Reflexcell™ Products

Technical Report

1 INTRODUCTION

1.1 All Blizzard products manufactured from our unique material, Reflexcell™, provide unrivalled warmth and protection against the elements, in the smallest and lightest of packages. Several factors combine to make this possible:

- The thickness and corrugation of the material create a layer of still air, which provides excellent insulation.
- The metallised surfaces of the material reflect radiated heat back to the body, and minimise the emission of radiated heat from the outside surface of the material.
- The elastication causes the material to hug the body, increasing its insulating ability, and reducing air convection in the space between the material and the body.
- The material is completely windproof, minimising losses due to wind chill.
- The material is completely waterproof, and continues to work perfectly even if completely wet both on the inside and outside.

1.2 Reflexcell™ is surprisingly robust for the following reasons:

- The principal raw material (polypropylene film) is strong and wear resistant.
- The exception to the above is that, once punctured, a single layer of film has a low tear strength when held in tension. This “crisp packet effect” is what makes cheaper, single layer products so fragile. Reflexcell™ overcomes this problem in several ways, making it extremely strong and robust in use.
    - Most importantly, the elastication ensures that the material is virtually always held in compression, so that tears do not propagate.
    - Secondly, the three layer construction means that all three layers would need to be perforated before serious tears could develop. In practice this is very unusual.
    - Any small tears which do form are usually stopped when they collide with one of the many seams in the material’s construction.
    - Finally, it is important to note that Reflexcell’s™ warmth is not seriously affected by small areas of damage.

2 THERMAL PERFORMANCE OF SAMPLES OF REFLEXCELL™

2.1 Samples of the Reflexcell™ have been tested in laboratory equipment designed to measure the thermal resistance (insulating ability) of textile materials. Blizzard have conducted their own in-house tests, and independent tests have been undertaken by the Textile Department at Leeds University.

2.2 Table 1 shows the performance of Reflexcell™ compared with that of other insulating materials. Performance is measured in "Togs", a unit of thermal resistance commonly used in the textile industry (1 Tog = 0.1 m^2K/W i.e. one Tog is a tenth of a square metre degree Celsius per Watt).

Table 1: Thermal performance of samples in laboratory tests

Material	Thermal resistance (Togs)
Reflexcell™ – in house tests by Blizzard	9
Reflexcell™ – independent tests by Leeds University	8
Single polythene sheet	2 [1]
Single film reflective sheet (“space blanket”)	4 [1]
Summer bed quilt	4
Winter bed quilt	12

1 Thermal resistance figures for the thin materials (polythene bags and space blankets) should be treated with a good deal of caution since they vary according to the conditions under which they are measured. The performance of these materials is determined in part by the extent to which they block radiated heat, yet the amount of radiant heat which a body emits varies according to the situation (amount of clothing worn, ambient temperature etc.), so that the materials' performances' will vary accordingly.

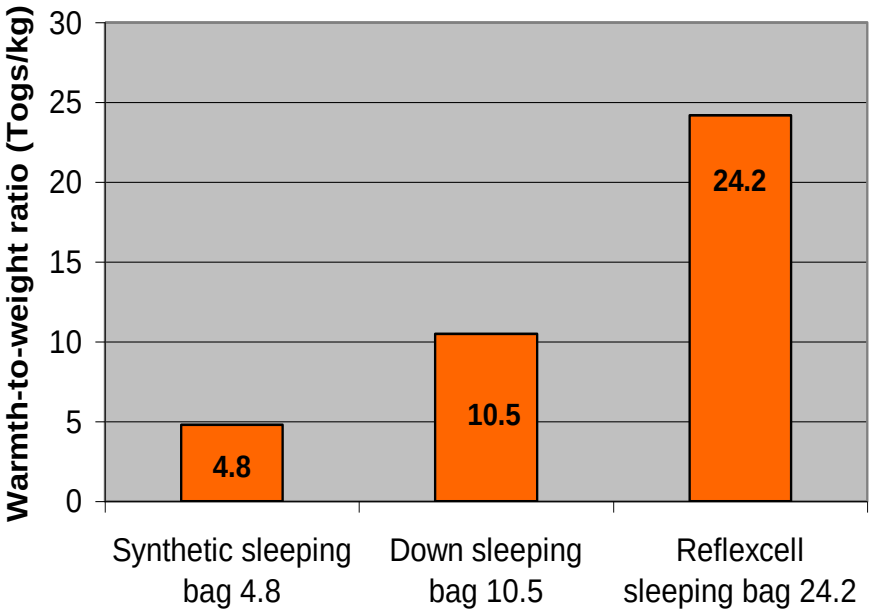
2.3 The results in Table 1 show that Reflexcell™ offers a degree of warmth intermediate between that of a summer and a that of a winter bed quilt. This is enough to make a very significant difference to a person's chances of survival in an emergency situation, and sufficient to provide very adequate comfort and warmth when used in more normal circumstances.

2.4 The relatively high figure for the single layer (“space blanket”) material is somewhat misleading. Using two layers of this material, or of the polythene sheet, will only slightly improve their thermal resistance, whereas with other materials, including Reflexcell™, the thermal resistance will be more or less doubled.

2.5 It is established practice to express the thermal efficiency of sleeping bag materials as a warmth-to-weight ratio by dividing the insulating value of the material (in Togs), by the weight of an actual sleeping bag made from the material (in Kilograms). Figure 1 shows typical values for synthetic and down sleeping bags (as ascertained by Leeds University), and for the Blizzard Survival Bag (Reflexcell™). Using a tog rating of 8 Togs and a weight of 330 grams for a Reflexcell™ sleeping bag gives a value of 24 Togs/kg. This is well over twice the value for goose down, which was previously regarded as having the highest practically achievable warmth-to-weight ratio. It is worth noting that the warmth-to-weight ratio of goose down is drastically

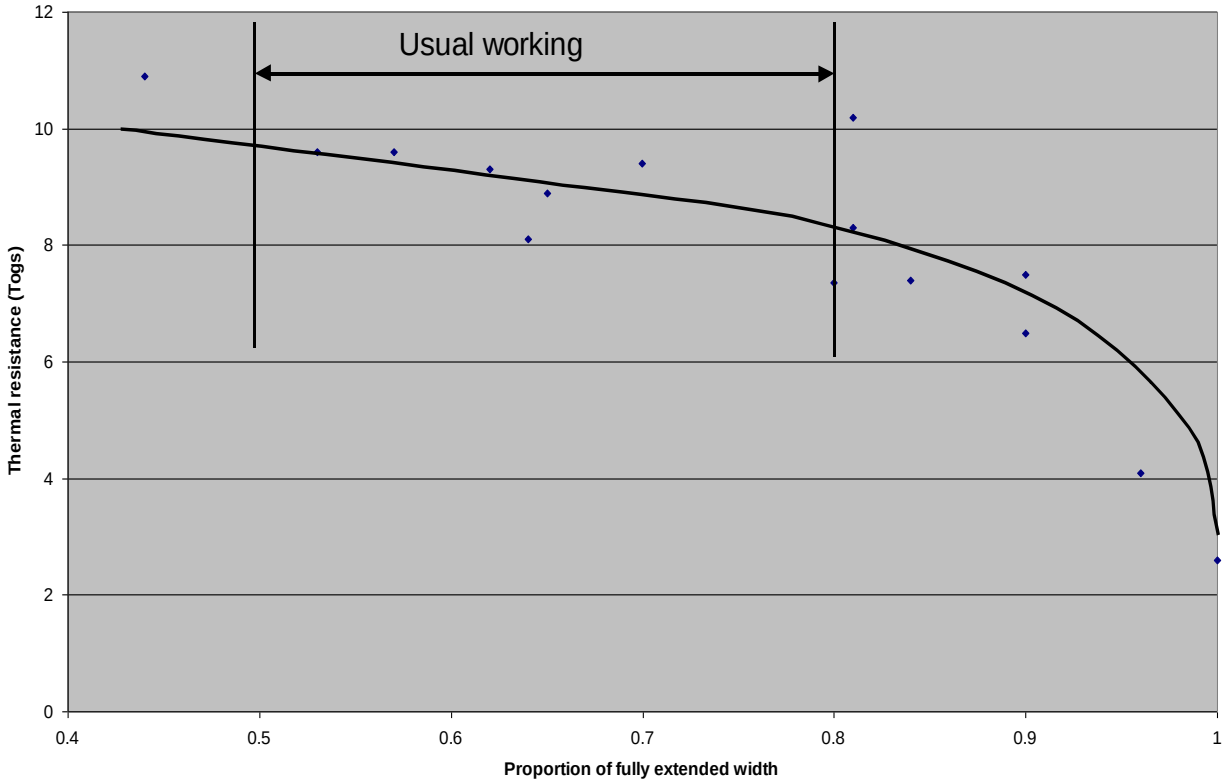
reduced by the presence of moisture, whereas that of Reflexcell™ is hardly affected.

Figure 1: Warmth-to-weight ratios of sleeping bag materials



2.6 Not surprisingly, the thermal resistance of Reflexcell™ changes as it is stretched. However, Figure 2, based on Blizzard's in-house measurements, shows that within the usual working range of the material, this effect is insignificant.

Figure 2: Thermal performance of Reflexcell™ at different degrees of elongation



3 THERMAL PERFORMANCE OF REFLEXCELL™ SLEEPING BAGS

3.1 Reflexcell™ sleeping bags (Blizzard Survival Bags) were tested in-house under laboratory conditions using a dummy filled with hot water. By measuring the rate at which the dummy cooled it was possible to calculate the thermal efficiency of the bags.

3.2 The process was repeated for a number of different bags and the results are shown in Table 2. The heat-retaining capability, and warmth to weight ratio of a new Reflexcell™ sleeping bag were arbitrarily taken as one.

Table 2: Thermal performance of complete bags in laboratory tests

	Mass/kg	Thermal efficiency[1]	Warmth to weight ratio
New Blizzard Survival Bag	0.33	1	1
Old Blizzard Survival Bag (previously used and re-packed)	0.33	0.96	0.96
Polythene "survival" bag	0.3	0.16	0.17
Single film reflective sheet ("space blanket")	0.05	0.46	3.29
Ajungilak 3 season synthetic bag	1.95	1.21	0.2
Rab 6 season down bag	2.18	2.04	0.3
Old woollen blanket	0.85	0.28	0.11

1 Thermal efficiency was measured with the bag resting on an insulating mat. In common with many sleeping bags, Reflexcell™ sleeping bags provide little insulation where they are compressed by body weight.

3.3 Several important points emerge from Table 2:

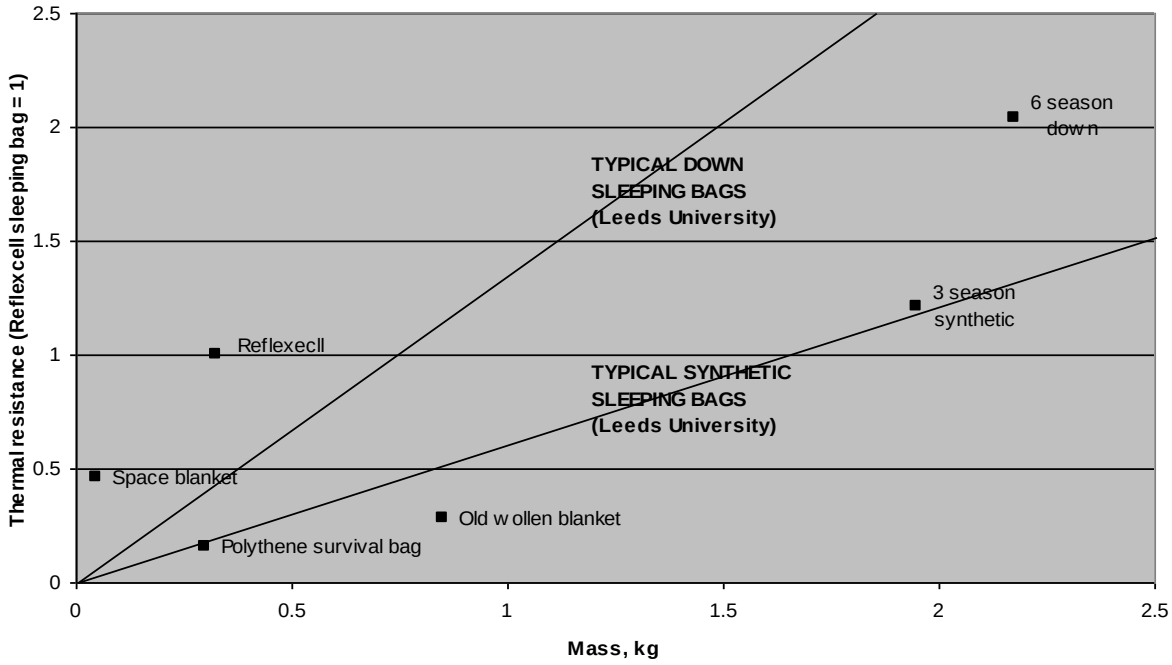
- Reflexcell™ sleeping bags are equivalent in warmth to a two to three season sleeping bag.
- The performance of Reflexcell™ sleeping bags is little affected by previous use.
- Reflexcell™ sleeping bags massively outperform their two nearest rivals, namely polythene "survival" bags and single layer "space blankets".
- As already discussed, the high figures for "space blankets" are misleading for several reasons: i) Using two such blankets will only slightly improve their performance, as already noted in the previous section. ii) The high warmth to weight ratio of space blankets is due to their extremely low weight, not to exceptional thermal

performance. iii) Space blankets are generally inconvenient to use and extremely fragile, meaning that these theoretical figures are rarely realised in emergency situations.

- The warmth to weight ratio of the bag is three times that of a quality down bag as measured in these tests.
- The warmth to weight ratio is many times that of a woollen blanket, a fact with significant implications for short-term disaster relief where air transport is involved.

3.4 The data from Table 2 are shown graphically in Figure 3. It can be seen that the Reflexcell™ sleeping bag is genuinely in a league of it's own. There is no pre-existing product able to deliver the same thermal performance at such a low weight.

Figure 3: Relative warmth to weight of bags tested



4 PERFORMANCE OF BAGS IN USE

4.1 Reflexcell™ sleeping bags have been field-tested in a variety of conditions from British summertime weather to sub-zero conditions in the Himalaya.

4.2 All bags performed well and none was damaged during use. Users generally felt the warmth provided was equivalent to that of a two to three season sleeping bag.

4.3 Sometimes a small amount of condensation formed in the bags after a number of hours use, but in no case was this felt to be a serious problem.

4.4 Some bags have been used a number of times with no discernible reduction in performance, even after having been roughly re-packed.