Photo courtesy Koble and Kolbe

Perfect Glass

Window condensation is a real pain in the glass. Here's how to make sure your buyers have moisture-free windows.

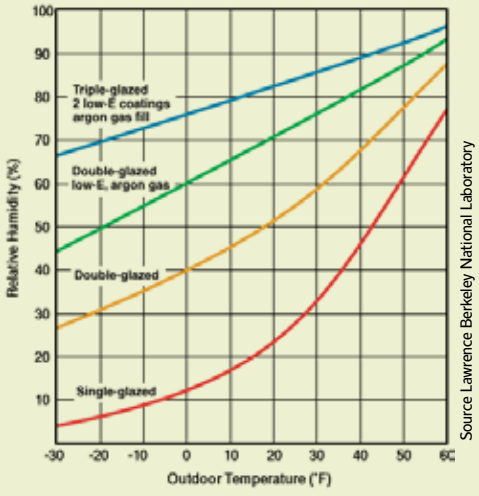
By Steve Easley

I get a fair number of requests to troubleshoot the causes of surface condensation on windows. People are often quick to blame window manufacturers or builders for this problem. In this article I'm not referring to condensation between panes of glass caused by a seal failure. This article is about surface condensation on glass and frames.

First, it's important to understand that windows do not create the moisture for condensation, they only react to their environment.

Condensation occurs on windows when warm, moisture-laden air comes in contact with a cold surface like a metal frame or glass, and the dew point is reached. Factors that contribute to the likelihood of window condensation include:

- The climate or outdoor environmental conditions
- The indoor relative humidity
- The U factor of the window assembly
- Whether window shades/curtains are closed for a long time during cold weather.



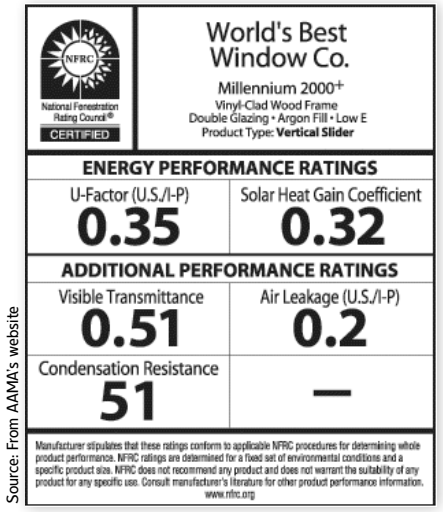
This chart illustrates condensation curves for various window configurations.

Problem: High Humidity

During cold weather homeowners often have elevated levels of humidity because of the use of humidifiers and vaporizers, or have other moisture sources that create high humidity conditions that lead to window condensation. The chart (below left) shows the indoor relative humidity at which moisture will condense on the glass at given outdoor temperature for different window configurations.

The left side of the graph shows the indoor relative humidity (%) from 0–100%. The scale at the bottom of the graph represents the outdoor temperature. So as an example, this chart shows us that if we have single pane windows (the red curve) and it's 30 F outside we will experience condensation on the surface of this glass at an indoor relative humidity of about 32%. If we look at the same conditions for a double pane, low-E window with argon gas, the window is likely not to experience condensation on the glass surface unless the relative humidity is above 72%.

Source: From AAMA's website



NFRC label required by most codes indicates the energy performance of windows

Not Just the Glass

The type of frame is equally important as the glass and the low-E coatings. It's also important to know that we have to select

the appropriate thermal technologies for the climate the window is to be used in. This means paying attention to the type of frame, glass configuration, spacers, etc. Selecting or specifying the wrong window technology for a given climate can be a costly mistake.

Window frames can be fabricated from metal, wood, vinyl, fiberglass, or composite materials. It is important to understand that metal conducts energy several hundreds times faster than wood or plastic materials.

You can have excellent thermal properties for the glass, but if you have a highly conductive metal frame you can easily experience condensation on the frame in cold weather.

NFRC Label to the Rescue

Most codes now require that windows have a temporary label that rates the energy performance of the window. The most common is the NFRC label. The

The mold on the window frame was caused condensation due to high interior relative humidity in conjunction with the occupants keeping the blinds closed during cold weather.

National Fenestration Rating Council has a label that includes:

- The U factor, or how conductive the window is to heat flow.
- The SHGC, which is the solar heat gain coefficient or the percentage of heat from the sun that gets through the window
- The visible light transmission, which is the percentage of light that gets through the window
- Condensation Resistance Factor, CRF, the window's ability to resist condensation. The Condensation resistance factor is a number between 0–100. The higher the number, the greater the resistance the window has for condensation.

The web site for the American Architectural Manufactures Association (AAMA) has a condensation resistance factor tool that provides some general guidance on suggesting a minimum CRF based on climate and environmental conditions for your project.

The chart below from AAMA shows us that for Atlanta with a design temperature of 18.8 F and a indoor relative humidity of 40% that the minimum CFR would be 50.

Keep in mind that this tool gives general guidance and field conditions; construction types and other factors can create conditions conducive to condensation.

Recommendations

Coach customers to control humidity levels. In general, I don't like to see interior relative humidity above 40%–45%.

MONITOR HUMIDITY TO CONTROL CONDENSATION

Examples of Major U.S. Cities (assuming an Indoor Air Temperature of 70°F)

RECOMMENDED CRF

Location	ASHRAE 99.6%	Relative Humidity			
		20	30	40	50
Atlanta	18.8	16	36	50	62
Washington DC	15.9	21	39	53	64
Boston	7.7	31	47	59	69
Chicago	-5.0	43	56	66	74
Minneapolis	-14.9	49	61	70	77

Source: Window and Door Manufactures Association

Condensation on non thermally broken aluminum frame

In cold weather conditions occupants need to realize that they need lower humidity levels to prevent condensation.

Often, humidifiers are set in the fall and are never adjusted for period of extreme cold weather. High humidity can also be caused by

- Humidifiers and vaporizers
- Plants
- Aquariums
- Lack of bathroom and kitchen exhaust fan operation
- Wet crawlspaces and basements
- Poorly vented clothes dryer exhausts
- Other moisture producing activates

High humidity can lead to other building envelope problems, so it's important that occupants recognize that window condensation can be a sign of excessive indoor humidity.

For example, if it is 20 F outside, and you have condensation on your low-E argon gas-filled window, the indoor relative humidity mostly will be at 70%, which is an ideal condition for mold growth. (See chart above.)

Don't cheap out when it comes to buying windows. Windows are expensive to replace once they are installed. Follow local codes for U-factor and SHGC.

Select a window with a condensation resistance factor (CRF) commensurate with the climate. Don't select window with metal frames in cold climates GB

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