Safety in Numbers: Sleeping Warm

Jon Bentley

Nothing is quite so cozy as drifting off to sleep in a warm sleeping bag after a long day in the woods. And nothing is quite so miserable as a sleepless night tossing and turning in a bag that isn't warm enough. If the temperature drops a little further, the misery can turn to real danger in the form of hypothermia and worse. So let's consider how we can stay warm all through the night.

The Big Picture of Warm Sleep

It's a nasty night outside: it might be 33 degrees with howling wind and rain, or it might be zero degrees with wind-driven snow. How do you keep your body at around 98.6 degrees in an environment like this? Let's consider your protection from the outside in.

Your first layer of protection is a well-chosen campsite. Avoid bad sites: open ledges are exposed to wind, valleys collect cold, and it is never fun to have a stream flowing through your bed. Next comes your tent: its thin walls keep out wind (wind chill increases convective heat loss) and shield you from rain. Or maybe the night isn't all that nasty, and a tarp provides a sufficient barrier from breeze and drizzle.

If you were to sleep directly on the cold ground, your body heat would quickly be conducted right into it. If you don't believe me, try to take a nap directly on a forty-degree rock; I guarantee it will be brief. A sleeping pad provides both comfort and insulation from the cold beneath you. Many pads nowadays include a shiny layer to reflect radiated heat back to you.

Err on any of these issues, and you'll be cold at night. But we usually get these things right, and the bulk of the warming load is carried by our sleeping bag.

Thickness = Warmth

The purpose of a sleeping bag is to insulate you from the cold: it slows the rate of convective heat loss from your body to the still, cold air within your tent. The main tool it uses to do this is neither waterfowl down nor some miracle fiber: the real insulation in an effective sleeping bag is the still, dry air held in place by the filling.

Hal Weiss explains this in detail in Chapter 2 of his book *Secrets of Warmth* (Mountaineers Books, 1998). Sleeping bags filled with the same thickness of goose down, Miracle Poly Whatever, crumpled up newspaper, popcorn, or steel wool will all be about equally warm. Sure, their weights will differ, and they will compress to different sizes, but their effective insulation will all be about the same. He summarizes that fact in the phrase "Thickness = Warmth".

Many decades ago, the Army Quartermaster labs in Natick, Massachusetts, quantified precisely how thickness translates into warmth. They presented their results in this table:

Temperature	40	20	0	-20	-40
Inches	1.5	2	2.5	3	3.5

According to this, the average soldier can sleep comfortably inside a tent at 20-degrees if his sleeping bag is at least 2 inches thick.

I don't even try to memorize the table. Instead, I notice that we start at 100 degrees, about the temperature of the human body. Then every additional inch of insulation we add drops our comfortable temperature by 40 more degrees. We can write this mathematically as the formula

$$Temperature = 100 - 40 \lceil Inches$$

But what precisely does the number mean? Will every person be blissfully warm in 20 degree weather under two inches of insulation, but bitterly cold if the temperature drops to 19? The truth is, of course, more subtle. This formula was developed for healthy, fit, young adults. Some groups tend to sleep warmer than others and therefore require less insulation: plump people tend to be warmer than skinny people, large warmer than small, and male warmer than female. As a large, plump, male, I am told that I'm a real furnace, and I find that the formula gives me a comfortable night's sleep. I therefore use this very formula as a first test for the effectiveness of a sleeping bag.

Every camper needs to experiment to find the right value for him or her. A small, slim female might start her experiments to find her insulation value with a smaller number: perhaps each inch gives her only 30 or 35 degrees of warmth.

The Life of a Sleeping Bag

Suppose that I'm in the market for a new twenty-degree sleeping bag. I walk down the aisles of the store, and see beautiful bags hanging on a rack. This one says 20 degrees, but I put my hands on both sides, move them together, and find that they end up only two inches apart. That means that each layer of the bag (top and bottom) has only one inch of insulation. For me, this is at best a 60-degree bag. Moving on, I feel a contender – this one appears to have a total of four inches of loft between my hands. I therefore remove it from the rack, put it on the floor, and fold the foot of the bag up to the head. It looks like eight inches of loft altogether, but I get out the ruler on the tool on my belt and check just to make sure. From the floor to the top of the bag – four layers in all – is 8.2 inches. This sure looks like a 20-degree bag, so I study it further.

If your bag is made of goose down, and it has two inches of loft now, it will probably have just about that much loft in a decade, if you take reasonable care of it. Here are a few ways to kill a sleeping bag:

Stuff it really tight. Never stuff a bag into a small stuff sack: I usually get a sack at least fifty percent larger than the one supplied by the manufacturer. Ultralight backpacking pioneer Ray Jardine taught me to think of "stowing" a bag gently, not stuffing it. And I cry every time I see a compression stuff sack.

Leave it stuffed during a trip. I stuff my bag right before I leave for a trip, and take it out as soon as I get into camp to let it fluff up. It airs out in the morning, and goes back in right before I load my pack.

Leave it stuffed between trips. When you get back home, air out the bag and then put it in a comfortable resting place. Some people hang it in a closet or place it under a bed. I put mine in a large (breathable) cotton sack, and leave it in a closet. I baby my down bags, and they return the favor by lasting forever. I bought a 20-below Eddie Bauer Karakoram bag in 1968, and today it remains a serviceable (if venerable) 10-below sleeping bag.

In my experience, and according to experts that I've consulted, synthetic sleeping bags are nowhere near as durable. Even if I pamper a synthetic sleeping bag, it seems to maintain its original loft for at most a few years. Today's three-season synthetic bag is almost always a summer bag in five years. I bought a zero-degree synthetic bag in 1999 that originally had two-and-a-half inches of loft, and when it was new it kept me warm on single-digit nights. In fifteen years, that insulation has collapsed down to just one inch, and the old furnace has now been retired to a quilt for watching television indoors on chilly evenings.

Before I take a bag on a trip, I measure it again by folding it over, toe to head, and using a ruler. While down bags hold their loft, synthetic bags tend to lose loft by usage (a week in the mountains), by washing (some folks estimate that six to eight machine washings will kill a synthetic bag) and even by just sitting on the shelf for a year. Before I crawl into a bag for the night, I measure it again: if the thickness isn't enough for the temperature that I expect that evening, then I might wear an extra jacket to sleep.

Thickness beyond Bags

I believe Hal Weiss: according to the science that I've read, and to all of my personal experience, *Thickness = Warmth*. That insight can answer lots of interesting questions.

Does it add warmth to wear clothes to bed? There are heartfelt screams on both sides of this perennial question, and there can be subtleties. If your clothes are soaked after a long day of sweating, be sure to remove them. But dry clothes will in fact hold still, dry air, and their thickness will translate into warmth.

What do you do if you are planning for a trip, your warmest bag has a loft that is twenty degrees for you, and the forecast is for zero degrees? If the stock formula works for you, and your bag has two inches of loft, then you need an extra half inch. If you are car camping, then you might bring along that ancient bag that is reduced to just one inch of loft that you currently use for summer nights: the total of three inches should keep you toasty. Double-bagging works in the woods, too.

Car camping is a great place to experiment to find how much loft you need. Go a little light, and see if you sleep warm enough. If so, revise your personal formula. If it doesn't work, add on an extra bag. And if you get too chilly, hop in the car with the heater blasting and breathe deeply to restore your core temperature before you go back to bed.

Even apart from loft, all bags are not created equal. Typically, a forty-degree bag will be pretty minimal, a twenty-degree bag might have a draft tube behind the zipper and a

collar around the neck, a zero-degree bag may have a system of collars, while a twenty-below expedition bag will have all sorts of bells and whistles to facilitate living in extreme conditions. These features are all quite useful in increasing cold. If you're always going to sleep inside a tent, a light exterior shell may be sufficient; if you want to be able to use your bag for an emergency bivouac, though, a waterproof / windproof shell is worth its weight and cost (it is also handy if you happen to spill water on your bag inside the tent).

For over a decade now, from late spring until early fall, I have abstained from sleeping bags in favor of a sleeping quilt. It wraps around me from foot to shoulders, and saves weight by avoiding both the insulation under me (which my body compresses to uselessness anyway) and the zipper to connect the two sides. My three-season synthetic quilt is rated to thirty degrees (about 1.75 inches of loft), and weighs in at just under two pounds. I'm hoping that with great care, it will be a serviceable 50-degree summer quilt in a few years.