



Humidity for Homes

An indepth look at the role humidity control plays in creating a healthy living environment.



A 2009 study by Markovic found that our eyes become more susceptible to infection at low humidity levels, due to the increased evaporation rate of the tear layer that would normally remove any pollutants.



In 2010, a study by Rainer found that skin dryness increases significantly between relative humidity of 35% to 15%.

Overview

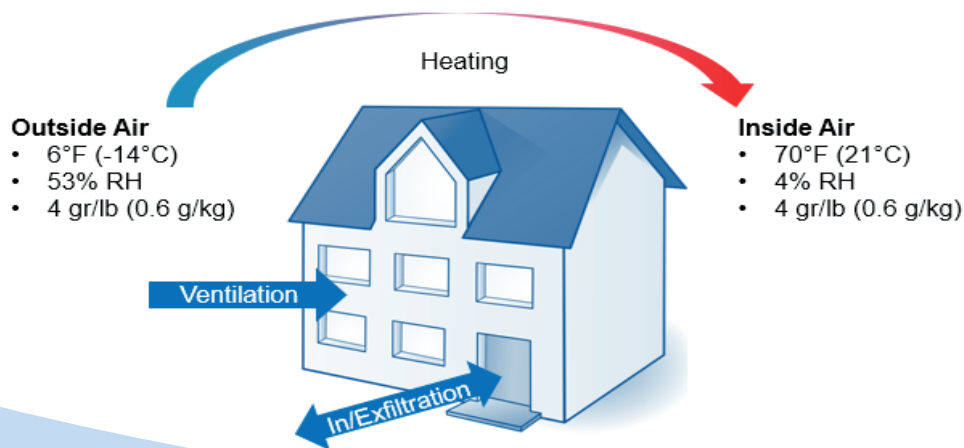
Humidification for residences is starting to become a large topic in the last few years as the importance of humidification for human health has become increasingly recognized. Whether you live in an apartment, a condominium, or a single-family home, in cold seasons, heating is required to bring cold outdoor temperatures up to acceptable indoor conditions.

Heating the outside air can really dry it out, reducing the relative humidity (RH) in your home. The image below shows the effect on the relative humidity of heating air from outside at 6°F (-14°C) to 70°F (21°C) indoors.

Our bodies are not efficient at sensing changes in RH, but you may notice some of these common symptoms of dry indoor air experienced in the colder months:

- Rough, cracked skin and lips.
- Frizzy, unmanageable hair
- Electrostatic shocks
- Sore throats, headaches, and tired eyes.
- Cracks in wooden furniture, doors, and flooring

When the air is dry, it will start to draw moisture from any available source. This includes our bodies, materials such as wood and textiles, our pets and even the fabric of our home itself. This will not just leave us feeling dehydrated but can have serious implications for our health.





Low air humidity below 40% RH acts as a conduit for viruses and airborne bacteria to disperse and travel around indoor environments.



Drying of the mucous membranes in our nose and bronchi inhibits our natural defence mechanism against airborne pollutants. This leaves us vulnerable to infections from airborne germs, such as the flu and common cold.

Benefits of Residential Humidification: For the Health of Occupants

On a family outing in the middle of the summer, we plan accordingly by wearing short sleeves, shorts, and possibly a hat or umbrella to give us shade from the heat of the sun. When it is appropriate, we will use an Air Conditioning unit to cool us off from the heat of the day. On a school snow day, you may take your family outside to go sledding and play in the snow. Before we do this, we bundle up to keep as warm as we can, and as our body cools off, our bodies will adapt and keep our core warm in a variety of different ways. No matter if we are shaking from the cold, or sweating from the heat, our bodies are remarkable at adapting to the climate we are in.

Water is essential for our bodies to function optimally, as it constitutes around 60% of our body's composition. In dry climates, the air can strip moisture from all available sources, including our eyes, hair, skin, and lips, leading to dryness, irritations, and itchiness.

We often resort to lotions, eye drops, and conditioners to mitigate these effects. However, it's not just external dryness that affects us. Our nose and throat have mucous membranes that protect us from airborne pollutants and germs like the flu, the common cold, and even COVID-19.

Dry air can impair these defenses, making us more vulnerable to illnesses. Therefore, it is crucial to maintain appropriate levels of humidity in our surroundings to promote overall health and well-being.

Our bodies have a remarkable ability to adapt to the climate we are in. However, in dry climates, the air can strip moisture from our bodies, leading to dryness and irritations, and impairing our defenses against airborne pollutants and germs. Therefore, maintaining appropriate levels of humidity in our homes is crucial for promoting the overall health and well-being of our loved ones.

Best Relative Humidity for Health

Scofield/Sterling Diagram

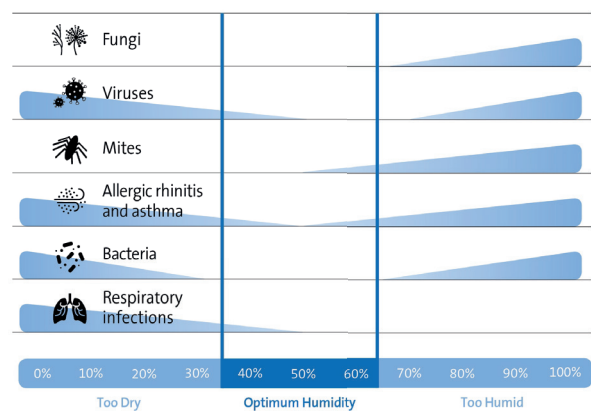


Figure 1: Sterling Chart, illustrates how relative humidity affects health and well-being and shows that the optimal air humidity level for humans is between 40 to 60% RH.



Hardwood floor cracking due to low air humidity levels.



Hardwood floor cupping due to high air humidity levels.

Benefits of Residential Humidification: For the Home

Optimal relative humidity is not important only for human health and comfort, but it is crucial for the buildings as well. The forced air heating system in the wintertime reduces the humidity level much faster than using the air conditioner in the summertime. While these systems make the indoor temperature more comfortable for humans, it can cause damage to other items within the home if relative humidity fluctuates.

Wooden Articles

Wooden objects to consider within the home include floors, walls, ceilings, musical instruments, furniture, etc. Wood is a hygroscopic material, making it perfect for the dry air to absorb moisture from, which can cause wooden items to shrink and expand, or even crack. Once the furniture is damaged due to low humidity, it's nearly impossible to repair.

On the other hand, very high relative humidity can cause cupping on the floor and dimensional changes in the furniture. Most times your floor and furniture can adjust, however drastic fluctuations in humidity can lead to permanent damage. Condensation that gets within wooden walls, ceilings, or floors due to dimensional changes can also eventually lead to the mold growth as well.

Dust

Dust is another problem associated with the low RH level in the home. Proper humidity control will not reduce the dust in the house, but it can reduce the amount of time dust particles linger in the air. Proper RH levels will bind these particles, causing it to precipitate.

A relative humidity between 40-60% in the building can help to avoid these common problems.

Artwork

The best relative humidity for artwork on canvas or wood is between 40-60%. Low RH levels can cause different elements of the artwork, the canvas, wood, paint layers, to contract which can introduce strains into the painting and cracking.

Excessively high RH, above 75%, can also cause similar damage as the elements contract and deform. As a result, fluctuations in RH are very damaging to artwork. ASHRAE describes best practice for paintings to avoid the risk of damage as precise humidity control, with no seasonal changes and short-term fluctuations (hourly) within $\pm 5\%RH$.



The combination of humidity in the range of 40-60% RH with a room temperature of approx. 20-22 °C (68-72°F) is the basis for peak performance for the human body.



Restful sleep, improved concentrated for work and learning, along with beautiful and healthy skin are just a few of the benefits resulting from humidity control in your home.

Humidification Load Sizing

To select the proper humidifier, generally, a humidification load calculation must be done. Traditionally, humidification loads are calculated in lb/hr, and indicate the lb of water/ moisture needed to be added to the air every hour to maintain your design set point.

The humidifier software assumes that the humidity and temperature in the space being humidified are at the design conditions. Therefore, the moisture that must be added is the amount required to bring incoming air to the design condition. The parameters needed for load sizing are:

- Design Conditions – Temperature and RH that must be maintained in the humidified space. For a typical home, this should be between 40-60%rh, and 65-75°F (18-24°C.)
- Outdoor Air Conditions (Incoming Air) – Temperature and RH of the outdoor air.
- Incoming Air Volume - The volume of outdoor air that flows into the space being humidified.

The outdoor air conditions vary with geographic location and the time of year. For calculating the humidification load the worst-case condition is generally used. The temperature value used is the 99% heating dry bulb temperature for the coldest month of the year. The relative humidity value is the average relative humidity of the driest month of the year.

Figure 2 is an illustration of the major climate zones in the US. Hot and dry climate zones (ex: 2B, 3B, 4B) and cold climate zones (5-8) will generally require larger humidification loads.

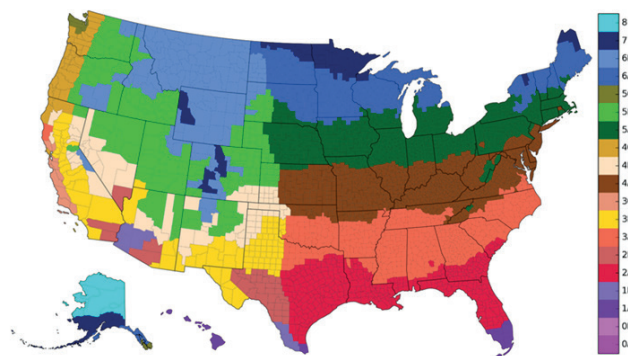



Figure 2: Major climate zones in the US.



The COVID-19 crisis shows us just how vital it is that we place management of the built environment at the very center of disease control. Many scientific studies have demonstrated that the ideal indoor humidity level of between 40-60%RH will reduce the spread of respiratory infections.

Strategies to Control Humidity in Residences

Most residences only require humidification in the winter months when the indoor air is being heated within the home. Using a hygrometer to display relative humidity will help determine whether humidification is needed or not. For optimal humidification for health, Condaire suggests keeping relative humidity between 40-60% RH.

Controls

Humidifiers can be controlled at the unit itself, or can be wired into a common household stat.

A distinction is commonly made between room or exhaust air humidity control and supply air humidity control. Which control variants are used depends on the respective installation concept and the task.

Room and Exhaust Air Humidity: air humidity control is preferable for use in air conditioners. The control sensor is placed in the room or in the air exhaust duct. The large distance between the steam distributor and humidity sensor normally ensures that the air mixes well. The controlled system in this type of humidity control is characterized by its large storage mass, and it simplifies a stable control mode.

Supply Air Humidity Control: is used where this

is necessary for system engineering reasons. This includes, for example, central humidification with subsequent zone branching which must be humidified individually.

Even room or exhaust air humidity controls can have the control engineering properties of a supply air humidity control if the room volume is very small, or air exchange rates are very high. In this type of control, the control sensor is placed in the air supply duct downstream of the steam distributor. Due to the low storage mass between the steam distributor and humidity sensor, the rating of the controlled system is usually high.

Maintenance

Humidifier maintenance always starts with water quality. Humidifiers should always be fed with clean, potable water. Different humidifier technologies also have different requirements for water quality. Maintenance requirements are summarized below:

Isothermal

- Boiled water produces pure, hygienic steam.
- Water quality is important for maintenance as minerals are left behind in the boiling tank and can form scale that needs to be cleaned or a full steam cylinder that needs disposal and replacement.
- Can run on treated water (softened, reverse osmosis) to reduce maintenance requirements



Condensation can form on indoor surfaces such as windows and doors when their surface temperatures are lower than the dew point of the surrounding air.

Adiabatic Evaporative

- Uses an evaporative media that should be cleaned or replaced monthly (30-60 days).
- Using treated water (reverse osmosis, de-ionized) along with built-in UV lights or other disinfectants will help to keep units hygienically operating, otherwise daily and weekly cleaning/ manual disinfection of the water basins is necessary. A disinfectant solution of vinegar and water can be used for manual cleaning.

Avoiding Condensation

Condensation is when water forms on a surface and the air RH exceeds 100%. Even if you are below 100% RH in a space, condensation can form on indoor surfaces such as windows and doors when their surface temperatures are lower than the dew point of the surrounding air. The dew point is the temperature at which water vapor will condense (i.e 100% RH). The higher the relative humidity, the warmer the surfaces need to be to avoid condensation. When it is cold outside, and surfaces such as windows are colder, this leads to conditions in which condensation can form.

There are a few ways to mitigate the formation of condensation in your home while also humidifying to healthy levels:

1. Choose quality building materials (such as double pane windows) that are insulated and keep surface temperatures higher during colder outdoor conditions.
2. Open blinds and curtains to allow airflow across window surfaces.
3. Set back your humidity set point. Although 40-60% is recommended, some humidity is still better than no humidity, and you will still see some of the benefits. See Figure 3 for recommended RH setbacks dependent on outdoor temperatures:

| Outdoor Air Temperature (°F) | Outdoor Air Temperature(°C) | Indoor Relative Humidity (%RH) |
|------------------------------|-----------------------------|--------------------------------|
| 20° to 40°F | -7° to 4°C | ≤ 40% |
| 10° to 20°F | -12° to -7°C | ≤ 35% |
| 0° to 10°F | -18° to -12°C | ≤ 30% |
| -10° to 0°F | -23° to -18°C | ≤ 25% |
| -20° to -10°F | -29° to -23°C | ≤ 20% |
| Below -20°F | Below -29°C | ≤ 15% |

Figure 3: Recommended indoor relative humidity based on indoor and outdoor temperatures.

Suggested Humidification Technologies

Isothermal Humidification:

Isothermal humidification consists of vaporization of water from liquid into steam. Energy, via electrode, resistive element or gas combustion, is supplied to boil the water and produce steam. For the residential application, the isothermal technology is the most common method for the humidification as steam humidifiers have the advantage of extremely hygienic operation; by boiling water in the cylinder, pathogens are eliminated and minerals are left behind, either in a metal boiling tank or plastic cylinder.

Adiabatic Humidification:

There are two adiabatic processes for humidification: atomization and evaporation. In adiabatic humidification (Ultrasonic, Humilife MN) water is provided to air in liquid form and must therefore still achieve a gaseous state. Energy is required for this purpose and is drawn from the surrounding air in the form of heat. Since a decrease in temperature also takes place in this case, the process is also called an adiabatic cooling effect.

| Model | Technology | Capacity | Features and Benefits |
|--|------------|------------------------|--|
| Condair Whole-home Flexible Room Solution | Adiabatic | 115V/1 8.81 lbs./hr | <ul style="list-style-type: none">▪ Humidifier discs, which feed the humidification water silently into the room Smartphone App for remote control and monitoring.▪ Robust filtration system with UV lighting and reverse osmosis so there is no airborne germs or scaling.▪ A central unit mounted in a mechanical space with access to water, a drain, power, and a LAN internet connection.▪ Each spray head continuously monitors the room for precise humidity control.▪ No ductwork or heating system necessary for installation.▪ Great for radiant heat applications. |

| Model | Technology | Capacity | Features and Benefits |
|--|------------|--|---|
| Condair Whole-home Steam Humidifier | Isothermal | @120V - 3.9 / 1.8 / 11 @208V - 6.7 / 3.0 / 19 @240V - 7.8 / 3.6 / 22 | <ul style="list-style-type: none"> ▪ Electrode steam technology ▪ Automatic control – set it and sleep easy ▪ Smartphone App for remote control and monitoring ▪ Easiest maintenance with no tools required ▪ Quiet operation ▪ Automatic cylinder lifetime detection to avoid manual reset ▪ Drain water automatically tempered to meet local plumbing codes ▪ Patented auto-adaptive water management maximizes cylinder life ▪ Direct furnace mounting or remote mounting |
| RH2+ | | 110-240V/1 In duct: 5-10 lbs./hr. In Space: 4-8 lbs./hr | <ul style="list-style-type: none"> ▪ Electrode steam technology ▪ Pure, clean, sterile steam humidification ▪ Easy maintenance using disposable cylinder ▪ QDV model is the quietest residential steam humidifier in the market ▪ Auto-adaptive technology ▪ Adapts to changing water conditions ▪ Automatic fill and drain cycles |
| EL | | Small Unit: 5,10,20,30 lbs./hr Medium Unit: 50,75,100 lbs./hr Large unit: 150,200 lbs./hr | <ul style="list-style-type: none"> ▪ Electrode steam technology ▪ Complete package product ▪ Highest efficiency of all technologies (98% efficient) ▪ Seismic certified ▪ Integrated controller ▪ Auto Adaptive technology ▪ EL quiet drain valve suitable for residential applications |
| RS | | Small Unit: 10,15,20 lbs./hr Medium Unit: 30,45,65,90 lbs./hr Large unit: 90,130,180 lbs./hr | <ul style="list-style-type: none"> ▪ Resistive steam technology ▪ Complete package product ▪ Integrated controller ▪ Tighter humidity tolerance ▪ Scale management option ▪ 304 Stainless steel tank ▪ Incoloy 825 heating element |



Conclusion

In summary, it is important to maintain a relative humidity of 40-60% not only for human health and comfort but also for our homes.

By staying in the optimum RH zone, we can reduce dryness as well as make us less vulnerable to illnesses such as the flu and COVID-19. In our homes, this RH range can help prevent cracking and movement of wood, reduce dust particles in the air, and prevent damage to artwork.

Two common ways to humidify our homes are through isothermal and adiabatic humidification. Isothermal methods involve the boiling of water into steam while adiabatic involves atomization or evaporation of water.

Benefits and Advantages

These are just a few reasons how providing Condair humidification solutions for your home can benefit your life:

- Skin and eyes stay hydrated.
- Minimized painful electrostatic discharge.
- Respiratory immune system's defenses function effectively.
- Minimize the transmission of viruses that are transported by aerosols.
- Restful sleep.
- Improved concentration for work and learning.

About Condair

Condair Group, founded in 1948 and based in Switzerland, is the global leader in humidification, dehumidification and evaporative cooling. Supported by science, we engineer individual, holistic solutions that customers can trust through the entire lifecycle. With optimal humidity, we increase productivity and create healthier built environments.

Condair Group has production sites in Europe, North America and China, its own sales and service organizations in 22 countries, and representatives in 50 locations worldwide. You can rely on our comprehensive portfolio of innovative technologies for air humidification, dehumidification and evaporative cooling for the entire lifecycle of each product.

