods than it would normally, please remember that it is possible that the moisture could come from the outside. In these periods, extensive ventilation may be disadvantageous, especially if the temperature of the exterior walls is below the outside daytime temperature because of the low night-time temperatures.

If moisture problems exist for any length of time, deeper layers of the wall covering including the plaster are probably soaked. Ventilation can only dry the surfaces of walls. The red warning lamp on the DampGuard® mould monitor may come on again a few minutes after ventilation after the initial installation of the monitor in such cases. During the next few days, the interval of time between ventilation and the reappearance of the warning light, however, should gradually become longer. If this is not the case, it could be an indication of a high level of **masonry moisture**. It is then essential that you contact the landlord / building manager so that the causes of this can be clarified.

If, despite following these recommendations, the yellow or red warning lights on the monitor are on all the time or come on again repeatedly a short time after ventilation, the landlord or building manager should be contacted so that the causes can be clarified.

Technical data:

Size in mm	61 x 58 x 50	
Material	ABS	
Type of protection	IP50 dust and contact protection	
Colour	Signal white RAL 9003	
Lettering	“DampGuard® “ Pantone 432 C on cover	
Display	4 LEDs: yellow, green, red, red	
Intermediate plates	5, lowest intermediate plate with hanging device	
Moisture sensor	Capacitive moisture sensor ROTRONIC AC-2	
Power supply	2 AAA batteries 1.5 V, inserted	
Display interval	5 seconds	
Battery working life	approx. 1 year	
Adjustment	80%rh	
Precision	80%rh	± 2%rh
	>90%rh	± 4%rh
	<70%rh	± 4%rh
	<30%rh	± 6%rh

Scope of delivery:	Appliance, adjusted, ready for use after insertion of the three AAA batteries supplied, 1 screw and 1 wall plug Operating instructions

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