



Condensation in Double Pane Windows

Condensation is the accumulation of liquid water on relatively cold surfaces.

Almost all air contains water vapor, the gas phase of water composed of tiny water droplets. The molecules in warm air are far apart from one another and allow the containment of a relatively large quantity of water vapor. As air cools, its molecules get closer together and squeeze the tiny vapor droplets closer together as well. A critical temperature, known as dew point, exists where these water droplets will be forced so close together that they merge into visible liquid in a process called condensation.

Household air is humidified from high levels of water vapor in human and animal exhalation, plant transpiration, and fixtures such as showers and dryers. This humidity can rise significantly higher than outside air because of the isolative design of a house. Cold indoor surfaces can cool the surrounding air enough to force vapor to condense. This often happens on single-pane windows because they lack the necessary thermal insulation available to better windows. Double-pane windows have a layer of gas (usually argon or air) trapped between two panes of glass and should be insulated enough to prevent the accumulation of condensation. If this type of window appears misty or foggy, it means that its seal has failed and the window needs to be replaced.

Silica Desiccant:

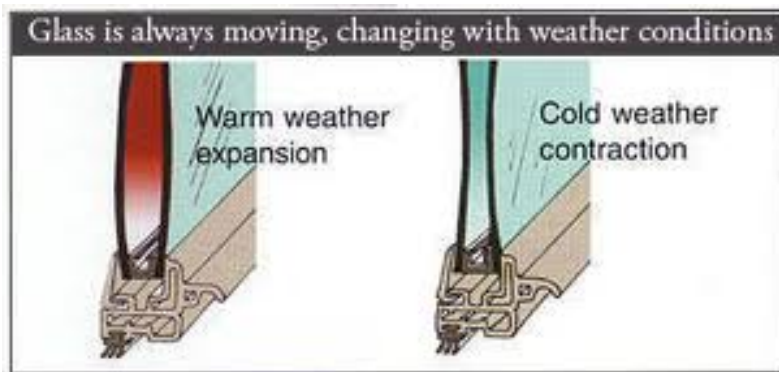
A desiccant is an absorptive material designed to maintain dryness within its vicinity. A common type of desiccant is silica gel, a porous plastic used to prevent spoilage in various food products. A tightly packed assortment of silica pellets is contained inside the aluminum perimeter strip of a window to dehumidify incoming household air, which was not stopped by the window's seal. If not for this substance, incoming air could condense on the glass.

Silica gel has an immense surface area, which allows it to absorb water vapor for years. Eventually, the silica pellets will become saturated and will no longer be able to prevent condensation from forming. A double-paned window that appears foggy has failed and needs to be repaired or replaced.

Why Double-Paned Windows Fail – Solar (Thermal) Pumping:

Although double-paned windows appear to be stable, they actually experience a daily cycle of expansion and contraction caused by “thermal pumping.” Sunlight heats the airspace between the panes and causes the gas there to heat up and pressurize. Expanding gas cannot leave the chamber between the panes and causes the glass to bulge outward during the day and contract at night to accommodate

the changing pressures. This motion acts like the bellows of a forge, pumping minute amounts of air in and out of the airspace between the panes. Over time, the constant pressure fluctuations caused by thermal pumping will stress the seal and challenge its ability to prevent the flow of gas in and out of the window chamber. Incoming humid air has the potential to condense on the window surface, if it is cold enough.



Can Failed Windows be repaired?

Home owners should be aware that there are companies that claim to be able to repair misty windows through a process known as “defogging.”

This repair method proceeds in the following order:

A hole is drilled into the window, usually from the outside, and a cleaning solution is sprayed into the air chamber.

The solution and any other moisture are sucked out through a vacuum.

A defogger device is permanently inserted into the hole that will allow the release of moisture during thermal pumping.

Condensation appears between double-paned windows when the seal is compromised and removal of this water will not fix the seal itself. A window “repaired” in this manner, although absent of condensation, might not provide any additional insulation. This method is still fairly new and opinions about its effectiveness range widely. Regardless, “defogging” certainly allows for cosmetic improvement, which is of some value to homeowners. It also removes any potential damage caused by condensation in the form of mold or rot.

Window condensation will inevitably lead to irreversible physical window damage. This damage can appear in the following two ways:

River bedding – Condensed vapor between the glass panes will form droplets that run down the length of the window. Water that descends in this fashion has the tendency to follow narrow paths and carve grooves into the glass surface. These grooves are formed in a process similar to canyon formation.

Silica Haze – Once the silica gel has been saturated, it will be eroded by passing air currents and accumulate as white “snowflakes” on the window surface. It is believed that if this damage is present, the window must be replaced.

Thermal Imaging as a Detection Tool

The presence of condensation in double-paned windows means that they have failed, but the absence of condensation does not mean the window is functional. This latter fact is especially true in hot, dry environments, and when the temperature inside of a house is the same as the temperature outside. A method has recently developed that uses infrared (IR, thermal) imaging to provide a better determinant of faulty windows.

In summary, condensation in double-paned windows indicates that the window has failed and needs to be replaced. Condensation, while it can damage windows, is itself a symptom of a lack of integrity of the window's seal. A failing seal will allow air to transfer in and out of the window even if it is firmly closed. Inspectors should be aware of this process and know when to recommend that clients' windows be replaced.