

Condensation

Introduction

Condensation is the fog that forms on the interior or exterior of window and patio door glass when cold weather sets in. This can freeze blocking the view out the window or door, or it can drip on to the windowsill or floor causing structural damage over time.

Many people assume that the windows are to blame for this. However, the inside surface of the window is just providing a visible location on which the excess humidity in your home is able to condense.

It is important to realize that condensation can be occurring elsewhere in your home that is not as visible as on the window glass. Condensation can be a sign that damage to other parts of your home may be occurring.

A few signs of excessive humidity:

Dampness in the home that can cause walls and ceilings to discolor

Closed areas such as closets and cupboards forming mold or having a musty smell

Wood warping

Paint on the home's walls blistering and cracking

Water condensing on pipes and window glass

Condensation and Humidity

What is condensation and what is causing it to form?

Condensation is water vapor from the air that is deposited on a surface when the humid air near the surface is cooled. The water forms since cool air is not able to hold as much water vapor as warm air.

What is humidity?

Humidity is the moisture in the air. It is usually only visible when it is in a concentrated form such as steam vapor or ground fog. Otherwise, all air contains a certain level of invisible moisture.

What could be causing this moisture in my home?

Many of your everyday activities can add more water vapor to the air and raise the relative humidity of your home. The breathing of a family, cooking meals, taking showers, washing dishes and doing laundry will contribute to making the air in your home more humid.

What is air's relative humidity?

The amount of water vapor that air can hold is its relative humidity and is limited by the air's temperature. 100% relative humidity occurs when the air contains as much water vapor as possible at that air temperature. When the air contains half that much water vapor it has a 50% relative humidity. As the temperature of the air drops, the maximum

amount of moisture it can hold also drops. So when air is 40° F and has 75% relative humidity it contains less moisture than when the air is 80° F and has 75% relative humidity.

Are there ways to tell if there is excessive humidity in my home?

Moisture forming on windows, paint blisters full of water on the home's exterior, and moist areas on the walls of closets and cupboards that are on an exterior wall are all indicators that your home has a problem with excessive humidity inside.

Are there any health problems that can arise from excessive indoor humidity?

Yes. With moisture condensing on surfaces, molds can begin to grow. Mold growth is evident by a musty smell in the general area of its growth. Some people can have more serious problems ranging from headaches and respiratory problems to allergic reactions from certain types of mold.

What regions of the country are more likely to have condensation occur?

It is more likely to have condensation problems in regions where the average temperature during the winter months is below 35° F.

Is excessive humidity damaging to my home?

It can damage your home's ceiling and walls when the frozen moisture thaws in the spring. It can also cause pressure on the exterior surfaces of the house causing blistering of the paint or siding.

How can the humidity go through the wall and what is the effect?

The water vapor in air tries to be equal. Since the air in your home is warmer and contains more water vapor, it tries to have an equal amount of water vapor as the cooler air outside your home. This equalizing is vapor pressure. It will move through porous materials such as cement, wood, plaster, brick and other types of masonry until it reaches a water-tight barrier such as the paint or siding on your home's exterior wall. It will collect under the watertight barrier and cause blisters in the paint or siding. The water that collects in these blisters on wood surfaces will then start to rot the wood.

Is winter the only time of year that condensation happens?

People with low-E glass in their windows can see condensation on the exterior of the window at other times of the year. Since low-E glass is so efficient, it causes the window to have a lower surface temperature for a longer time during the day. Humid summer days are a good example of this. The warm, humid air outside will form condensation on the outside window glass since the air conditioner is keeping the window glass cool.

How will my home's age affect my condensation problem?

Homes built years ago were not built to be as tight and energy efficient as homes today. Older homes were built with more porous materials that allow the water vapor to move more easily through the walls.

Builders use much tighter materials when building today's homes to make them more energy efficient. These modern materials and building techniques that are designed

to better keep the cold outside, also keep the water vapor inside. This prevents the escape moisture generated from everyday family activities. The homeowner has to rely on mechanical methods of removing the excessive humidity from the air instead.

Controlling Indoor Humidity

Will raising the relative humidity level in my home allow me to lower the thermostat temperature and save money?

When the relative humidity level in a room is between 30% and 45%, you will feel a little warmer than in a room with the same temperature and 25% or lower relative humidity. Also, once the relative humidity rises past 50%, the room may begin to feel chilly or clammy. You may initially feel warmer in a room that is 65 ° F and 35% relative humidity than one that is 70 ° F and 20% relative humidity. After a few minutes, your body will adjust to the change in temperature and if you usually feel cold when the temperature is 65 ° F, increasing the humidity level will not help.

Are there any problems to having the relative humidity higher in my home?

Heating and ventilation experts recommend that when the outside temperatures drop below 0 ° F, you should lower the relative humidity level in your home to the 20% range to prevent excessive condensation from forming on your windows. You should also make sure the air is able to circulate well near the windows during the days when the temperature is below 0 ° F. Since there is a greater chance of condensation forming when the air stays near the windows like behind drapes, blinds and shades.

Are there any benefits to having the relative humidity higher in my home?

Static electricity is almost eliminated for most materials when the relative humidity level is 40% or above. Fine furniture and musical instruments made of wood do not dry out as much when the relative humidity is kept in the 30% to 50% range. Low relative humidity causes the glues used in the joints of furniture to loosen and save veneers to delaminate.

What are some ways to ventilate my home and control the humidity level indoors during the winter?

Here are a few fairly easy ways that can help reduce the humidity level in your home and help eliminate condensation problems:

- If you use a humidifier, turn it down or off when the weather gets cold.

- Install a vapor barrier in the crawl space under your house if there is not one already.

- Use the exhaust fan over your stove when cooking and in the bathroom when taking a bath or shower. This will allow the steam to go outside instead of remaining indoors. Be sure not to run it too long so the motor does not overheat.

- Store firewood outside instead of in the house or basement.

- Make sure to ventilate the attic and crawl space to the outside.

- You can even get rid of humid air by opening a window and allow the moist air to escape and allow the drier cool air indoors.

Is there a way to monitor the relative humidity level in my home?

Yes. Using a hygrometer will measure the humidity level within your home. Another way is to watch for condensation forming on the windows in a bedroom or den. When this begins to occur you are reaching a level that could begin to cause your home problems.

Ventilating Your Home**What forms of ventilating my home are available?**

Structural and interior are the two main forms available for ventilating your home. You should consult a heating and ventilation expert for recommendations on what structural methods will be best for your home.

Should my attic be closed off during the winter to prevent heat loss?

Many people close off all the louvers in the attic with plastic during the winter to save money on heating bills. This practice can cause some moisture problems inside the attic. When the attic is not ventilated the moisture from inside the home is trapped in the attic and condenses on the insulation and on the inside of the roof instead of being released into the outside air.

What problems can occur from this attic condensation?

When the condensing moisture wets the thermal insulation in the attic, the insulation does not prevent heat loss as well. The condensation can also contribute to mildew and rot for form. It can also fall on to the ceiling and cause damage.

What types of ventilating should I use for my home's attic and crawl space?

You should consult and heating and ventilation expert for recommendations on the types and amounts of ventilation that is appropriate for the size and material makeup of your home.

Condensation on Windows**Are windows a cause of condensation?**

Windows do not cause condensation. They just provide a visible indication of excessive moisture in your home's air.

Why is condensation forming on my windows and patio doors?

If the flow of warm air in the room is restricted by something like shades or drapes, condensation will be more common. The drapes and shades allow the air to remain in contact with the glass longer and cool and not retain as much moisture, thus condensing more water vapor onto the glass surface.

Would condensation be forming anywhere else in my home?

If you are seeing window condensation, you probably have other areas inside your home's wall that are as cold and that condensation is forming. This usually occurs in areas that there is not good circulation of the air and areas where insulation is weaker. The inside surface of the exterior walls usually will not have any signs of condensation. However, there are occasions that nail heads and closets on an exterior wall will have signs of condensation forming.

Why does condensation form on my windows and patio doors first?

You see condensation forming on the surface of the windows and patio doors first since they have the lowest surface temperature of any visible surface in your home.

Does the type of window in my home determine the chances of condensation forming?

Having bay or bow windows can increase your chances of condensation forming on them. This is usually an effect of the restricted airflow around these windows. You can combat this by putting more insulation around the window platform since they project from the side of the home more. You can also help to prevent condensation by using a small fan to better circulate air across the window.

What would cause this strip of condensation around the edge of my insulated window a little more than an inch wide?

Your window probably has a metal spacer holding the windowpanes together and apart. Since metal is a good conductor of energy is it keeping that strip of the window cooler than the rest of the window glass and condensation is forming there. This just indicates that window is doing its job, keeping the majority of the glass pane warmer since no condensation is forming there.

Why is there condensation forming on the inside of my storm windows?

What causes condensation on the inner surface of combination-type storm windows? Since operating windows like single and double hung windows are not completely sealed with caulk, they all leak a small amount of air between the sash and main frame. When the warm inside air leaks into the area between the sash and storm window, the water vapor condenses on the surface of the storm window since it is cooler than the glass surface of the window sash. You can alleviate this problem by ventilating this area to the outside.

Will this window condensation cause any damage?

The water from this condensation can cause paint to peel or stain. The water could also run into the window frame and dampen the area around it.

Is there any time during the year that the condensation forming on my windows is temporary?

There are a few cases that temporary window condensation will appear.

Newly constructed homes and remodeled homes are likely to see window condensation the first heating season after construction is finished. Since the materials

used, such as wood and cement, give off a great deal of moisture. Before the end of the heating season is over, the condensation problem should clear up.

During the humid summer months, homes absorb some of the humidity from the air. So at the beginning of the heating season, it is common for window condensation to occur until the house dries after few weeks.

If the temperature drops quickly during the heating season, window condensation can temporarily occur.

What can I do to lessen the chances of condensation forming on my home's windows?

If your windows are single-paned, you can install storm windows to help. Installing insulated replacement windows such as the Southern Rose 4006 Series will help, if you have the option of installing replacement windows.

Low-E Glass and Exterior Condensation

What does Low-E glass in my insulated windows do for me?

Low-E glass has a thin metallic composite coating bonded to the interior face of the outside windowpane. This coating prevents radiant heat from passing through it. In the summer time it keeps the hot radiant heat of the sun outside and in the winter it keeps your home's heating inside.

Why do my windows with Low-E glass have condensation forming on the outside during the spring and fall?

Since Low-E glass prevents heat from inside your home from escaping as easily as windows that do not use Low-E glass, the outside surface of the glass stays cooler for a longer period of time. This will cause condensation to form just like the dew on grass and car windshields. Most of the time this occurs in the spring and fall when the days get warm and the nights a cool.

What would cause the window to be cooler than the air outside at night?

Night radiance: Heat radiance which occurs at night: On nights when the sky is clear, a surface facing the sky sends and receives radiant heat to and from the sky. The radiant temperature of a clear sky is usually well below zero, particularly at night. Because of this the surface temperature of the window can easily descend below the temperature of the air outdoors and cause water vapor in the atmosphere to condense on the outside of your windows.

Is this going to happen on all my Low-E windows and is it preventable?

It can occur on any of your windows, but you will probably notice it more on those that face to the west. Since the sun does not shine on them to evaporate the condensation in the morning. With it only occurring under certain atmospheric conditions on a few days during the year, there is not a practical way of preventing this from occurring.

Are my windows not functioning properly when this occurs?

Condensation forming on the outside of low-E windows shows that they are working properly. Since the outside glass surface is insulated from the warm inside area, there is no heat loss to warm the outside pane of glass to prevent the condensation from forming. With regular window glass, enough heat will be lost through the window to warm the exterior pane of glass and prevent condensation from forming on the window.

Suggestions for Planning a Low-Condensation Home**What are some steps I can plan into my new home to reduce the chances of excessive condensation forming?**

Selecting vinyl or wood windows and sliding patio doors, which insulate better than metal-framed windows, will reduce your chances of having condensation forming on the inside during the winter.

Make sure your builder installs a vapor barrier in the crawl space under your home to prevent water vapor in the ground from rising into your home. And make sure the crawl space and attic are cross-ventilated.

Vent your clothes dryer and gas appliances outside to prevent the water vapor that is produced by their use from staying in the house. Also, use the exhaust fans in the kitchen and bathrooms to get rid of the water vapor produced while using those areas and replace it with fresh air.

Have your builder use kiln-dried lumber of a high quality since it will have less water vapor to release during the heating season.

Place vents for the heating system below areas with windows and patio doors.

Use windows and patio doors with double-pane insulated glass. For best performance, use Southern Rose vinyl windows and sliding patio doors with low-E glass.

Have your builder to take measures to prevent moisture from leaking into your basement.

Consult with a heating and ventilation expert on other suggestions that might be appropriate for your home.

Summary

The best way to prevent condensation from forming is to reduce the humidity inside your home. You have to determine the balance of ventilating the water vapor with the increased electricity consumption from running fans and opening windows.

Make sure your crawl space has a vapor barrier installed and properly ventilate your attic and crawlspace to prevent mold and mildew from forming.

Install storm windows if your windows are single-paned and if replacing your old windows and patio doors is an option, use Southern Rose vinyl windows and sliding patio doors.

Reduce the amount of moisture you can control that is released into your home's air. Turn your humidifier down or off. Also use exhaust fans in the kitchen while cooking and in bathrooms while showering or bathing. Use the fans for a few minutes after you are done to make sure most of the excess moisture has been removed, but don't run the fan too long that the motor would overheat. Be sure to store firewood outdoors. Make sure that your gas appliances and heaters are vented outdoors.

Keep the drapes, shades and blinds on windows open to facilitate airflow across them.

Check with your gas or electric company for heating and ventilation experts that they would recommend to assist you in implementing any of these recommendations and any others that they may have for your home's design.

The following sources were used to provide you with accurate information in this guide:

Angell, William J. *Home Indoor Relative Humidity: What Is Acceptable?* Garden State EnviroNet. <http://www.gsenet.org/library/07eng/wntrhome.php> (10 Mar. 2003)

Consumer Energy Information: EREC Reference Briefs. U.S. Department of Energy <http://www.eere.energy.gov/consumerinfo/refbriefs/ee2.html> (10 Mar. 2003)

DeWitt, Craig. *Window Condensation*. RLC Engineering, LLC. January 3, 2002. http://www.rlcengineering.com/win_cond.htm (10 Mar. 2003)

Lstiburek, Joseph and Carmody, John. "Fundamentals of Moisture in Houses". *Home Energy Magazine Online*. November/December 1995. Volume 12, Number 6. <http://homeenergy.org/archive/hem.dis.anl.gov/eehem/95/951108.html> (10 Mar. 2003)

Merrill, John. *Solving winter condensation problems*. University of Wisconsin-Extension. December 27, 2002. http://www1.uwex.edu/news/print.cfm?release_id_pk=547&style=print_story (10 Mar. 2003)

Merrill, John. *Tips to help reduce moisture problems on windows*. University of Wisconsin-Extension. January 29, 2001. <http://www1.uwex.edu/news/story.cfm/241> (10 Mar. 2003)

... *What is the Origin of Dew?* International Organization For Dew Utilization. May 22, 2001. http://www.opur.u-bordeaux.fr/angl/phenomene_physique_ang.htm (10 Mar. 2003)