

Sports clothes being made from more than a single type of textile material may not be new but research into body mapping technology is revealing new possibilities for achieving maximum performance and comfort.

Mapping the future

The concept of mapping areas of the body to provide best performance and comfort is nothing new. In 2006, W.L.Gore & Associates created 'comfort mapping technology', enabling "the needs of the various climatic zones of the body to be addressed more specifically and more efficiently through the strategic placement of functional fabrics".

In April last year, German textile machinery provider Karl Mayer launched a collection of performance sportswear garments produced on the company's RSJ 5/1 Rascheltronic machine, which uses body mapping techniques to apply performance qualities to particular zones of the garments. A shirt from the line

features a sporty, ribbed construction at the front with different mesh zones extending in long arcs from under the arms and across the chest. The mesh constructions, which alternate between having long, narrow openings and variable openings, provide customised breathability. The openings in the fabric are filled-in with a hatched, filigree pattern made from polyamide yarn. The result is a stable, non-stretch fabric that transports moisture and ensures that the air can circulate freely.

In February this year, Swedish sportswear company Craft revealed its new Elite Pace Jacket at ispo. The soft shell running jacket was developed with the company's body mapping knowledge, and features laser-cut perforations on 'hot spots' and bonded fleece insulation on

Body mapping is not a new idea, however the Hohenstein Institute's study into comfort mapping sheds new light on the concept.

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colder areas. On the 'hot spots' (under the arms and on the back) laser-cut perforations allow ventilation, while brushed microfleece panels are bonded on shoulder, chest and kidney areas to provide comfortable warmth and ensure moisture management.

Comfort mapping

Sports clothing made without body mapping technology is usually made from one or two types of textile material. In order to meet the various different requirements for moisture wicking, insulation and weatherproofing, sportsmen and women often have to wear several layers of clothing. By using body mapping technology, sports clothing can provide enhanced temperature and moisture regulation. Researchers at the Hohenstein Institute, Germany, are now saying that body mapped clothing should also take skin sensory aspects into account in the interests of comfort. Experts at the Bönningheim-based textile research centre have analysed the heat and moisture management specifications for textiles worn on different parts of the human body. In a process called 'body mapping with comfort zones' (or comfort mapping), the experts say their findings should make it possible in future to use different textile materials for different parts of a garment, so making sportswear significantly more comfortable to wear.

The principle of comfort mapping, as developed by the Hohenstein Institute, takes account of the spatial distribution of heat and moisture production in different parts of the body by using different textile materials. A statement from the institute says: "The principle of body mapping is based on findings about human thermoregulation. The term thermoregulation refers to a complex, interconnected system of the body's own reactors, which trigger certain physical reactions when they receive messages from the brain. These control mechanisms are set in motion in conditions of either heat stress or cold stress. Under extreme heat stress, for example when cycling in summer, the sweat glands are activated, but these are not evenly distributed over the whole body. So different quantities of sweat are released in different parts of the body. With cold stress, for example when skiing, the control mechanism automatically triggers a protective function. This prevents the body core, i.e. the essential organs in the torso and the brain, from losing too much heat. Consequently, the skin and the extremities, especially the hands and feet, cool down. There are specific cold receptors in human skin that are responsible for detecting cold stress. However, these cold receptors are not evenly distributed over the surface of the skin, with



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relatively more on the torso and head, and fewer at the extremities. This is why we are generally more sensitive to low temperatures around our trunk than at our extremities.

"Based on these findings about thermoregulation, it makes sense to develop clothing, especially for sportswear, that is adapted to meet the needs of different parts of the body, to make it comfortable to wear."

While performance remains the top priority for sports apparel, comfort should also be a key factor. A research team at the Institute, led by Dr Jan Beringer, have developed a sample prototype of a sports top with comfort zones based on the principle of body mapping, for the high-intensity sports of cycling and running. Alongside the criteria for temperature and moisture control, skin sensory aspects such as softness and suppleness also played a role in the quest for the ideal product. The scientists were by no means satisfied with purely qualitative or subjective assessment criteria, but were looking for quantifiable, objectively verifiable benchmarks based on absolute criteria.

"With this project, we entered new territory, scientifically speaking," says Dr Beringer. "Because of the complexity of the task, absolute criteria for thermophysiological and skin sensory investigations had never been formulated in this way before."

To begin, the researchers identified which properties the materials should have for use on

the different parts of the body. Specific property profiles were produced for the various materials, combining thermophysiological and skin sensory criteria. The researchers kept in mind that these requirements differ depending on the type of sport, the garment or part of the body involved and the weather conditions. The most important thing was the composition of the materials. For example, where to use synthetic fibres, hygroscopic natural fibres and a mixture of fibres. The researchers also looked at how the so-called regenerated fibres such as viscose, Modal or Lyocell, which are made of sustainable raw materials, behaved. "According to the results of the investigation, the greatest benefit is gained from using innovative fabric structures where the surface of the fibre can be modified depending on the requirement," the Hohenstein Institute says. "However, at the scientific heart of this project was the way that the results of thermophysiological studies, in terms of specific criteria such as heat insulation, breathability, moisture management and drying time, were combined with the results of skin sensory investigations. The context for this was the requirement that sportswear worn next to the skin should offer not only good thermophysiological properties but also excellent skin sensory comfort."

The specific parameters measured in the tests were: sticking, wetting and surface indices, the number, number of contact points between textile and skin, and stiffness.

Measuring comfort

With this information, the researchers began calculating exactly which specific properties a ready-made sports textile would have to have to be best suited for a particular purpose, depending on the type of sport, climatic conditions and the garment in question. Working alongside partner companies in the textile industry with an interest in the project, the Institute developed a prototype of a short-sleeved sports top with comfort zones, for running and cycling.

"With the help of a thermal articulated manikin, which simulates the thermoregulatory system of a human, the scientists were able to obtain the information they needed to design this top in advance, by carrying out appropriate tests," says the Institute. "For this purpose, the manikin was divided into 16 segments, such as the chest, back and upper arms. A computer-controlled heating system was attached to each segment, which could be used to regulate the heat production for each section of the body separately. The tests were carried out when the manikin was both stationary and in motion, and using a wind machine which simulates the movement of air or turbulence. The findings



made in the laboratory tests were backed up by wear tests conducted with volunteers in controlled conditions in the climate chamber.

"These volunteers were fitted with sensors in the relevant places and had to test various textiles in defined climatic conditions during a sporting activity (running on a treadmill or riding on an exercise bike), and also using a wind machine."

The Hohenstein believes its prototype sports top illustrates the idea of comfort mapping, which it says could be applied to nearly all sports and other kinds of garments. "Together with our partners from the German textile and clothing industry, we have created a starting point for innovative products with tremendous customer benefits and well thought-through functionality," concludes Dr Beringer. 🌐

The thermal articulated manikin developed at the Hohenstein Institute simulates the thermoregulatory system of a human.

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