



Condensation Information

Condensation

Every year, with the arrival of cold, winter weather, questions about condensation arise. The moisture that forms on window glass, obscuring the view, freezing or even collecting in puddles on the window sill, can be irritating and possibly even damaging. The first reaction may be to blame the windows for this problem, yet windows do not cause condensation. Excessive water vapor in the air, the temperature of the air and air circulation or movement are the three factors involved in the formation of condensation.

Today's modern homes are built very "air-tight" for energy efficiency. They provide better insulating properties and a cleaner, more comfortable living environment than older homes. These improvements in home design and construction have created some new problems as well. The more "air-tight" a home is the less fresh air that home circulates. A typical central air and heat system only circulates the air already within the home. This air becomes saturated with by-products of normal living. One of these is water vapor.

Excessive water vapor in the home will most likely show up as condensation on windows. Condensation on your windows is a warning sign that the relative humidity (the measure of water vapor in the air) in your home is too high. You may see it develop on your windows, but it may be damaging the structural components and finishes through-out your home. It can also be damaging to your health.

The following review should answer many questions concerning condensation and provide good information that will help in controlling condensation.

What is condensation?

Condensation is the process by which water vapor becomes a liquid. The air in our atmosphere contains anywhere from 0 to 4 % water vapor. This water vapor will remain in the air until either 1) so much water vapor is added to the air that it becomes saturated and can no longer hold the water vapor, or 2) the temperature of the air drops low enough that the air can no longer hold the water vapor. In either case the water vapor turns into liquid and forms on a surface as condensation.

What does it indicate?

When you see condensation forming on your windows it is a warning that there is too much water vapor in the air of your home or that there is insufficient air circulation next to the windows on which the condensation is occurring.

What causes condensation?

Condensation is caused by the air temperature becoming too low to hold the water vapor that is in it. The factors involved in condensation are as follows:

1. The amount of water vapor in the air of the home (measured in relative humidity).
2. The circulation of the air within the home.
3. The air temperature. Both in the home and outside.

The air in a room contains water vapor. The amount of water vapor in the air varies and is commonly expressed in terms of relative humidity. Relative humidity is the measure of the amount of water vapor actually in the air compared to the maximum amount of water vapor the air can hold at that particular temperature and pressure.

The fundamental principle concerning air and relative humidity is: the warmer the air temperature, the greater its capacity for holding water vapor. When warm air in a room comes in contact with a cold surface the air around that surface begins to cool. As it cools its ability to hold water vapor decreases. Eventually, it reaches a temperature at which it can no longer hold the water vapor. This is sometimes referred to as the dew point. When the air reaches this point the water vapor begins to condensate, forming as tiny droplets of water on the cooler surface. Often times the glass in your windows is the coolest visible surface and this is why you may see condensation develop there first.

Where does water vapor come from?

Water becomes vapor by a process known as evaporation. Evaporation is the opposite of condensation. The air in a home gains water vapor by evaporation from a number of sources. The most obvious are running water in sinks, baths and showers, washing machines, and cooking. Some less obvious sources may include house plants, the ground beneath the house, leaky basements, humid outside air allowed in through open windows or doors, any new construction materials and even the air that you exhale contains water vapor produced by your body.

Newly built or remodeled homes will acquire excessive amounts of water vapor from the new materials and finishes used in the project. As the water evaporates from these materials it will cause high levels of relative humidity in the home until the materials stabilize and the humid air is properly vented.

How does air circulation affect condensation?

Air circulation affects the supply of fresh air to the living areas of your home. Poor air circulation within your home will cause the air next to your windows to cool down quickly. When air remains still, next to a cool surface, it cools down sooner than air that is well circulated. As the room air temperature decreases its ability to hold the water vapor in it decreases. Using the same principle as a defroster in an automobile, supplying fresh air circulation to the glass area slows down the cooling process and reduces condensation.

Drapes, blinds or other coverings tend to trap air next to the window greatly reducing the air circulation around them. Bay and bow windows and other windows that extend from the walls of the home outward are also susceptible to air circulation problems.



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What about air quality?

Not only is it important to have good air circulation in a home, but the quality of the air that is being circulated is very important. The new home construction designs and materials that are used today help make the homes more energy efficient and air-tight. This has greatly affected the quality of the air in the home. Most heating and cooling systems are used as the primary air circulation system. In a modern air-tight home, these systems will only circulate the air already within the home unless a fresh air supply system is also used. Fresh air supply is mandatory to properly vent and maintain humidity levels in the home.

How does the temperature affect condensation?

The amount of water vapor air can hold is directly related to the air temperature. Warmer air can hold more water vapor than cooler air. When warm air is cooled it loses its capacity to hold water vapor and, if it cools enough, it will begin to condensate.

It is important to remember that relative humidity is not the measurement of the actual amount of water vapor in the air, but rather the amount of water vapor present compared to the maximum amount of water vapor the air can hold at that particular temperature and pressure. For example: The air temperature in a room is 70° and it has an amount of water vapor that produces a relative humidity of 50%. Without changing the amount of water vapor, the air temperature is lowered to 50°. This changes the relative humidity to 100%. The air is now holding its maximum amount of water vapor for that temperature. It has the same amount of water vapor, but because of the lower temperature the relative humidity becomes greater.

During the heating season the air temperature in your home will probably be maintained at a fairly constant temperature. The real affect of temperature will be the relationship between the indoor air temperature and the outside temperature. The colder the temperature outside the colder the glass surface temperature will become as well as the air temperature in the hidden structural areas of your home. As these areas cool down the air near them begins to cool as well. The air temperature in the room may be relatively unaffected, but the air next to the window glass or in these hidden areas will cool down. The air in these areas may cool below its maximum vapor saturation point and condensation will begin to form.

What should be done when condensation occurs?

When condensation occurs it is important to first identify the cause before a solution can be implemented.

1. Is the home new or newly remodeled? New or newly remodeled homes will often have high levels of water vapor present in the air for the first year or longer. This occurs because the new materials used are slowly stabilizing and water is evaporating from them into the air of the home. During the first heating season, condensation will often appear on the windows, until the high level of water vapor in the air is dispersed.
2. Check the relative humidity in each room of the home. Your windows are your first gauge for measuring relative humidity. When you see condensation on the windows it is a warning sign that excessive water vapor is present. The best way to measure relative humidity in a home is to use a sling psychrometer. It will give accurate readings when properly used. Take reading when condensation is on the windows. Take readings in every room, even if the windows in other rooms do not have condensation on them. Relative humidity levels will often vary significantly from room to room. Keep a record of your readings, the time of day, the weather conditions, and the temperature outside and inside. It may be necessary to take readings more than once a day, especially if condensation occurs at a particular time each day.
3. Where is the window located? Windows that do not receive direct sunlight will probably develop condensation before windows that are exposed to direct sunlight. Windows, such as bays and bows, that extend out from the main walls of the house may be more exposed to the cold elements outside and may be isolated from good air circulation inside the home.
4. Other conditions. Window treatments like drapes, mini-blinds, and shutters can prevent good interior air circulation, cutting off air exchange near the glass surface. Windows in different rooms are likely to have different environments due relative humidity levels, the location of heat registers and other physical factors.

Solutions

To control condensation it is necessary to control the relative humidity levels, air temperature, and air circulation within the home.

Controlling Relative Humidity

Relative humidity is controlled by controlling the amount of water vapor in the home. The best way to control the amount of water vapor in the home is by properly venting the home with a fresh air exchanger system. Fresh air exchangers can work in conjunction with your heating/cooling system or they can function independently, depending on the system. These systems will exhaust the moisture saturated air and continually provide a fresh air supply to the home. Additionally, use exhaust fans in the kitchen and bath rooms to remove excess moisture from those rooms. Make sure the basement or crawl space is properly sealed or protected from ground moisture. Ventilate the attic and crawl spaces to promote evaporation. Ventilate all appliances to the outside, not to the attic or crawl space. In extreme cases a dehumidifier may be needed to remove high levels of water vapor. Dehumidifiers should only be considered as a temporary solution because they do not affect the source of the moisture.