At the 2003 Survival Conference, hosted by Leeds University in the UK, Dave Brook gave an enlightening talk on the mechanics of insulation evaluation in regard to sleeping bags, which was reported in *World Sports Activewear*. He was particularly concerned with the implications of the new EN13537 test standard proposed for 2005. This is now with us and at this year's conference he returned to the subject.

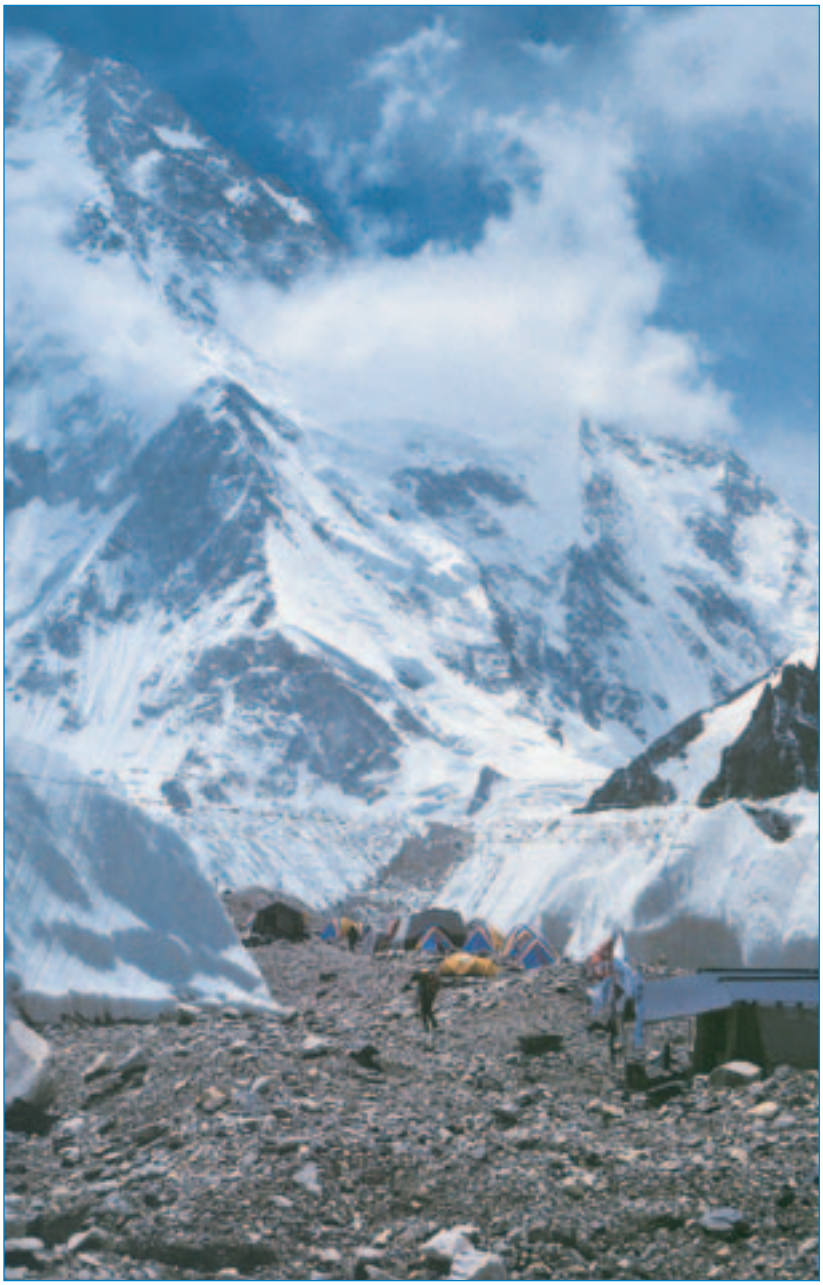
How realistic are temperature test standards?

One needs a little background information first. Up until now the standard has been ISO 11079. This was well proven, having been developed as a result of a request by the Norwegian army, which was concerned about the welfare of its men serving within the Arctic Circle. The accuracy of the resultant tests was extensively field tested by the army and earlier and continuing tests by Leeds University using a TOG testing machine have also verified the ISO results - and it involved hundreds of user trials.

Now, various bodies in Europe have seen fit to bring in a new test — EN 13537 — which differs from both ISO 11079 and the TOG test in several significant ways:

1. Unlike the TOG test there is no reference material included in the test to control its accuracy and verify its legitimacy.
2. EN 13537 uses an insulation mat under the sleeping bag. This has a tog value of 8.5 and, if in a sleeping bag, would have a Comfort Temperature of around -7°C.
3. This pad affects the results when testing summer and winter bags. For example, testing a summer +5°C bag on a -7°C mat improves the bag. Testing a -20°C winter bag the same way will detract from its performance rating.
4. Detractors of EN 15357 say this mat adversely influences results. Those in favour say it has to be used and rightly or wrongly that is what they will do. (The ISO test uses a 10mm close cell foam mat that accurately reflects a commercially available product). They do, however, accept that the test cannot produce accurate data for winter bags.

The extreme temperature used by EN 13537 is one at which "frost bite is quite likely but death is not expected". This differs substantially from most consumers' perception of what is an 'Extreme Temperature'.



How the body works

Effects of cold – the human body performs best at a core temperature of 37°C +/- 2°C and outside this range its physical capacity becomes increasingly affected.

Production of heat – the human body normally produces about 70-100W when resting. Physical activity increases this 5-10 times. The ability to withstand cold varies from person to person, but with any individual it is their 'perception' of cold that is important.

Defence mechanisms – the body is designed to protect its most vital organ — the heart. When the body (and heart) is threatened by cold, the tiny blood vessels furthest from the heart (fingers and toes) contract, blood flow is reduced and heat loss occurs from these areas. While this helps maintain core temperature, it also reduces bodily capacity and performance. When the body wants to cool down, the opposite occurs. This does not, however, apply to blood flow in the head and even resting in a temperature of -10°C without a hat or scarf can cause up to 50% body heat to be lost.

Muscular performance – if muscle temperature reduces by 1°C, performance falls by around 10%. Tests have indicated that the body's physical capacity can be reduced by as much as 17% in cold conditions.

Heat loss – there are four possible routes:

- Convection causes 50-80% to be lost. The body heats up cold air in contact with it, which becomes lighter and rises to be replaced by more cold air to be heated, etc.
- Radiation means that a body warmer than its surroundings will always radiate heat, so protection of the head and face in adverse conditions is important.
- Respiration causes cold air to be warmed as it is inhaled and a subsequent heat loss when exhaled. This alone can result in 10-15% of body heat loss.
- Contact, whereby any contact with cold surfaces results in high local heat loss by conduction.

Comfort temperature – as we have already said, this is very much a matter of individual perception. However, the consumer – whoever that might be – is entitled to have access to as accurate a guide for their intended use of a sleeping bag as possible. EN 13537 is aimed at civilian use and the best thing that can be said for it is that it will at least enable all European retailers to be quoting temperatures based on the same standard.

Activity	Heat Output (W)	Insulation (togs)
Sleeping	80	20
Sitting	110	14.5
Standing	175	9
Walking (gentle)	250	6.5
Walking (hard)	450	3.6
Pulling sledge	500 - 1000	3.2 - 1.6

Table 1: Insulation required for comfort at –40°C with no wind.

Empirical results (1 tog = 0.1 M2 K/W)

Is this good enough?

The basis for EN 13537 is that the human body produces 60W when resting and not 70-100W. The standard gives four different temperatures and this alone could be more confusing than informative to an end user. In particular, the big difference between 'comfort' and 'extreme' temperatures is both confusing and potentially dangerous.

Users could well be unwittingly exposed to extremes of temperature they had not expected and the 'extreme' temperature given by EN 13537 is in fact one at which the risk of frostbite is extremely high. It has also been pointed out that the standard is a theoretical one based on a limited number of 'reference sleeping bags'. It is also unclear if any actual field tests have been carried out on humans to check the inevitable variables.

There is also as yet no conversion formula for the EN 13537 test. On the committee's own admission, the test does not work on winter bags, so the end users need to be extremely cautious if they anticipate harsh conditions. If a summer bag does not work, the user may become cold but that is not the end of the world. With a winter bag things can, at the extreme, become life-threatening. A temperature of –20°C is rarely seen in cities but it is almost always in the wilderness where a crisis can turn into a disaster. It would be encouraging to learn that all the committee members responsible for drawing up EN 13537 have spent winter nights with the Norwegian armed forces in the Arctic. After all, there's nothing like practical experience to decide whether suffering frost bite is an acceptable risk.

Background information courtesy of the University of Leeds Performance Clothing Research Group.

Season	Night Temp (°C)	Insulation (togs)
Summer	15 to 8	3 to 5
Spring / Autumn	10 to 10	5 to 8
Winter	3 to -10	7 to 10
Mountain	-5 to -20	9 to 12
Polar / High Mountain	-15 to -40	11 to 16+

Table2: Thermal insulation (Togs) needed by the average person.