

## Technical Bulletin

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### CONDENSATION AND ICE DAMMING ON RESIDENTIAL ROOFING

#### What is condensation?

Condensation and ice damming can be a real problem on any residential project. Every fall we get numerous calls the first time the temperatures start to get cold from people with condensation problems. The callers usually say something like: “Your Sentrigard metal roofing is sweating and causing water to drip onto the ceiling of our house.” Some home owners will report this moisture as a “roof leak” even though it may not have rained for many days before this “leak” occurred.

First; metal roofing doesn’t “sweat”. It has no sweat glands and does not produce any moisture. What they are experiencing is condensation that is occurring on the metal roof. Condensation occurs when warm, moisture laden air comes in contact with anything that is below the dew point temperature. You see an example of this in the summer when you have a glass of any cold drink; particularly if you put ice in the glass to keep the drink cold. Moisture forms on the outside of the glass. The glass is not sweating and, hopefully, is not leaking; it is merely colder than the dew point temperature so moisture in the warm air is condensing out on the cold glass. Since the glass does not absorb any of the moisture, the water droplets run down the glass. The same thing happens with a metal roof. Metal does not absorb any moisture so any condensation runs off it and can drip down onto the ceiling. Also, since metal conducts heat very easily, the metal roof will get down to the outside temperature quicker than other items, like the wood, in the attic. Combine that with the fact that the wood can absorb some moisture and you will find that moisture will condense out on the metal roofing before it will appear on the wood below it.

For the record, warm air can hold much more moisture than cold air. It is typically much warmer inside your house in the winter than outside. There are also many sources of moisture inside the house including cooking, showers, laundry and even people, who give off warm moist air as they exhale. That’s why you can see your breath outside in the winter when it’s cold. That’s the moisture you exhale condensing in the cold air. If you wear glasses, I’m sure you’ve noticed how they “fog up” when you come in from outside into a warm, moist house. This occurs because the moisture in the house is condensing out on your cold glasses. The same thing can actually happen on your cold coat, but a cloth coat can absorb some moisture so you don’t notice it like you do on your glasses.

#### What are the sources of the moisture that causes condensation?

As stated earlier, condensation is caused by moisture in the air condensing out on a cold surface. Since metal gets cold faster than other items and does not absorb any of the moisture, this condensation occurs on metal panels first. The moisture held in warm air can come from a number of sources. They include showers, laundry, humidifiers, non-vented kerosene heaters, non-vented gas fireplaces, damp basements or crawlspaces, roof leaks, plumbing leaks, green lumber from new construction and people.

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### What can I do to minimize attic condensation?

Since condensation is caused by moisture coming in contact with a cold surface that is below the dew point temperature, you must prevent the moisture from coming in contact with the cold surface. In the winter it's impractical to prevent the attic and metal roof from becoming cold so you need to eliminate the moisture from getting into the attic and/or remove it from the attic before it condenses onto the cold surfaces. This is done by providing a good, continuous vapor barrier between the ceiling insulation and the warm, moist air inside the house. In many houses this vapor barrier is the drywall ceiling. If the drywall has all the joints taped and sealed and the whole thing is sealed with a good paint coating, that is normally adequate to prevent the moisture in the house from getting into the attic. If the ceiling is a tongue and groove wood ceiling, a continuous vapor barrier, such as a plastic film needs to be installed under the insulation to provide the vapor barrier. A good layer of insulation also helps prevent the flow of hot air out of the house, but without the vapor barrier, the moisture can still flow thru the insulation and cause condensation problems.

You must also eliminate short circuits that can allow moisture to bypass the vapor barrier. These short circuits include unsealed light fixtures, ceiling fans, and vent pipes. Worse yet, you must eliminate items that actually pump moisture into the attic. These would include bathroom and kitchen exhaust fans and laundry dryer vents that are vented into the attic. These items must be vented to the outside of the house; not into the attic.

Since you can't absolutely eliminate all moisture from getting into the attic and since moisture can be trapped in the attic during construction and from the green lumber used in new construction it is also important to properly ventilate the attic. Ventilation allows warm moist air to be replaced by cold dry air from outside the building. Ventilation should be evenly distributed between the eave and the ridge and a clear path must be provided so the air can enter at the soffit and move up and out at the ridge. This includes making sure the insulation does not block the ventilation path over the exterior wall. Where ventilation is difficult it may be necessary to use power vents to move the air.

The final suggestion to eliminate condensation problems is to always install residential metal roofs over a solid deck with an underlayment under the metal. This prevents the moisture from coming in contact with the metal roofing. If condensation occurs it would be on the underside of the plywood; which will absorb some of the moisture minimizing the problem. It also allows a way for any moisture from condensation or roof leaks to be channeled down the roof and out at the eave.

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### What is ice damming?

Ice damming occurs when the outside temperature is below freezing, but snow melts from the roof over heated areas and runs down the roof. When this water hits the overhang it refreezes, because the overhang is not over a heated area and is not warmed by heat loss from the building. This process continues and the ice builds up further and further on the eave. As the roof warms up, water can pond behind the ice dam at the eave and back up under the metal panels and cause roof leaks. This condition is even worse if valleys exist on the building since it is much more difficult to seal a valley and the panels that terminate in the valleys. Also, there is more water channeled into the valleys creating deeper ponds.

### How do you avoid ice damming?

The answer to this is very similar to the answer to prevent condensation. It is very important to have the attic well insulated so the metal roof stays cold when the outside temperature is below freezing. Then the snow doesn't melt, run down and refreeze at the eave. It is also important to have the attic well ventilated. This also ensures that the roof will not be warmed up by heat build-up in the attic.

### Are there any special considerations for cathedral ceilings?

Yes, cathedral ceilings are more difficult to properly insulate and properly ventilate so they are more prone to condensation and ice damming problems. You are normally limited to the amount of insulation you can put between the rafters and you need a way to hold that insulation away from the underside of the plywood decking so you have at least a 1" air space from ventilation. There are products available that are designed to provide this ventilation cavity. You also need to make sure the intake air from the soffit vents can get into this 1" vent cavity. Recessed lights in the cathedral ceiling also need to be properly sealed to avoid humidity short circuits.