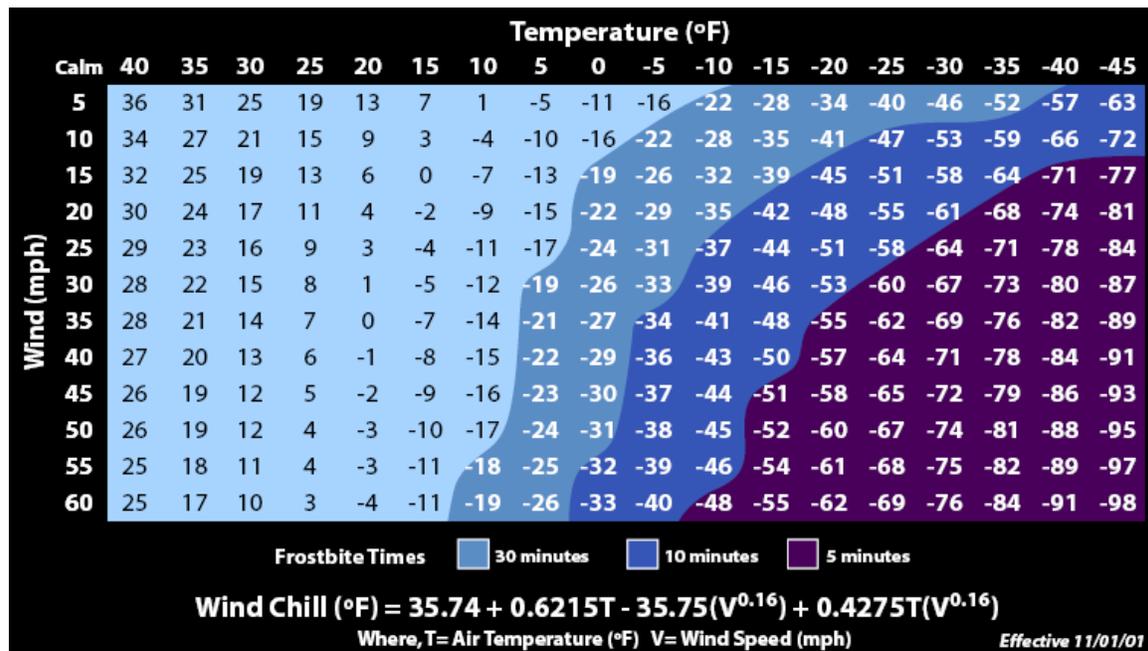


Ask Dr. SOO

by Dr. Bill Martin – Science and Operations Officer

Q.: Hello Dr. Soo. I have a question. When the wind chill is below freezing, say 20°F, can you get frost bite even if the air temperature is above 32°F? Chilled in Montana.

A.: Hello Chilled. The short answer is “no”. Let’s say the air temperature is 35°F and the wind is howling at 40 mph. Then, according to the handy NOAA/NWS Wind Chill chart below, the Wind Chill is 20°F:



To use the chart, you find the temperature along the top row and then go down the column to the row with the wind speed on the left. This gives you the Wind Chill.

However, 20°F is neither the temperature of your skin nor the temperature of the air. Ordinarily on a cold day, the coldest your skin can be is the temperature of the air, and it will usually be warmer than this because your body produces heat, warming your skin above the air temperature.

So what does this 20°F refer to? Well, wind does chill, and the Wind Chill Index gives you some idea of how cold it “feels”. To understand the cooling effect of wind, consider your body on a 35°F day with no wind. In this case, the interior of your body is a toasty 98.6°F. The surface of your skin might be 65°F. The warmth of your body actually heats a thin layer of air around it, helping you to stay warm. Hairs on your skin’s surface help to trap this warm air close to your skin, insulating your skin from the cold air only inches away. Now, turn on 40 mph of wind. Woosh! That thin layer of warm air is blown away. Your skin is now in almost direct contact with 35°F air. Your skin will cool-off

and you will feel much colder as your body rapidly loses heat. With wind, your skin temperature will be much closer to the air temperature. In this example, it might cool-off to 40°F. It can't; however, get below the air temperature. So you can't get frost bite.

The Wind Chill Index is designed to be the temperature non-windy air would need to be (20°F in this example) to have the same cooling effect on bare skin as windy air (35°F in this example). Any time the air temperature is below 32°F, frost bite becomes possible, but it isn't really a problem until the temperature gets down into the teens, at least.

Up here in northeast Montana, we can get some truly impressive Wind Chill. In an arctic cold-air outbreak, you can get temperatures into the -30's with wind speeds over 30 mph. This combination can give you a Wind Chill of 70 below. Under conditions like that, spending any time outside with exposed skin is very dangerous.

While the Wind Chill Index was designed to estimate the cooling effect of wind on bare skin, wind will always chill. Even bundled-up with no exposed skin, you will feel colder on a windy day than a calm one. The effect is reduced over that on bare skin because clothing is a good insulator. However, all warm objects warm a thin layer of air around them. This layer of air is always blown away by wind, leading to greater heat loss from the object. On a windy day, houses lose more heat than on non-windy days.

So, according to Wind Chill theory, it is perfectly safe from a frost bite standpoint to go jogging on a windy day in your underwear when it is 35°F. Not that Dr. SOO would recommend that. In fact, under-dressing like this can lead to hypothermia. In hypothermia, the body loses so much heat that the internal body temperature plummets to dangerously low levels. Hypothermia used to be referred to as "exposure". Being wet greatly enhances heat loss from the body and increases the risk of hypothermia. Most of the victims of the Titanic died from hypothermia from being in cold (but not freezing) water. None of them got frost bite.

If you have a question for Dr. SOO, send it by e-mail to his publicist at: bill.martin@noaa.gov