

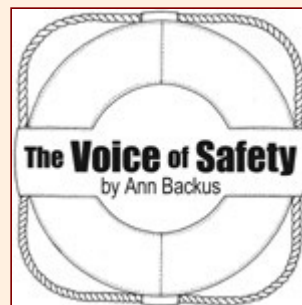
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Wind Chill and Frostbite

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Who has ever heard of the 1945 Siple and Passel Index? Well, if you haven't, don't worry, because it has been replaced by the New Wind Chill Temperature Index. Wind chill is the effective temperature on your skin of the air at a given temperature combined with a wind speed specified in mph or knots. It is the temperature it "feels like" to quote a new brochure available in pdf format at www.weather.gov/os/windchill/index.shtml.

At three mph, there is no appreciable decrease in the effective temperature on your skin, however, as wind speed increases above five mph, the "feels like" temperature on your exposed skin, i.e., face and hands, drops.

From a public health standpoint, the reason for having a Wind Chill Temperature Index is to be able to advise people when they are at risk for frostbite. The risk of frostbite increases as temperature decreases and wind speed increases, because more and more heat is lost from the skin. The skin eventually freezes and will die. Frostbite is painful and, in extreme cases, can require amputation of fingers or toes.

In 2000, the Office of the Federal Coordinator of Meteorological Services and Supporting Research convened a U.S.-Canadian group named the Joint Action Group for Temperature Indices (JAG/TI). The JAG/TI consisted of representatives from the U.S. federal government and Meteorological Services of Canada, the academic community, specifically, Indiana University-Purdue University in Indianapolis, the University of Delaware and the University of Missouri, and a professional society, the International Society of Biometeorology. Their charge was to "upgrade and standardize the Wind Chill Index" for international use.

Human trials were held at the Canadian Defence and Civil Institute of Environmental Medicine in Toronto. The heat loss from the faces of six men and six women was measured while they were walking on a treadmill at 3 mph in a chilled wind tunnel. Varying temperatures and wind speeds were introduced into the tunnel and each volunteer participated in four trials of 90 minutes each according to the Wind Chill Temperature Index brochure

Improved Accuracy.

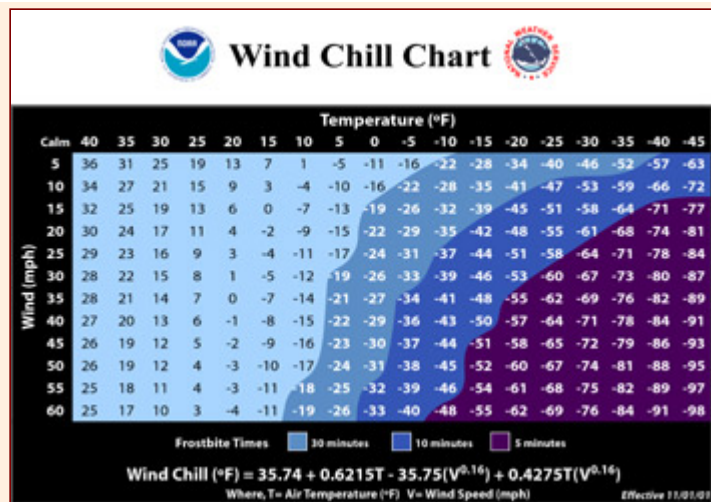
According to the National Weather Service and NOAA, the new wind chill temperature index greatly improves the accuracy of the frostbite threshold, the temperature at which your skin freezes. The changes are due both to application of modern theory and consideration of more realistic exposure scenarios.

On the theory side, the new wind chill temperature index (WCT) "incorporates modern heat transfer theory" and "uses a consistent standard for skin tissue resistance." On the exposure scenario aspect, the new WCT uses the wind speed at an average height of five feet rather than, as previously, at a height of 33 feet which is the "typical height of an anemometer." Five feet is a better representation of the height of a face above the ground than is the height of a wind gauge at 33 feet. The new WCT also assumes that the skin exposure is hands and face, not whole body. The calm wind threshold is now three mph (it was previously four mph), and the new model does not factor in heat from the sun. The net result is a WCT index that is much more realistic because it is based on actual human values.

Calculation of the Wind Chill Temperature

In order to figure the wind chill temperature from the chart included

with this article, find the temperature as registered by an outdoor thermometer in the horizontal row of temperatures across the top of the chart. Then locate the current wind speed in mph along the vertical axis. The number where the temperature and wind speed intersect is the wind chill temperature. It is interesting to note that at 40oF with a wind speed of only 15 mph, the skin temperature is 32oF—enough to freeze the skin. Frostbite will ensue in 30 minutes for temperatures in the medium blue band; in 10 minutes for temperatures in the darker blue band; and in five minutes for temperatures in the maroon band. So for example you



can figure that if the WCT is -18 or below, frostbite will happen in 30 minutes or less. These colored bands are a new feature of the Wind Chill Temperature that help us gauge our risk for frostbite more accurately.

Although this chart starts at 40oF, WCT index is only defined for 50oF and below at wind speeds of five mph or greater. There are a number of websites, such as the one mentioned above, which offer a wind chill temperature calculator. After you enter the temperature and wind speed, press “calculate” and read the wind chill. Some websites offer conversions between Fahrenheit to Celsius as well as between mph and knots. For a quick estimate, I like to remember the 15/15=0 calculation: at a temperature of 15o F and a wind speed of 15 mph the wind chill temperature index equals 0o F. I know that frostbite can occur at higher temperatures and lower wind speeds, but these numbers help me estimate my risk.

Clip out this chart, slide it into a plastic sheet protector, and tack it up on the wall in your vessel. Or if you carry a computer on board, bookmark the wind chill temperature calculator and inform the crew when there is a risk of frostbite. To avoid serious injury due to frostbite, you should go inside when you lose feeling in hands, face, feet or elsewhere, and make it a practice to check your fellow crew members for white or pale spots on their faces, which may be an indication that frostbite has set in.

Care of Frostbitten Hands, etc.

When hands, face, or feet are very cold or frostbitten, do not warm them up fast with hot water or any other means, because those portions are numb and cannot register being burned. Warm them up slowly. Seek medical help as soon as possible if frostbite has occurred.

Repeated exposure to cold can result in Raynaud’s syndrome. It is commonly the hands that are affected; as in frostbite, the fingers turn white. In the case of Raynaud’s, the circulation in the hands has been shut down. This situation can mimic frostbite because of the whiteness, but with slow warming, blood and the usual pink color return. Once you have it, Raynaud’s is a chronic condition—you will always have it, and exposure to cold or possibly vibration will trigger it.

The bottom line is, if the wind chill temperature indicates a possibility of frostbite, keep exposed skin covered and limit time spent in the cold, windy environment. Precipitation or wet conditions will increase the risk of frostbite and bright sunshine will reduce the risk. It should be mentioned also, that although alcohol provides a sensation of warmth, it actually increases the blood supply to the extremities (vasodilation) and thus increases the rate of heat loss from the skin. Drinking alcohol hastens the occurrence of frostbite.

This chart applies whether you are on land and on the water. Discuss it with your kids and grand kids and help them understand how the combination of temperature and wind speed changes their risk of frostbite.

Other resources:

www.cdc.gov/nceh/hsb/extremecold

www.nws.noaa.gov/om/windchill/

www.msc.ec.gc.ca/windchill/index_e.cfm