



Controlling home moisture problems

Homeowners are often concerned when they notice excessive condensation on windows, or water stains, mold, and mildew on walls and ceilings. These symptoms can indicate excess moisture in the home, or they can be a sign of a poorly insulated wall, air leakage, poorly performing windows, or extremely cold outdoor temperatures.

MOISTURE SOURCES

There are many possible moisture sources in a home. Some important sources are water from a leaky roof, deteriorated flashing, plumbing leaks, or gutters that don't drain properly. Another source is people. An average family of four can add two to three gallons of water per day into the air just through normal activities such as bathing, dishwashing, cooking, and breathing. Other less obvious culprits are unvented exhaust from ranges, ovens, gas fireplaces, clothes dryers and water heaters; plants and green firewood; and hot tubs, fish tanks, and wet laundry.

TYPES OF MOISTURE PROBLEMS

The first place you may notice moisture problems is on windows, especially if they are older and inefficient units such as single-pane or double-pane windows without a gas fill. Some condensation is normal on the coldest days because windows are often the coldest interior surface of the house. However, persistent and severe window condensation is a warning that moisture could also be condensing on hidden surfaces where it can lead to a variety of problems such as mold and rot in walls. More obvious problems are wet spots or mold patches on inside walls—a clear indication to take action.

Leaky houses may not show signs of moisture in the living space. They may, in fact, appear to be too dry because moist air escapes out of the house through gaps and holes in ceilings or walls. This may result in moisture damage within walls or in attic areas as warm, moist house air leaks into cold cavities.



Bathing and showering are major moisture sources. Run the exhaust fan for at least 30 minutes to clear fogged mirrors and avoid moisture problems elsewhere in the house.

Many modern homes have an adequate amount of insulation and fairly good windows. However, without adequate ventilation, these homes can be so tight that moisture builds up from internal sources, such as cooking and bathing, and leads to condensation problems. For instance, condensation can occur inside walls and on the underside of the roof sheathing in the attic—problems that a properly designed ventilation system can avoid. Condensation inside walls is not usually a problem as long as it is not persistent. In the winter, the outer walls are so cold that rot and mold growth is inhibited, even if condensation occurs. In the spring, the wall warms up and moisture evaporates back into the air and drains away. However, persistent wall moisture can occur in poorly ventilated, tightly sealed homes.

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(top) **Wood rot—the result of moisture getting into the attic.**
(bottom) **Ice dams are caused by poor insulation and air leaks between the ceiling and attic.**

Attic moisture is a bigger problem. If there is inadequate air sealing between the house and the attic, warm, moist air can be drawn into the attic. When the moist air reaches the cold underside of the roof, the moisture condenses, forming frost or wet spots that can drip back onto the insulation and into the ceiling, forming a stain visible from inside. Even worse, roof sheathing can rapidly rot or delaminate and the shingles themselves can deteriorate.

Dry indoor air can cause problems by creating ice dams. Most ice dams form when heated air from the house escapes into the attic and warms the underside of the roof, causing snow to melt and then refreeze when the water hits the cold overhang. Ice dams can force water back into the attic, where it can soak insulation and damage ceilings. Sealing leaks between the house and the attic is important for preventing both types of problems.

UNDERSTANDING CONDENSATION

Condensation occurs anytime warm, moist air contacts a surface that is colder than the air's dewpoint temperature. At dewpoint, the air is completely saturated—it is holding all the moisture it can hold for that temperature (i.e., the relative humidity is 100 percent). If the temperature of a surface falls below the dewpoint, the excess moisture will

condense as dew or frost. Window condensation is common in the wintertime, as warm, relatively moist air contacts the cold surface of the glass, much like the moisture that forms on a beverage when taken out of the refrigerator.

Thus, moisture problems depend on temperature and relative humidity. The tighter a home is, the more likely it is that humidity generated inside will remain inside and cause problems—unless the home is properly ventilated. But even if moisture levels stay constant, condensation can occur if surfaces get very cold, as they often do on extremely cold nights. Adding moisture to the air will raise indoor humidity levels and make condensation more likely.

Air movement also influences moisture problems. In the winter, the warm air inside the house has a natural tendency to rise. Warm, moist air leaves the house through the attic or the upper story and is replaced by dry, cold air that is pulled in through the lower level. This is called the *stack effect*. The stack effect causes moisture problems to be most pronounced in the upper stories of a house. For example, the windows on the lower level may be clear while the second story windows are frosted over.

SOLVING MOISTURE PROBLEMS

Reduce moisture sources

Deal with obvious sources of moisture:

- Repair plumbing leaks.
- Fix leaky roofs.
- Ensure that gutters are properly drained away from the house.
- Install a sump pump if the water table is high.
- Ensure that ductwork in a damp basement or crawl space is properly sealed—especially the ducts that return cold air to the furnace.

Ventilate areas where moisture is produced:

- Use the exhaust fan when cooking.
- Use bathroom fans while showering and allow them to run for 20 to 30 minutes after showering (installing a timer will make this easier).
- Make sure your bath and kitchen fans exhaust outside the house.
- Make sure your furnace, clothes dryer, gas fireplace, and water heater properly vent to the outside and don't spill exhaust back into the house (which is a serious safety issue as well).

Watch life-style patterns that could contribute to moisture problems:

- Avoid drying large amounts of laundry inside the house.
- Store firewood outside.
- Keep basement and crawl space windows closed in the summer time.

Warm up exposed surfaces

Warm up walls so that moisture doesn't condense on them:

- Install dense-pack cellulose in uninsulated or poorly insulated older houses. Insulation will make the walls warmer and prevent interior condensation.
- Move furniture or add registers from your furnace to improve warm air circulation in the living space.
- Open cupboard and closet doors or add louvers to provide extra warm air circulation if there are problems in these areas.

To solve condensation problems on windows, follow these guidelines:

- Make sure inner windows are properly sealed. Otherwise, moist air will leak to the outer storm and condense. Check that the windows are closed tightly with sash locks firmly latched. Use plastic film kits on troublesome windows to increase comfort.
- Check that warm air is getting to the windows. Is furniture blocking warm air registers? Also, open blinds and shades occasionally. Closing blinds and drapes—though a good way to save energy—can

worsen condensation problems by cutting off the flow of warm air past the windows.

- Consider adding storm windows or replacing your windows with more efficient units, especially if your old windows are single pane or aluminum-framed. Efficient windows are much less likely to show condensation because the glass stays warmer. Shop around for units displaying the ENERGY STAR® label. These products meet the highest standards of energy efficiency in their category.
- Windows are expensive. Consider window replacement as part of a whole-house approach to solving all your energy and moisture problems.

The kitchen is another common moisture source. Both cooking and running a natural gas stove releases water vapor. Remove moisture and odors with a range hood that is vented outside.



PROBLEM SOLVING WINDOW CONDENSATION

Controlling excess window condensation in the winter can be difficult. It can usually be controlled by using a hygrometer and your home's existing ventilation system.

A hygrometer is an instrument used to measure indoor and outdoor air temperatures and the amount of moisture present in the indoor air (usually expressed as relative humidity).

Interior Relative Humidity Levels, by Temperature, to Minimize Moisture/Condensation Problems

Outdoor Temperature	-20°F	-10°F	0°F	10°F	20°F
Relative Humidity	15-20%	20-25%	25-30%	30-35%	35-40%

Using the table

This table shows target humidity levels in your home given a certain outdoor temperature.

When you see excess condensation (more than 2 inches around the edges) on your windows:

- Check the outside temperature on your hygrometer.
- Check the relative humidity.
- If the relative humidity is higher than the target, turn on exhaust ventilation (usually a bath fan or range hood fan) until you see the relative humidity drop to the target.*

A hygrometer can be purchased at most local hardware stores for nominal cost.

*This solution will only work if your bath or hood fan is directly vented to the outside.

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Reduce window condensation by making sure furnace registers aren't blocked and by opening the drapes occasionally to keep warm air circulating.

Practice proper ventilation

Ventilation helps alleviate moisture problems by getting rid of excess moisture. Either spot ventilation or whole-house approaches can be effective:

Spot ventilation. Your kitchen and bathroom fans can effectively remove moisture from the home if they are vented outside.

Make exhaust fans easy to use by wiring them to a switch or a dehumidistat. A dehumidistat measures relative humidity levels and turns on the fans when needed. If you need spot ventilation in other areas, quiet, low-sone fans ducted to the outside are the best choice.

Whole-house ventilation. You may want to install a duct system that mixes outside air with air that returns to the furnace. An air-to-air heat exchanger—a more expensive option—captures heat from the air being exhausted. It's a good option for maintaining comfort in homes without a central furnace.

Don't go overboard on moisture control

Be a savvy homeowner when it comes to moisture. Some wintertime condensation on windows is normal, even in an efficient, well-ventilated home. Not all houses suffer from high relative humidity. In fact, leaky houses can become

exceedingly dry in the winter as cold, dry air flushes moisture from the home.

Having some moisture in your home will make it more comfortable and healthy. Humidity levels between 20 percent and 40 percent are normal. Below a relative humidity of about 20 percent, human health suffers because the respiratory system doesn't operate as efficiently. Low humidity also causes static buildup, warped floors and trim, and other problems.

However, running a humidifier or putting pans of water on the stove is not a good way to solve dry air problems. This can cause moisture to migrate to other locations in your home and cause problems.

Get help

Moisture problems can be difficult to solve. Hire a consultant that partners with the Home Performance with ENERGY STAR Program to help you. They will use a blower door test to find air leaks that are causing your house to be too dry. They can also find where moisture is getting into building cavities and causing condensation problems. Contact Focus on Energy for more information.

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