

## SECTION 5

### CONDENSATION

#### 5.a. ABOUT CONDENSATION:

Moisture on windows and doors is commonly referred to as condensation. While it can be concerning or frustrating, condensation can be minimized or prevented by controlling the inside relative humidity.

##### Interior Condensation:

Condensation on the interior of windows and doors is not caused by the window or door product. Condensation is the result of high humidity levels in the building. Air with high humidity holds water vapor until it comes into contact with a surface temperature less than or equal to the dew point (the temperature at which air becomes saturated and produces dew). Because window surfaces are usually the coldest part of the building envelope, condensation appears on windows first, generally in the form of water droplets or frost on the roomside of the window. As interior air becomes drier or as the window surfaces become warmer, condensation will begin to dissipate.

Replacing drafty windows and doors reduces air infiltration into the building, making it tighter. Because a tighter building retains more humidity, condensation on colder surfaces in the building may occur more frequently than before the renovation.

**Condensation Causing Conditions**

**Interior**

Temp: 70° F  
Humidity: 40%  
Dew Point: 44° F

Temp of Int. Surface of Window: 43° F



**Exterior**

Exterior Air Temp: 0° F


- Humidity is higher than recommended.
- High humidity causes higher dew point.
- Condensation appears on interior of window because temperature is below dew point.

**Condensation Preventing Conditions**

**Interior**

Temp: 70° F  
Humidity: 30%  
Dew Point: 37° F

Temp of Int. Surface of Window: 43° F



**Exterior**

Exterior Air Temp: 0° F

- Humidity is at recommended level.
- Lower humidity causes lower dew point.
- No condensation appears on interior of window because temperature is above dew point.

#### Maximum Recommended humidity Levels

Outside Temperature	Inside Humidity
20° F to 40° F	Not over 40%
10° F to 20° F	Not over 35%
0° F to 10° F	Not over 30%
-10° F to 0° F	Not over 25%
-20° F to -10° F	Not over 20%
-20° F or below	Not over 15%

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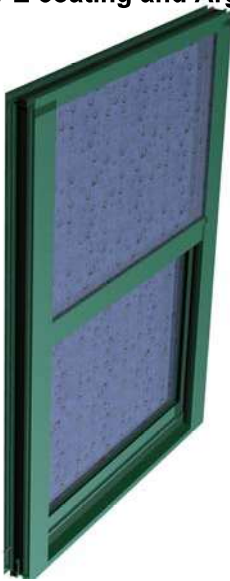

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#### 5.a. ABOUT CONDENSATION:

##### Exterior Condensation:

Exterior condensation generally occurs in the summer months. It is caused by three main conditions: high outdoor humidity, little or no wind and a clear night sky. It forms in the same way as roomside condensation when the temperature of the window is cooled below the dew point of the outside air (as opposed to inside air in roomside condensation).

To combat exterior condensation, open window coverings at night to warm up exterior glass and remove or trim shrubbery near windows or doors to promote air circulation. Increasing the air conditioner setting by a couple of degrees warmer might also help.

High Performance Insulated Glass w/ Low-E coating and Argon infill		Standard Clear Insulated Glass	
<b>Interior</b>		<b>Exterior</b>	
Interior Air Temp: 70° F		Air Temp: 50° F Dew Point: 48° F	Air Temp: 50° F Dew Point: 48° F
		Temp of Ext. Surface of Window: 47° F	Temp of Ext. Surface of Window: 55° F
<ul style="list-style-type: none"><li>• Heat loss to the night air and sky cools outside glass.</li><li>• Energy efficient windows keep heat inside the building so exterior surface of window stays cool.</li><li>• Condensation appears because exterior window temperature is below the dew point.</li></ul>		<ul style="list-style-type: none"><li>• Heat loss to the night air and sky cools outside of window.</li><li>• Less energy efficient windows allow heat from inside the building to warm up exterior surface of window.</li><li>• Condensation does not appear because the temperature of the exterior surface of window is above the dew point.</li></ul>	

##### Condensation Between Glass:

Condensation between two pieces of insulated glass is not controllable and is an indication of glass seal failure. Contact your local EFCO sales representative or EFCO Corporation.

##### Effects of Condensation:

Higher interior humidity can lead to structural damage to the building and health hazards. Because these effects frequently occur unseen in wall cavities, drops ceilings, and crawl spaces, the visible signs of condensation on the window is a good clue that humidity levels are too high.

Problems such as window condensation and musty odor are nuisances, while others can be more serious such as water stains on walls and ceilings or structural damage. The important thing to remember is that the windows are trying to tell

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#### 5.b. PREVENTING CONDENSATION:

Quick tips for controlling humidity and condensation:

<u>Source of humidity</u>	<u>Suggested Action</u>
Cooking and dishwashing	Vent stove range hoods to the outside, cover cooking pots to reduce steam
Showers and baths	Vent bathroom exhaust fans to the outside and use fans for at least 15 minutes after taking a shower
Ironing, washing and drying laundry	Properly vent appliances to the outside, use clothes dryers instead of hanging wet clothes indoors, use exhaust fans
Inadequate ventilation of windows	Open window coverings (shades, curtains) and make sure interior doors are left open during the day to allow air circulation; remove inside screens
Moisture producing areas	Close doors and windows to greenhouse areas, hot tubs or pools, cover large aquariums
Furnace	Make sure furnace is working properly and serviced regularly. Consider dryer heat sources such as gas or electric furnaces
Stale, damp air	Install an Air-to-Air exchanger to vent moist air outside and make sure its openings are not blocked. Don't cover or deflect warm air registers, don't close off rooms, open windows slightly to let in cool dry air
Excessive humidifier use	Monitor humidity levels with hygrometers to keep moisture in air at optimum levels, turn humidifiers off or down
Indoor plants	Circulate air with small fans
Damp basement	Run a dehumidifier in the basement to reduce excess moisture
New wood, plaster, cement, and other building materials	Building materials contain a lot of moisture. The first heating season causes this moisture to flow into the air and settle on cool surfaces. This type of condensation may last a few heating seasons.

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#### 5.c. FREQUENTLY ASKED QUESTIONS:

##### WHAT IS CONDENSATION?

Condensation is the process by which a gas changes to a liquid. As air become saturated with too much humidity, it cannot hold the water vapor. Moisture is in the air all around us. When warm, moist air contacts a cooler surface, such as window glass, the air cools and cannot hold as much water vapor so it condenses and collects on the cool surface.

##### DO WINDOWS OR DOORS CAUSE ROOMSIDE CONDENSATION?

Windows and doors do not cause condensation. Typically the first place condensation can be seen is on window and door glass. Just like a bathroom mirror doesn't cause condensation after a hot shower and car windows don't cause interior frost in the winter when several passengers are in the vehicle; the cooler surface is simply where it collects.

##### WHY DOES ROOMSIDE CONDENSATION OCCUR?

Condensation is water appearing on the roomside of windows and doors because conditions are just right for this to happen. The roomside glass surface temperature is at or below the dew point for the amount of moisture (humidity) in the inside air. When warmer air, which can hold more moisture than cooler air contacts the cool surface of the glass, the air condenses the excess moisture out onto the cool surface.

##### WHAT IS DEW POINT?

The temperature of air, at a given humidity level, at which it can no longer hold all of its water vapor and some of the water must condense into liquid water.

##### WHAT CAUSES EXCESS HUMIDITY?

Everyday living: Showers, baths, cooking, washing dishes, laundry, pet water bowls and cleaning all add moisture to the air; as much as 4 gallons or more per day in some living areas. People even exhale moisture into the air as they breathe. Building construction: Modern, energy efficient, well insulated, building help hold down heating and cooling costs however, the same building techniques that help blocks outdoor air from entering buildings also keep moisture from venting to the outdoors.

##### IS ROOMSIDE CONDENSATION MORE LIKELY TO OCCUR IN CERTAIN CLIMATES OF TIMES OF THE YEAR?

In areas where January temperatures average 35° F or less, condensation is more likely to occur. In the summer and fall months, buildings pick up moisture from the damp air. As the heating season begins and windows are closed, the indoor air will have more moisture, so temporary condensation for the first few weeks is possible.

##### ARE THERE OTHER CASES WHERE WINDOW CONDENSATION IS ONLY TEMPORARY?

Building materials used in new construction or renovation such as wood, cement, dry wall, plaster and paint all contain moisture which is gradually released into the air. This excess moisture can cause condensation but will usually disappear after the first few heating seasons. Buildings also absorb moisture during humid summers. This moisture condenses during the first few weeks of heating until the building dries out. Additionally, anytime there are quick and sudden drops in temperature during the heating season, condensation may temporarily appear.

##### WHY DO I HAVE CONDENSATION WITH MY NEW WINDOWS WHEN MY OLD WINDOWS DID NOT?

Windows do not cause condensation; however, they are an indicator of high humidity levels. The older less efficient windows allowed air to move across the glass by letting outdoor air inside or allowing inside air to escape outdoors, preventing the air temperature of the glass from reaching the dew point.

##### WHY DO I HAVE CONDENSATION ON MY WINDOWS AND MY NEIGHBOR DOES NOT?

Indoor temperature, ventilation, air exchange, window coverings and floor plans as well as everyday life can vary from room to room. It is not unusual for a family of four to contribute 15 to 20 pounds of moisture per day to their indoor environment depending on their habits. The typical family of four can produce 12 pounds of moisture per day just breathing. Washing dishes for three meals a day can produce one pound of moisture. One shower can add 1/4 pound and there are many other activities or situations where moisture is added to the indoor air.

##### IN THE SAME ROOM, WHY DOES ONE WINDOW HAVE ROOM SIDE CONDENSATION AND OTHERS DO NOT?

There are many factors attributing to this phenomenon including any number of the following: Air circulation within the room or building varying room temperatures, air register location, type of window (hung and sliding windows may be colder), window size, glass type (Low-E versus clear), window coverings, window screens, placement of moisture sources in relation to windows (i.e. plants), the direction the windows are facing, elevation of the windows, wind direction, direction of the sun or partial blockage of the sun due to trees, buildings, etc.

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#### 5.c. FREQUENTLY ASKED QUESTIONS:

##### **DO WINDOW COVERINGS OR DRAPES CAUSE ROOMSIDE CONDENSATION ON WINDOWS OR DOORS?**

Drapes and other window coverings do not cause condensation; however they can contribute to the problem by restricting the flow of air over the glass surface. Therefore, condensation is more likely to occur when drapes are closed and shades are pulled down.

##### **HOW DOES AIR CIRCULATION IMPACT ROOMSIDE CONDENSATION?**

Air circulation affects the supply of fresh air to all areas of the room. Poor air circulation within the room will keep the air next to your windows cooler. When air movement is restricted next to a cool surface the air will cool down sooner than well circulated air. As room are temperature decreases, its ability to hold the water vapor decreases. Using the same principle as a defroster in an automobile, supplying fresh air to the window areas slows down the cooling process and reduces condensation.

##### **DOES THE AMOUNT OF ROOMSIDE CONDENSATION DEPEND ON WINDOW TYPES?**

Sometimes hung and sliding windows may experience more condensation than other window styles. The window depth must be split between the two sashes because the glass is oriented in different planes, therefore those sashes are sometimes not as deep as other window type making them generally have less condensation resistance. Hung and sliding windows could be a few degrees cooler in temperature than other window types in the same room.

##### **WHY DOES A STRIP OF CONDENSATION SOMETIMES FORM ALL THE WAY AROUND THE ROOMSIDE OF THE WINDOW?**

The center of the glass stays warmer than the glass close to the edge. The strip of condensation is NOT an indication the window is leaking air or not functioning correctly.

##### **HOW CAN EXCESS HUMIDITY CAUSE PROBLEMS?**

Excess humidity can create problems; some are just nuisances like condensation on the windows, musty smell, others can be serious such as blistering of peeling paint, damage to insulation, stains on walls and ceilings or structural damage to the building.

##### **WILL ROOMSIDE CONDENSATION RUIN MY WINDOWS?**

If condensation issues are not addressed, window problems may appear over time.

##### **WHY DO I STILL HAVE ROOMSIDE CONDENSATION EVEN THOUGH I AM RUNING A DEHUMIDIFIER?**

The humidity is likely still too high. There are a variety of reasons condensation may still be appearing including but not limited to; varying air temperature in the home, air circulation, window coverings and other sources of water placing more moisture in the air than the humidifier can remove.

##### **WHAT CAN I DO TO CONTROL ROOMSIDE CONDENSATION?**

Reduce humidity. See table on page 15 for specific examples.

##### **DO WINDOWS OR DOORS CAUSE EXTERIOR CONDENSATION?**

No, windows and doors do not cause condensation. Exterior condensation is dew; the same condensation you see on cars and lawns on some mornings. Dew on windows is a natural atmospheric phenomenon, and it doesn't mean your windows are leaking air or malfunctioning in any way. Actually, exterior condensation is a sign of energy efficiency, indicating the outside pane is thoroughly insulated from the heat indoors.

##### **WHY DOES EXTERIOR CONDENSATION OCCUR?**

Exterior condensation happens when the exterior surface temperature of the window falls below the dew point of the air. This type of condensation is more likely to occur when outside humidity levels are higher. It typically occurs in the spring and fall when cool nights follow warm days.

##### **HOW CAN I CONTROL EXTERIOR CONDENSATION?**

Open the drapes or shades at night, increase the interior temperature a few degrees at night or shield the windows or doors from direct line of sight to the sky using trees, awnings, etc.

##### **WHAT DOES CONDENSATION BETWEEN THE GLASS MEAN?**

Condensation between the sealed panes of an insulated glass unit is an indication if seal failure and the insulated glass unit will need to be replaced.

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#### 5.d. SOURCES AND ADDITIONAL INFORMATION:

- <http://www.aamanet.org>
- <http://www.wdma.com>
- <http://www.extension.umn.edu>
- <http://www.uwex.edu>
- <http://www.efficientwindows.org>
- Condensation Problems In Your Home: Prevention and Solution: U.S. Dept of Agriculture Forest Services. Agriculture Info Bulletin No. 373
- The Condensation Answer Book: Anderson