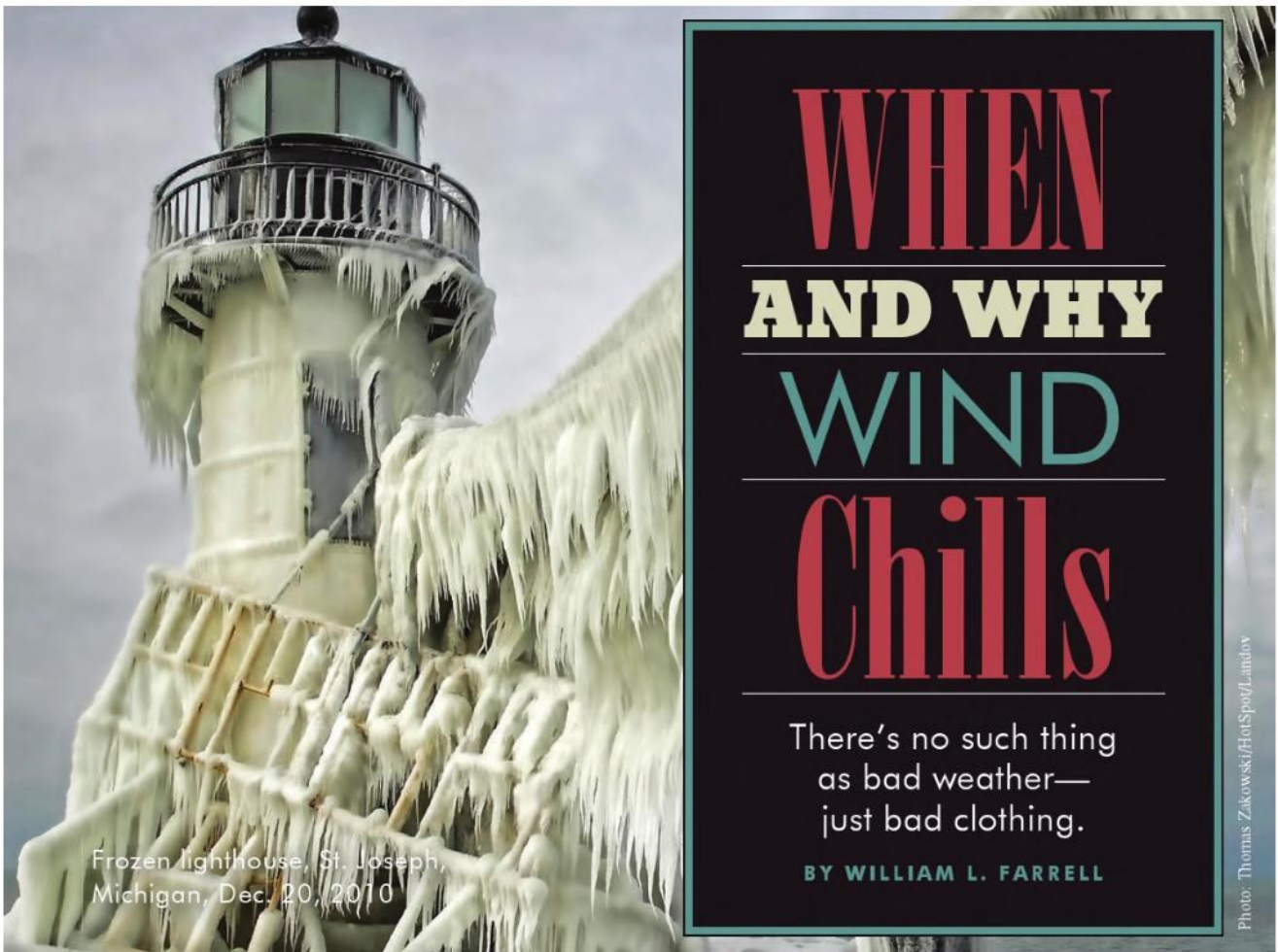


## When and Why Wind Chills



There's no such thing as bad weather—just bad clothing.

*By William L. Farrell*

Many of us decide how to dress or go outdoors based on information we receive through our meteorologists. Every once in a while in winter in northern states and southern Canada, the local meteorologist's forecast will sound something like this: "Northwest winds gusting to nearly 30 miles per hour will combine with temperatures near 20 below zero tonight to create windchill values of 50 below."

Wow! Does this really mean that our faces will freeze in minutes while walking the dog? What does it mean?

The Windchill Temperature Index (we'll just call it "windchill") is an important piece of information that can come in handy for your comfort, health, and even survival. When a low temperature and high wind speed indicate a windchill at or below  $-25^{\circ}\text{F}$ , the National Weather Service (NWS) issues a windchill warning. The dangers are real: Your appendages can freeze and your chance for survival is reduced, if you are not properly prepared. People are advised to bring pets indoors, children are not allowed outside during school recess, and the homeless are advised to seek shelter. Dangerously low windchill readings, especially when the ambient air temperature is below  $32^{\circ}\text{F}$ , can result in permanent injury from frostbitten skin and, when the body's core temperature falls below  $95^{\circ}\text{F}$ , death from hypothermia.

## Coldly Calculating

Windchill is not measured with an instrument; it is a calculated value based on temperature and wind speed. According to the NWS, the measurements for calculating windchill were originally, and for years, based on the research of Antarctic explorers Paul Siple and Charles Passel in 1940. Their findings were published in 1945. They measured the cooling rate of water in a small plastic cylinder attached to the top of a 33-foot-high pole. Because Siple and Passel's results underestimated the time necessary to freeze human flesh, a new index designed to more accurately reflect how cold air feels on human skin was developed in 2001.

This calculation, still in use today, is based on the results of trials conducted by the Defence and Civil Institute of Environmental Medicine in Toronto, Canada. Six men and six women, with thermal transducers attached to their faces to measure the heat flow from their cheeks, forehead, nose, and chin, were placed in a chilled wind tunnel. Skin temperature readings were obtained at an average height of 5 feet—the typical height of the adult human face.

Temperatures used to calculate windchill are now taken at or below 50°F. Wind speed measurements are taken above 3 miles per hour.

## Getting Under Your Skin

Our bodies radiate heat and generate a thin layer of warm air a few millimeters thick on the surface of our skin. When left undisturbed in low temperatures and no wind, this thin layer of air protects and insulates us from the cold. If we disturb this layer of air—for example, by blowing on a small portion of our skin—this area quickly falls to the ambient air temperature. Conversely, in warm (or hot) temperatures, such as in a sauna, blowing on the skin will disturb the protective layer of air and we will become uncomfortably warm, even hot.

Since cold is what matters most here, if you were to stand outside in a bathing suit when the temperature is 30°F (as I did in research for this article, but do not recommend), it would take a certain amount of time to lower your body temperature. If you set up a fan that moved the ambient air across your skin at 20 mph, the wind would increase your body's rate (or speed) of cooling as if you were standing in still air at 17°F.

Here's why this phenomenon is called the windchill effect: As the wind speed increases in cold air, it effectively increas-

es the rate at which you lose heat from exposed skin. The wind has the effect only of cooling the skin quickly; with no wind, the skin would cool to the ambient temperature more slowly. In both calm and windy conditions, the skin's surface temperature would never fall lower than the ambient temperature—in this case, 30°F.

In this example, with a constant temperature of 40°F, the windchill temperature index goes down as the wind speed picks up. At a 40°F temperature, you can not get frostbite, but you can get hypothermia.

Actual Temperature	Wind Speed	Windchill Temperature
40°F	4 mph	37°F
40°F	10 mph	34°F
40°F	20 mph	30°F
40°F	30 mph	28°F
40°F	40 mph	27°F

You can explore these and other calculations with an online windchill calculator at [www.weather.gov/os/windchill](http://www.weather.gov/os/windchill). View the Canadian windchill chart at [Almanac.com/content/windchill-chart-Canada](http://Almanac.com/content/windchill-chart-Canada).

It is worth pointing out that although the skin temperatures would never fall below the ambient temperature, when this temperature is below freezing, your skin would become frostbitten and eventually you would die from hypothermia.

This brought to mind my years growing up in the Berkshire Hills of Massachusetts. For several days during February 1958, when I was a third grader, the temperature fell to  $-10^{\circ}\text{F}$ . Yet I vividly remember skiing on our local rope tow after school every day (and all day during school vacation) and walking home in the dark carrying my skis on my shoulder. My mother dressed me in two pairs of socks, two sets of long underwear, a sweater, a jacket, ski pants, insulated mittens, a trooper hat, a face mask, and a wool neck gaiter. (When I peeled off the last layers, I found that I was drenched in sweat.)

Nowadays, these conditions would require a warning from the National Weather Service. While a warning should be taken seriously, it should not be an excuse to cower from winter. While I am not suggesting that you don what I wore as an 8-year-old, if you know how to dress accordingly, you can enjoy the outdoors. With careful preparation, we should all be able to get outside and embrace the cold.

*William L. Farrell, a retired mathematics teacher, writes from Dublin, New Hampshire.*