

A G U I D E T O  
**UNDERSTANDING  
CONDENSATION**





## Summary

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

- A.**
1. Recognize that the best way to stop condensation is to reduce the moisture in the inside air.
  2. Be sure that attic and crawl spaces are properly ventilated. Add a vapor barrier to cover the earth in the crawl space.
  3. If you have single-pane windows, install storm panels. If you have windows with double-pane insulating glass, add removable glazing panels. If window replacement is a possibility, replace with PARCO High-Performance windows and patio doors.
  4. Be willing to try living with lower humidities.
  5. Eliminate any controllable sources of moisture in your home.

6. 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.

7. If troublesome condensation persists, see your heating contractor about an outside air intake for your furnace (required by some state building codes on all new residential construction), about ventilation of gas-burning heaters and appliances, or about installation of ventilating fans. Heating and ventilating contractors are listed in the Yellow Pages.

8. When you're planning a home, take the necessary steps outlined in this booklet 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, the *best* way to avoid condensation is to reduce the humidity of the inside air.



**WINDOW SYSTEMS**

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### MAINTAINING PROPER HUMIDITY LEVELS

Condensation is merely a visual indication that the humidity in your home is above recommended levels. It is not a defect of the window. If condensation does occur the National Warm Air Association encourages that you comply with the chart below to maintain proper humidity levels that will help alleviate this condition.

This chart is based on the maximum recommended interior humidity levels, based on 70°F interior temperatures.

<b>Outside Temperatures</b>	<b>Inside Relative Humidity</b>
-20°F and below	15%
-10°F to -20°F	20%
0°F to -10°F	25%
10°F to 0°F	30%
20°F to 10°F	35%
40°F to 20°F	40%

## Windows and Condensation

### Q. Do windows cause condensation?

A. Windows are not a cause, as such. 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 simply indicators of that moisture.

### Q. Why do I see condensation on my windows and patio doors first?

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

### Q. Are windows the only place condensation is forming?

A. Possibly not. There's a point between 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. Room-side surfaces of exterior walls are normally warmer, but occasionally condensation occurs on cold spots such as nailheads and in the corners of outside walls and closets. That's because insulation is weaker and circulation restricted in those areas.

### Q. What causes condensation on windows and patio doors?

A. Remember: cool air can't hold as much moisture as warm air can. So when the warm, moist air of the room comes into contact with the cold glass surface, some water vapor which the cooled air can no longer hold is deposited on the glass. Condensation can also occur when the flow of warm room air over window surfaces is restricted.

### Q. Does the amount of condensation depend on window type?

A. Sometimes. Angle bay or bow windows, for example, usually experience more condensation than other window styles. This is because inside air circulation around those window types is usually more restricted. And, since they hang away from the insulated house wall, bays and bows could be a few degrees cooler in temperature. To diminish excessive condensation, it's smart to insulate between the window head and platform, as well as between the seat and platform. In extremely cold climates, additional insulation above and below the window platform may also be necessary. As a secondary measure, placing a common electric fan near the window to promote air circulation may be helpful.

### Q. Do drapes and window shades cause window condensation?

A. Drapes and other window coverings don't cause window condensation, but they can contribute to the problem by restricting the flow of warm room air over the glass surface. Therefore, condensation is more apt to occur when drapes are closed and shades are pulled down. Today's heavily insulated drapes and tighter shades can contribute to the problem even more.

### Q. What causes condensation on the inner surface of combination-type storm windows?

A. All operating windows leak some air between the window frame and sash. (Because, in order for them to open and close, they are not caulked shut.) So when warm household air seeping in around the sash becomes trapped by the colder storm window, condensation forms on the inside-surface storm pane. Providing outside ventilation to the combination storm window usually lessens this problem.

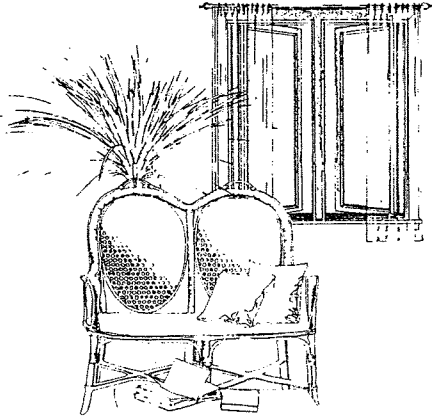
### Q. What damage can excess window condensation do to windows?

A. It can cause the paint to peel from the sash or stain the inside. Water can run down into and cause dampness around the window frame. It can sometimes cause paint to peel on the outside of the window.

### Q. Are there any cases where window condensation is only temporary?

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

- Wood, plaster, cement, and other building materials used in new construction and remodeling produce 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 will have absorbed some moisture. After the first few weeks of heating, it 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.



## Ventilation

### Q. How can I ventilate my home?

A. There are basically two types of ventilation: interior and structural. As a temporary solution to an acute problem, open a window in each room for just a few minutes. Remember, 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 you costly repair bills in the long run. Consult a heating and ventilating contractor or some other expert in this field.

### Q. Should structural ventilation include attics?

A. 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: 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.

### Q. What harm can attic condensation do?

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

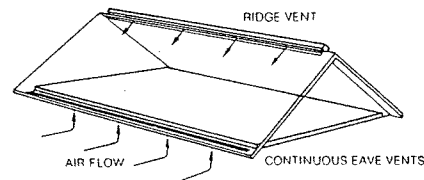
### Q. Are some kinds of attic ventilation better than others?

A. Yes. The best type of attic ventilation for your home is a system that provides maximum air flow through the attic to the outside. For this reason, a combination of continuous eave vents and ridge venting is one of the most effective types. To be on the safe side, consult a local heating and ventilating contractor listed in the Yellow Pages. He'll help you determine whether your attic ventilation is adequate.

### Q. Just how much attic ventilation should I have?

A. 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.



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

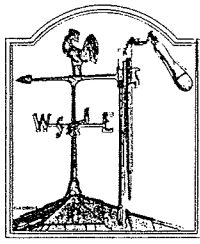
A. Yes. It's important that the crawl space beneath a house also be ventilated. It can evaporate gallons of water each day. If the space is sealed, that water penetrates the floor above and causes more indoor humidity problems.

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

### Q. How much ventilation should I have in the crawl space?

A. At least one vent should be located near the corner and 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.



## Controlling Indoor Humidity

**Q. If I increase the relative humidity in my home in winter, can I lower the temperature and save energy?**

**A.** Not really, although there is a relationship between how warm you feel and relative humidity. That's why it feels hotter in summer when the humidity is higher. In winter you might feel colder initially in a room at 70° F and 20% relative humidity than in one at 65° F with 35% relative humidity. However, the body soon adjusts to such slight differences, and if you feel cold at 65° F, the humidity level really doesn't matter – you'll still feel cold.

**Q. Then I shouldn't increase the humidity in my home in the winter?**

**A.** Even though increasing the relative humidity won't mean changing your thermostat setting significantly, higher humidities in the home in winter might mean greater comfort. Some people think they feel more comfortable breathing humidified air.

At one time it was believed that humidifiers helped people stay healthy during the winter months. Recent tests have shown that for usually healthy people this is not the case. In fact, humidifiers may actually cause some health problems.

Humidified air can help reduce static electricity and shrinkage in furniture and woodwork caused by dryness. Weigh the advantages and disadvantages. You may decide to use a humidifier. But remember, too much humidity causes condensation – and that's not good.

**Q. So how does humidity affect window condensation?**

**A.** Excessive humidity is generally the cause of window condensation. As the outside temperature drops, the window glass also develops a lower temperature. When moist air particles in the warmer room come in contact with the colder glass pane, the moisture particles condense and form water droplets.

That's *how* condensation occurs. Determining *when* condensation will occur and preventing it depends upon the type of window, the relative humidity level inside your home, and the temperature of the air inside and outside.

However, experts have a general guide we can follow to help us control humidity and window condensation. Basically, it is this: As the outside air temperature drops, you should also decrease the humidity level within your home. For example, if your indoor air temperature is 70° F when it's 20° F outside, your relative humidity level should be 35-40%. However, when the outside temperature drops to – 20° F, your inside relative humidity level must also drop – to a 15-20% range – in order to minimize condensation.

By the same token, if you lower your room temperature to conserve energy, you must also decrease the level of relative humidity to minimize condensation.

According to another commonsense guideline, you should maintain as high a relative-humidity factor as you can for comfort. Then reduce the humidity level when condensation occurs. In many homes, this simply means turning off the humidifier.

**Q. How do I measure indoor relative humidity?**

**A.** It's important to remember that relative humidity levels quoted in weather reports indicate outdoor humidity in outdoor air. So they have little bearing on your home's indoor relative humidity.

To get an accurate reading, you can use humidity-measuring instruments called hygrometers. (The sling psychrometer is one type available.) Otherwise, keep the commonsense guideline in mind and 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.

**Q. How can I reduce indoor humidity in winter?**

**A.** There are at least two steps you can take:

- 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" inside humidity. 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 about ventilation in the next section.)

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

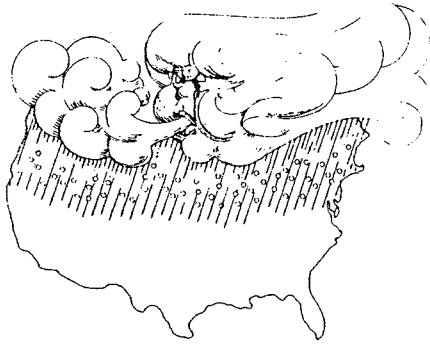
**A.** It's the most practical way. Condensation indicates excessive humidity. Eliminate the excessive humidity, and you eliminate the condensation.

**Q. You mean moisture can actually go through walls?**

**A.** 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.

**Q. What happens then?**

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



**Q. Is condensation more prevalent in any geographical region?**

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

**Q. Does condensation occur only in winter?**

**A.** Usually. However, condensation can occur whenever water vapor in the air comes in contact with a surface whose temperature is lower than the dew point (the temperature at which air becomes saturated and produces dew). Exterior condensation may occur on windows glazed with High-Performance glass. It is so efficient at keeping radiant heat indoors it creates a lower exterior glass surface temperature for longer periods of time than regular insulating glass.

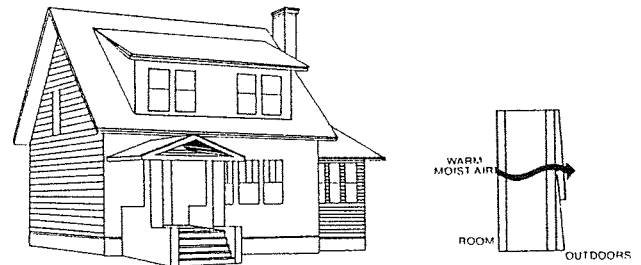
Also, during hot, humid summer days, for example, condensation can form on the outside of windows when conditioned air inside the house makes the surface temperature of the glass cooler than the dew point.

**Q. I notice a 1" to 2" wide strip of condensation all the way around the window. What's this?**

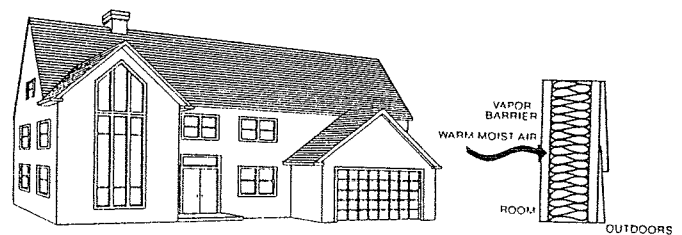
**A.** You have purchased High-Performance windows, and this is evidence they are working exactly as they should. The two panes of glass in your High-Performance windows are held together—and apart—by aluminum edge-spacers. Because aluminum is highly conductive it will transmit cold from the outside to the inner glass... cooling that 1" strip to the point that condensation forms. It doesn't mean that your window is leaking air or not working. Quite the contrary.

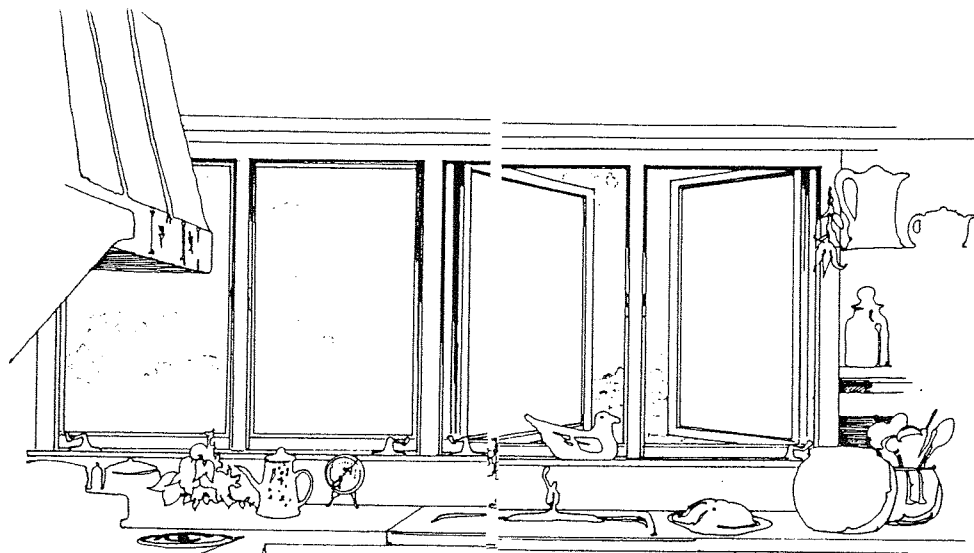
**Q. Does condensation depend on whether my home is new or old?**

**A.** Generally, yes. Years ago, before all the concern about energy efficiency, homes were built less weathertight than they are today. Insulation concepts were very basic. 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 reduce air leakage substantially. Weatherstripping, modern insulation, vapor barriers, and construction techniques intended to keep out cold air all can 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.





## Humidity and Condensation

### Q. What is humidity, anyway?

- A. Humidity is water vapor, or moisture, in the air. Usually it's invisible. But sometimes, as in the form of steam or ground fog, it's concentrated enough to be seen. Nevertheless, all air contains a certain amount of moisture, visible or not.

### Q. Where does the moisture come from?

- A. There are many things that generate indoor moisture. The normal perspiration and breathing of a family of four adds about half a 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 another half-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 to the air in their home. And the more water vapor in the air, the higher the relative indoor humidity.

### Q. What's relative humidity?

- A. 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 as much water vapor as it could, 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.

### Q. Just what is condensation?

- A. 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.

### Q. What causes it?

- A. 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.

### Q. What does condensation on windows mean?

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

### Q. How can I tell if there's too much humidity in my home?

- A. Check for damp spots on ceiling 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.

### Q. What does excess humidity do to my home?

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



# House with condensation needs immediate attention

By Knight-Ridder News Service

**Q:** We recently purchased a well-insulated house with gas heat. In cold weather, we get extreme condensation on the insides of all windows. Water must be mopped up several times a day. Any suggestions?

**A:** The first step, which should be taken immediately, is to have the heating system and chimney checked to make sure it is venting properly. Some cases of severe condensation in houses with gas heat are caused by a blocked chimney. Needless to say, this can be dangerous.

If the heating system and chimney

are OK, these are other ways of reducing the humidity or moisture level in the house:

- If a humidifier is being used in the house, turn it off.

- Use exhaust fans in the bathrooms, kitchen and laundry room, where much moisture is generated.

- Make sure the clothes dryer is vented to the outside.

- If the house sits on a crawl space, cover the floor with sheet plastic or roll roofing to help prevent moisture from rising into the living area.

- Ventilate the house on fair winter days by opening some windows and doors briefly.