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Controlling Moisture *in your home*



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Controlling Moisture in Your Home

Excessive moisture in homes is a common problem that causes discomfort, building damage, and even illness.

It is most common in homes without central heating, which by design, helps to circulate air flow and ventilate the home. Homes with base board, wall and radiant electric heaters, and poorly insulated homes more commonly experience moisture problems.

Molds, mildews, dust mites, and other microorganisms grow and multiply best in a warm, moist environment. A high moisture level in a home can seriously affect people with allergies and other respiratory problems. Also, high levels of moisture encourage wood decay damage, creating extra maintenance. And some pollutants (such as formaldehyde) are released more easily into moist air than dry air.

You can easily measure the moisture level in your home with a hygrometer, an inexpensive device available in some hardware stores, and through greenhouse supply outlets. It measures relative humidity — an indicator of the amount of water vapor in the air. Most people are comfortable when the relative humidity is 40 percent to 60 percent. Move the hygrometer from room to room, checking humidity levels throughout the house.

If you don't have a hygrometer, answering yes to the following questions indicates a problem:

- Do you often have condensation on double-pane windows during the winter?
- Do you have problems with mold or mildew on walls or ceilings?
- Do any rooms seem damp or stuffy?
- Do you turn up the heat in your home to reduce these symptoms?

Moisture basics

Figuring out why a house has moisture problems is like putting together pieces of a puzzle. First identify whether the moisture is high in the whole house or only in certain rooms. Then try to find where the moisture comes from. Most houses have many moisture sources, so finding the most troublesome sources may take some detective work.

Excessive moisture in a house is caused by one, or more, of the following:

- Sources of moisture from inside the house
- Sources of moisture from outside the house
- Inadequate ventilation

To understand how moisture travels through your house, it's helpful to understand some basic principles. The amount of moisture the air can hold depends on temperature. Warm air can hold more moisture than cold air.

Moisture moves from areas of high humidity to areas of low humidity. In the winter, the air inside most houses is warm and moist. Even in our rainy climate, outside air is colder and can't hold as much moisture. When it's colder outside than inside, the moist inside air moves toward the outside, primarily through small cracks and holes in the walls and ceilings – around electrical outlets and switches, pipes, wires, windows, and doors.

To solve a moisture problem you have to limit the sources of moisture or make ventilation more effective. Often it takes a combination of both strategies.

Inside sources of moisture

All living things generate moisture. Each person in the household can introduce 2 to 3 quarts of water a day just by breathing and perspiring. Animals, plants, and aquariums also add moisture.

Normal household activities are sources too. Cooking, bathing, and cleaning raise the moisture level in your home. Also, hanging clothes to dry and storing firewood indoors raise the humidity significantly.

Limiting indoor sources of moisture

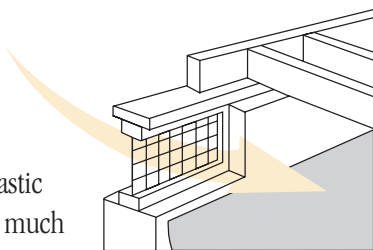
- If you have a larger-than-normal number of people, pets, or plants in your household, increasing ventilation will be a key part of solving your moisture problems.
- Make sure everyone in your household uses the bathroom fan when showering or bathing.
- Cook with lids on your pots, and use the fan in the kitchen range hood.
- Open windows or use your bath and kitchen fans when you scrub floors, walls, or other large surfaces.
- Avoid drying clothes inside your home – even in the basement, on the porch or in the garage.
- Make sure your clothes dryer is vented to the outside. If the dryer duct ends in the basement, crawl space, attic, or garage, the dryer is probably adding significantly to your moisture problems. Up to one pound of water per pound of laundry is vented from a clothes dryer. Also, for most dryers, the duct to the outside should be no longer than 14 feet and have no more than two elbows to be effective. Flexible ducting should be stretched smoothly to the manufacturer's recommendations to maximize venting. For fire safety, wire reinforced vinyl duct should be replaced with solid metal or flexible aluminum dryer duct.

- Don't use your house to dry and store firewood.
- Although allowed by code in some cities and counties in the U.S., non-vented (ventless) gas fireplaces and heaters introduce very large quantities of water vapor into living spaces when operated. They can produce severe moisture problems in Western Washington homes.

Outside sources of moisture

The crawl space under the house can be a major source of moisture to the interior of the house if there is standing water present, or if there is not a continuous plastic vapor barrier to cover the dirt or concrete. Crawl space vents should be placed as close to corners as possible with the remaining vents evenly distributed along the walls. Crawl spaces with low amounts of water vapor may need as little as one square foot of ventilation area per 300 square feet;

those with seasonal standing water and/or, high levels of water vapor (even with a continuous plastic vapor barrier) may need as much as one square foot of vent area per 150 feet of crawl space area. Exposed



Crawl space ventilation

dirt or even a thin slab of porous concrete in the crawl space under the house should be covered with black, 6-mil (0.006-inch thick) plastic sheeting to reduce the amount of water vapor entering the house. Overlap the edges of the plastic at least two feet and extend it about 4 inches to 6 inches up the foundation walls. The plastic should not come in contact with the wood of the house structure. Corners and edges of the plastic can be secured with bricks or rocks.

A leaky basement can be a major source of moisture. After a basement flood, wet concrete, floor coverings and furnishings raise the humidity in the whole house as they dry. Usually correcting a leaky basement requires the help of an expert. Check in the yellow pages under Waterproofing Contractors.

Attics

Your attic is unlikely to be a source of moisture to your house, unless the roof leaks. But the attic can develop serious moisture problems of its own if the inside of your house has a high humidity level. Remember that moisture moves from an area of high relative humidity to an area of lower relative humidity. During the heating season, moist air from inside your house travels to the attic through small holes and cracks. Unless your attic has good ventilation, the moist air can condense, become trapped, and cause mildew, rotting wood, and wet attic insulation. If severe enough, the condensation can drip through and damage the ceiling below.

Limiting outside sources of moisture

- If you have a crawl space, make sure that you have the recommended number of crawl space vents, that they are not obstructed, and that they are distributed well for cross ventilation.
- Be certain that under floor insulation over a crawl space has been installed with its vapor barrier side up against the under side of the subfloor.
- If you have a crawl space or a combination half basement/half crawl space, make sure a black plastic vapor barrier covers the ground, overlapping at each joint and extending up the foundation wall.
- If your basement leaks during heavy rains, contact a specialist to solve the problem.
- Check your attic for signs of moisture (stained rafters or roof sheathing, damp insulation) and for adequate venting. Add more venting if you find any problems not related to a roof leak.

Inadequate ventilation

Good ventilation is critical to controlling moisture levels in your home because many household activities such as cooking, doing laundry and bathing produce moisture. Ventilation moves moist air out and helps replace it with drier outside air. However, simply opening windows and doors may not be adequate enough and may be uncomfortable depending on the season. The most effective ventilation is provided by fans that are the right size and properly installed.

During the last decade in the Pacific Northwest, considerable work has been focused on improving ventilation systems in new homes and apartments. Washington state's building codes for new homes now require two kinds of ventilation: spot ventilation and whole house ventilation.

A spot ventilation fan must be provided in any room where moisture or odors are produced: the kitchen, bathroom, laundry room, spa or pool room. Spot ventilation fans carry moisture and pollutants directly from where they are produced to the outside. These fans must have ducts that end outside the building, connecting directly to wall cap or roof cap, including a damper. The wall or roof cap prevents rain and drafts from entering the duct.

Whole house ventilation is controlled by a clock timer that operates the system periodically. The timer should be set to provide ventilation during sleeping hours (if windows are not opened) and during activities such as cooking and bathing. Smaller homes and homes with numerous occupants will often require more hours of fan operation. The length and number of whole house fan operating periods should be adjusted to maintain relative humidity in living areas and bedrooms in a range of between 40 percent to 60 percent to prevent accumulation of stale, unhealthy air in rooms.

If you are having moisture problems, consider installing spot ventilation where moisture is produced and consider upgrading to provide whole house ventilation for improved indoor air quality around the clock.

Analyze your home's ventilation. Do you have fans in the bathrooms? Do you have a vented range hood over the kitchen stove? Are the fans used regularly? If you have fans that are used daily, but moisture levels are still too high, it may be time to check the fan ductwork.

To be effective, each fan should have a duct from the fan to a small vent (cap) on the outside wall of your house or on the roof. Walk outside and look for a vent cap for each of your household fans. (While you're at it, look for the vent for your clothes dryer, too.) Next, try to check each fan's duct. When a duct goes through the wall, checking is difficult, but often exhaust ducts are routed through the attic. Ducts that go under the house are rare, but if you can't find wall or attic ducting, check in the basement or crawl space. Here are things to look for in ducts:

- **What is the duct's diameter?** Fan exhaust ducts should generally be a minimum of four inches in diameter to be effective at moving air. Three-inch ducts were commonly installed in the past. Upgrading to a larger diameter duct should improve fan performance.
- **Is the duct smooth metal or is it "flex duct" a flexible metal with spiraling ridges?** Although flex duct is often used, smooth metal ducts move air more effectively than flex duct. A fan connected to flex duct has more resistance to overcome and moves less air. Small diameter flex ducts cause the most problems. If your fan is connected to three-inch flex duct, it probably doesn't work very well. Changing to four-inch smooth duct should greatly improve performance. If flex duct must be used, make sure it is at least four inches in diameter, kept as short as possible, and installed with no dips or droops.

- **Is each duct directly connected to an outside vent?** Or does the duct end in the attic? Sometimes fan ducts exhaust moist air into the attic, causing high moisture levels and structural damage to the roof assembly. If you don't see any ducts, check the attic insulation above each fan to see if it is disturbed. This could indicate that moist air is being blown directly into the attic. Fans should always be ducted outside the building shell.
- **How long is each duct?** Short duct runs are the best. Long ducts restrict air flow, especially when flex duct is used. For average bath fans, four-inch flex duct should be no longer than six feet.

If you can't find any ducting for your kitchen range hood, you may have a "recirculating" range hood. Moisture and odors from cooking are pulled through a filter and blown back into the kitchen. These hoods don't remove moisture.

If your fans and ducts appear to be in good condition, operating the fans more should lower the moisture level in your house. Sometimes the fans installed in homes are so noisy that people have a hard time using them. Today, quiet fans are available that make moisture control easier on the ears. Fans are rated for noise in sones; the lower a fan's sone rating, the less noise it makes. If you're replacing a fan or adding a new one, look for a fan with a rating of 1.5 sones or less. Another strategy for reducing noise — while maintaining a high air flow rate — is to install an in-line model fan at least four feet from the room it serves.

Using a bath fan for a longer time is easier with an upgraded control. Crank timers (also called interval timers) are readily available in hardware stores. They allow you to set the fan to operate for a length of time after you leave the bathroom. Look for a timer that allows up to one hour of run time.

A clock timer (also called a time-of-day timer) allows you to schedule a fan to operate for several periods during each 24 hours. Washington's building code requires a new home's whole house ventilation system to operate for at least 8 hours out of 24. By installing a clock timer, you can operate an existing bath fan as a whole house fan.

If controlling moisture sources and increasing fan operation do not control reduce the moisture level, you may need to add sources of outdoor air. Small vents are screened on the outside to keep insects out. The grille on the inside wall is designed to direct air upward and avoid drafts. Install a vent high on the wall in each bedroom and main living area. Leave the vents open year round.

Combustion appliances warning

Bathroom fans, kitchen fans, clothes dryers, and wood, gas, oil, and propane combustion appliances remove household air when operating. Sometimes removing air from the home can create negative pressure resulting in back-drafts. The use or increased use of exhaust fans can, at times, draw combustion gases such as carbon monoxide (CO) into the home from the combustion equipment. Safety officials recommend installing a CO detector in homes with combustion appliances. If a recurring presence of CO is detected in the home, immediate action should be taken to locate the source and correct the cause.

Back-drafting can be diagnosed and corrected by some experienced heating contractors and safety specialists.

Improving your home's ventilation

- If you have combustion appliances in your house, read the warning on page 10.
- If you have a new house with wall or window vents, leave the vents open. If you have an exhaust fan with a clock timer controlling it, set the timer to operate the fan at least 8 hours out of every 24. Schedule operation during the morning and evening when cooking and bathing take place, and during the night when people are sleeping.
- Periodically check your fans for effectiveness by assessing their air removal capacity. There should be a strong flow of air passing into the fan's grille. Remove the fan grille and inspect the fan for accumulation of dust and lint which can reduce ventilation effectiveness. Cleaning should be performed in accordance with manufacturer instructions. Fan blades can be easily bent and unbalanced by an improper cleaning technique.
- If ducts for existing fans are too small in diameter, very long, or are not connected directly to a wall or roof vent, upgrade the ducts.
- If your home does not have exhaust fans in the kitchen and bathrooms, consider having them installed. Call your local building department for information on fan sizes and ducting.
- If your fans are not used regularly because their noise is annoying, replace them with quieter models.
- If your fans and ducting seem to be in good condition, increase the time you use them. Automatic controls such as a crank timer or a clock timer make it easier to do. If you use a clock timer, set it to operate at least 8 hours out of every 24. Schedule operation during the morning and evening when cooking and bathing take place, and during the night when people are sleeping.

- If source control and using your fans more doesn't reduce moisture sufficiently, consider installing wall vents in bedrooms and the main living area to supply outside air.

Condensation on windows

Condensation occurs when warm, moist air comes in contact with a cool surface. In your home, this cool surface is most often a window. Reducing the humidity level inside the house by controlling moisture sources and increasing ventilation will help control condensation, especially on double pane windows.

Because of their high heat loss rate, single-pane windows nearly always experience winter condensation problems, even when indoor moisture is controlled. Due to its high heat loss rate, the aluminum frame of a window will nearly always experience seasonal condensation, unless an outer storm window is added.

A modern, vinyl frame, double-glazed window will rarely experience condensation on the inner glass surface if relative humidity in the house is maintained below 60 percent during the winter.

When storm windows are added to single pane windows, the problem of condensation on the inner surface of the original window will be reduced. Sometimes, if the inner window is poorly sealed, warm moist air from the house will enter the space between it and the storm window. Condensation may appear on the inner surface of the storm window. Sealing the original window will reduce this problem.

To solve a condensation problem with storm windows, identify where the condensation occurs. If condensation is on the inside surface of glass in your house, try weather stripping your storm windows to keep cold air out. If the condensation is on the outside layer of glass, try sealing air leaks on the inside of the window by replacing weather stripping or old putty. If the

condensation on the outside window persists, sometimes you can add ventilation, or “breathing holes” around the edges of the outer storm window sash to permit moisture to escape.

Cleaning up after a moisture problem

Molds and mildews are hardy fungi that grow rapidly in damp, poor ventilated places where they are left undisturbed. Keeping things clean and dry is the best way to prevent mold and mildew growth. Once established, it can be a difficult problem to eliminate. Look for cleaning products with fungicide or mildewcide on the label, which are specifically made to kill the organisms and their spores. Be sure to kill mold and mildew before painting. Paint alone will not kill these organisms.

For more energy efficiency information:

➤ Energy Efficiency Hotline: 1-800-562-1482; Option #1

Information about:

- Free Personal Energy Profile
- Insulating your home
- Energy-related products and services
- Low income weatherization assistance

If you have questions about your bill or need to report an emergency or outage, please call:

**Puget Sound Energy – Customer Service
(425) 454-2000 from the greater Seattle
local calling area or toll-free 1-888-CALL PSE
(1-888-225-5773). Or visit our web site at:
www.pugetsoundenergy.com**

For more information, or to ask about one of the following services, please call our Energy Efficiency Hotline at **1-800-562-1482** or visit us at **www.pugetsoundenergy.com**

The Personal Energy Profile

A free do-it-yourself home energy audit.

Enliance™ Registered Dealers

A free contractor referral service with information on furnaces, water heaters, gas fireplaces, electric heat pumps, air conditioning, insulation or high-efficiency replacement windows.

Weatherization Assistance

Weatherization assistance program for low-income customers.

Informational Brochures

Information-packed brochures to help you reduce your energy costs.

Additional Resources:

When using national information resources, recognize that because climate, fuel costs and housing types differ, energy savings and recommended improvements may differ from those cited in this brochure. The following URLs were current at the time this brochure was published. These references are intended for informational purposes only, and do not represent an endorsement by Puget Sound Energy of any organization, business, product or service.

Home Energy Magazine

<http://www.homeenergy.org/>

Northwest EcoBuilding Guild – Services

www.ecobuilding.org/greenpages/iaq.html

Bonneville Power Administration – Fans/Controls

<http://www.bpa.gov/Energy/N/PRC.htm>

Energy Ideas Clearinghouse - Moisture-related topics

www.energyideas.org/energy_solutions

U.S. Environmental Protection Agency

<http://www.epa.gov/iaq/>

Sound Home Inspections, Inc

www.soundhome.com/topics/topic_basement.shtml

Washington State University-Energy Programs

Washington State Ventilation and Indoor Air Quality Code

www.energy.wsu.edu/buildings/

(Click on 'Code Forms' and 'Builder's Field Guide')

IRIS Communications, Inc

www.oikos.com/library

(See sections 'Ventilation' and 'Air Sealing')

