



Facts About Condensation

Condensation is the fog that suddenly appears in cold weather on the glass of windows and sliding glass doors or the moisture in the attic or other places throughout the structure. It can block out the view, drip on the floor, and freeze on the glass, or appear as a roof leak. It's annoying.

While it's natural to blame the windows or the roof, you shouldn't. Condensation is the result of excess humidity in your home. And the windows provide a visible cold surface on which humidity can condense.

The important thing is your foggy windows and sliding glass doors are trying to tell you to reduce indoor humidity before it causes hidden, costly problems elsewhere in your home.

Problems like peeling paint, rotting wood, buckling floors, insulation deterioration, mildew, and even moisture spots on ceilings and walls.

Foggy windows and sliding glass doors are the indicators, the warning signs, that humidity could be damaging your home.

What to do? We've compiled this Condensation Answer Book to answer that and other questions you may have about indoor humidity and condensation. We'll start with the basics, and offer solutions and alternatives along the way.

However, some solutions to condensation problems pose a different kind of problem – that of energy efficiency. Some ventilation techniques (e.g. opening windows to air out a home; running fans more frequently) may add slightly to a home's energy bills. It is up to the reader to decide which solutions are most practical for him. This, of course, will depend on the severity of the condensation problems, both on windows and in other less obvious places in the home, such as the crawl space or attic.

Finally, as you read through this information and learn the causes and cures for condensation, remember: it's not the windows or the roof, it's the humidity.

Humidity and Condensation

What is humidity, anyway?

Humidity is water vapor, or moisture, in the air. Usually it's visible, but sometimes, such as with steam or ground fog, it's concentrated enough to be seen. But see it or not, all air contains a certain amount of moisture.



Where does the moisture come from?

There are many things that generate indoor moisture. The normal perspiration and breathing of a family of four adds about ½ pint of water to the air every hour. Cooking three meals a day adds four or five pints of water to the air. Each shower contributes ½ pint. In fact, every activity that uses water (like dishwashing, mopping floors, doing laundry) adds moisture to the air. The truth is daily living activities of a family of four can add more than 18 gallons of water a week into the air in their home. And more water vapor in the air means a higher indoor relative humidity.

What's relative humidity?

Air can hold only a limited amount of water vapor, and that amount depends on the air temperature. When air at a certain temperature contains all the vapor it can hold, it's said to have a relative humidity of 100%. Thus, when it holds only half the water vapor it can hold, the relative humidity is 50%. Cooler air is capable of holding less vapor than warmer air. So air at 30° F and 100% relative humidity actually contains less water than air at 70° F and 100% relative humidity.

Just what is condensation?

Fog on windows is a form of condensation. So is the water that forms on the outside of a glass of iced tea in the summer. It all comes from water vapor in the air.

What causes it?

Excess moisture in the air. When warm, moist air comes into contact with cooler surfaces, the moisture condenses. That's because the cooler air surrounding cooler surfaces can't hold as much moisture as warmer air.

What does condensation on windows mean?

Window condensation can be a danger sign. It may mean that excessive indoor humidity could be doing unseen damage to other parts of your homes.

How do I know if I have excess indoor humidity?

Check for damp spots on ceilings and room-side surfaces of exterior walls, particularly closets. Look for water and ice on windows. Even water-filled blisters on outside paint surfaces indicate excessive indoor humidity.

What does excess humidity do to my home?



Excess humidity contributes to the deterioration of a home. Excessive humidity can pass through walls and ceilings and freeze in the insulation. In spring it melts, damaging your ceiling and walls. Or, humidity can force its way out through siding to form blisters under your exterior paint.

You mean moisture can actually go through walls and ceiling?

You bet. It's because of a force called "vapor pressure". Moisture in wet air tries to flow toward drier air to equalize itself. This flow acts independently of air currents. In winter, inside air is much more humid than colder outside air. So, the vapor pressure, or equalization process, actually forces the inside moisture through cement, wood, plaster, and brick, toward the outside.

What happens then?

Because certain varnishes and paints block the flow of moisture, condensation can occur between the inside and outside walls, in the roof attic or under exterior paint surfaces. It can rot a home's wood frame and blister the paint.

Is condensation more prevalent in any geographical region?

Yes. Condensation is more apt to occur in climates where the average January temperature is 35° F or colder.

Does condensation occur only in winter?

Usually, but it can occur during cold weather anytime, and occasionally it will form on the outside of windows on hot, humid summer days, when your air conditioner has cooled the glass.



Does condensation depend on whether my home is new or old?

Generally, yes. Years ago, before the concern with energy efficiency, homes were built with less weather-tightness than homes today. Insulation concepts were not as advanced as today. Walls and ceilings were built with much more porous materials. Water vapor could easily flow in and out of walls.

Today's homes are much "tighter". Windows and doors are built to substantially reduce air leakage. Weather-stripping, modern insulation, vapor barriers, and construction techniques, which are intended to keep out cold air, lock moisture inside. As a result, moisture created by bathrooms, kitchens, laundries, and occupants no longer flows to the outside, unless provisions for mechanical ventilation have been made. So it's very easy to build up excessive, even harmful moisture levels in today's homes.

Controlling Indoor Humidity

How do I measure indoor relative humidity?

To get an accurate reading, you can buy humidity-measuring instruments, called hygrometers, or sling psychrometers. Otherwise, watch your windows for symptoms of excess humidity. When excessive moisture collects on the inside glass in a living room or bedroom, you're approaching the humidity danger level.

Isn't high indoor humidity healthy in winter?

That's a common belief, but there's little evidence to support it.

Many believe that dry air increases the susceptibility to colds. But humidity in a heated house, whether it's high or low, is not an important health factor to a normally healthy person. And there's little scientific evidence that the health of most people will be adversely affected if humidity is kept at a level that prevents excessive condensation.



Then what are some recommended indoor relative humidity levels for winter?

The University of Minnesota Engineering Laboratories performed a series of long and careful experiments on that subject. The following table shows the maximum safe humidity for your home, paint, insulation, and structural members:

Outside air temperature	Inside relative humidity for 70-deg. F Indoor air temperature
-30° F or below	not over 15%
-20° F to -10° F	not over 20%
-10° F to 0° F	not over 25%
0° F to 10° F	not over 30%
10° F to 20° F	not over 35%
20° F to 40° F	not over 40%



How can I reduce inside humidity in winter?

There are at least two steps you can take to reduce indoor humidity in winter:

Control the sources of humidity. Vent all gas burners, clothes dryers, etc. to the outdoors. Use kitchen and bathroom exhaust fans.

Ventilate your home. Because outside air usually contains less water vapor, it will "dilute" humidity of inside air. This takes place automatically in older homes through constant infiltration of outside air. But again, in newer "tighter" homes, the only way outside air can get in is by ventilation. More on ventilation in the next section.

Will reducing the humidity in my home during winter help control condensation?

It's the most practical way. Condensation indicates excessive humidity. Eliminate the excessive humidity, and you eliminate the condensation.

How can I reduce humidity in my home during the summer?

Air conditioners or dehumidifiers are your surest ways of reducing humidity to desired levels. However, in most cases, outside air will be more humid in warmer weather, and condensation on the inside of windows usually isn't a problem.

Ventilation

How can I ventilate my home?

There are basically two types of ventilation: interior and structural ventilation.

As a temporary solution to an acute problem, open a window in each room for just a few minutes. Remember that inside air continually gains humidity through daily living activities. Opening windows allows the stale, humid air to escape, and fresh, dry air to enter.

After a shower, for example, open the bathroom window or turn on the exhaust fan, so steam can go outside instead of remaining in the home.

Structural ventilation is slightly more complex, but will save your costly repair bills in the long run. Miniature louvers in exterior walls can be installed to prevent moisture from condensing between the outside and inside walls. This will keep paint from peeling as a result of indoor vapor pressure.



Does structural ventilation include attics?

Definitely. Many homeowners cover all attic louvers in winter in hopes of saving fuel. If the attic is properly insulated, this practice can only do harm. Because the indoor moisture penetrates ceilings, then condenses on the cool underside of the roof and can even form frost. If the attic were ventilated, moisture would be transferred to the outside air.

What harm can attic condensation do?

A lot. Moisture condensing in attics produces mildew, or rotting conditions. Or it drips down to the ceiling below to damage plaster or paint. Thermal insulation also becomes wet and provides less resistance to heat loss.

Are some kinds of attic ventilation better than others?

Yes. A combination of vents at the eaves and at the gable ends is better than gable vents alone. And, a combination of continuous eaves and ridge venting is best of all. However, regardless of the type you have, there should always be at least two vent openings, located so that air can flow in one and out the other.

Just how much attic ventilation should I have?

That's a difficult question to answer, because the size and number of vents depends on the location of the home, wind direction, physical size of the building, quality of workmanship and kinds of building materials used.

Consult a local heating and ventilating contractor, listed in the Yellow Pages. He'll be able to tell you exactly how much ventilation your attic should have.

What about the crawl space? Should it be ventilated, too?

Yes. The crawl space beneath a house is another place where ventilation is important. The crawl space can evaporate gallons of water each day. When you seal the crawlspace, that water penetrates the floor above and causes more humidity problems in the home.

Providing foundation vents in the crawlspace reduces the humidity, and a vapor barrier (like polyethylene film) on the ground prevents moisture leakage into the house above.



How much ventilation should I have in the crawl space?

At least one vent should be located near each corner, and should be placed as high as possible, but not higher than the bottom of the joists. Plus, if you have a ground cover, one 8" X 16" vent for each 350-sq. ft. is needed, with a minimum of four vents.

Again, it's wise to consult your local heating and ventilating contractor for number and proper placement of vents. He's listed in the Yellow Pages.

Windows and Condensation

Do windows cause condensation?

Windows are not a cause, per se. They provide a ready medium on which the vapor can condense. But the primary cause of condensation is excessive moisture in the air. Windows are only indicators of excessive moisture.

Why do I see condensation on my windows and sliding glass doors first?

Condensation is generally seen first on windows and sliding glass doors because they tend to have the lowest temperature of any of the visible surfaces in the house.

Are windows the only place condensation is forming?

Probably not. There's a point between the exterior and interior walls that's just as cold as the inside window surface. Chances are, if you can see condensation on your windows, it's also forming between the walls and in the attic, too. Room-side surfaces of exterior walls are normally warmer, but occasionally condensation occurs on cold spots such as nail heads and in the corners of outside walls and closets. This is because insulation is weaker and circulation is restricted in these areas.



Are there any cases where condensation is only temporary?

Yes, there are primarily three: new construction or remodeling; the beginning of each heating season; and quick changes in temperature.

New construction and remodeling produce a lot of moisture. Wood, plaster, cement, and other building materials contain a great deal of moisture. When the heating season starts, this moisture will gradually flow out into the air in the home. It will usually disappear during the first heating season and not cause any further trouble.

At the beginning of the heating season there may be a certain amount of temporary condensation. During the humid summer your house absorbs some moisture. After the first few weeks of heating your house will dry out, and you'll have fewer condensation troubles.

Sharp, quick drops in temperature can also create temporary condensation problems during the heating season.

Can windows help control moisture in my home?

Only in the sense that they can be opened for ventilation. Otherwise, windows are only indicators of excessive moisture in the air.



Building a Low-Condensation Home

I'm building a home. What steps can I take to prevent excessive condensation?

There are several ways you can plan your home to prevent excessive condensation:

Choose vinyl or thermally broken aluminum rather than metal for windows and doors. This will reduce the likelihood of condensation on the frame and sash. Metal frames without thermal breaks, on the other hand, conduct heat quite readily. So in the winter, the inside surface of a metal window frame is cold. When humid inside air comes into contact with cold metal, condensation, and often freezing, occurs.

Make sure the attic and crawl space are cross-ventilated. The crawl space should be covered with a vapor barrier. This will prevent water vapor from rising for the soil into your home.

Insulate the attic area with the DOE recommended R-Value for your area and roof style. This is probably the most important aspect of lessening attic condensation.

If you have a hot air furnace, install an outside fresh air intake.

Make sure your clothes dryer and all gas appliances have outside vents. Water vapor is one of the products of gas combustion.

If you have a basement, take the necessary steps to prevent leakage of soil moisture into the basement. These steps will vary with soil and drainage conditions on your lot.

Make sure heat outlets are places below glass areas of windows and sliding glass doors.

Use exhaust fans in the kitchen, bathrooms, and laundry. They'll not only help reduce excessive moisture, but will clear away stale air as well.

Select windows and sliding glass doors with double-pane insulating glass, Low-E glass or triple-glazing systems.



Summary

What steps can I take to reduce excessive humidity in my present home and control window condensation?

Recognize that the best way to stop condensation is to reduce the moisture in the inside air.

Be sure that attic or crawl spaces are properly ventilated. Add a vapor barrier to cover the earth in the crawl space. Improve insulation throughout the home. If you have single-pane windows, install storm panels. If you have double-pane-insulating glass, install triple-glazing panels.

Be willing to try living in lower humidities.
Eliminate any sources of moisture in your home that you can control.

In winter, provide more controlled ways for moist inside air to get out. Run kitchen or other ventilating fans longer and more often than you normally do.

If troublesome condensation persists, see your heating contractor about an outside air intake for your furnace, about ventilation of gas-burning heaters and appliances, or about installation of ventilating fans. Heating and ventilating contractors are listed in the Yellow Pages.

When you're planning a home, take the necessary steps outlined in this circular to prevent condensation problems. Again, work with your heating and ventilating engineer. Your gas or electric company may have a residential heating engineer you can consult.

Remember that the best way to avoid condensation is to reduce the humidity in the inside air.

Condensation is certainly a problem. But in the vast majority of cases, it's a problem that can be controlled or eliminated. If you follow the steps and suggestions outlined in this circular, you shouldn't have a serious condensation problem.