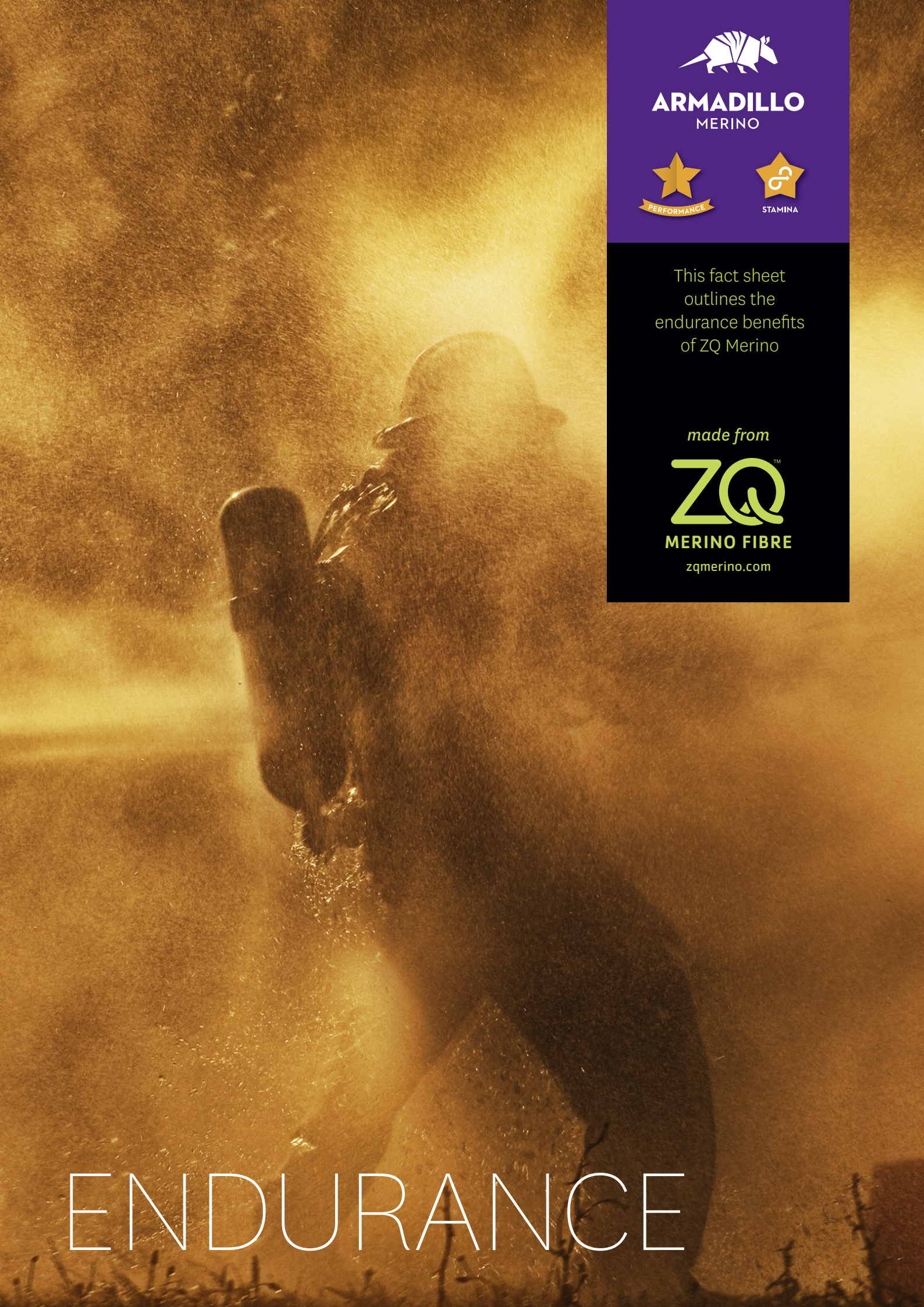

ARMADILLO
MERINO

PERFORMANCE

STAMINA

This fact sheet outlines the endurance benefits of ZQ Merino

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ENDURANCE

INTRODUCTION

By definition endurance is the ability to withstand hardship and stress over a long period of time, as well as the ability to resist, recover from, and have immunity to fatigue. In the case of an extreme athlete or professional risk taker, they must rely on both their physical stamina and their equipment, including garment system, to assist in maintaining their performance:

- Respiration rate increases
- Heart rate increases
- Body temperature increases
- Metabolic rate increases
- More sweat is produced as the body endeavours to cool itself down via evaporative cooling
- Muscles are fatigued

The heat production of a person in a thermo-neutral environment (33°C or 91°F), at rest mentally and physically, more than 12 hours after the last consumed meal, is defined as the Basal Metabolic Rate (BMR). The standard BMR for a man weighing 70kg is approximately 1.2 W/kg. However during exercise the body heats up, mainly as a result of muscular activity which generates substantial amounts of heat. Active skeletal muscles release roughly 85% of the heat needed to maintain normal body temperature, and this consequently increases the metabolic rate.

When muscles become active, their consumption of energy escalates. As anaerobic energy production becomes the primary method of Adenosine triphosphate (ATP) generation, muscle fibres become less efficient at capturing energy. At peak levels of exertion, only about 30 percent of the released energy is captured as ATP. The remaining 70 percent warms the muscle and surrounding tissues. Body temperature soon climbs, with the body needing to remove this excess heat. The heat produced by exercising muscle causes blood vessels in the skin to dilate, which increases the blood flow to the skin. This elevated blood flow to the skin, combined with its large surface area, allows the excess heat to be lost to the surrounding air. At the same time, receptors carry the message of excess heat to the body's thermostat, the hypothalamus in the brain. Nerve impulses from the hypothalamus stimulate sweat glands in the skin to produce sweat. The sweat evaporates from the skin, removing heat and cooling the body.

WHY ENDURANCE IS IMPORTANT

Exercise increases heat production in the body during exercise in both warm and cold conditions. The major consideration from a performance and endurance perspective is the dissipation of that heat.

Clothing is worn to provide both a modesty barrier and a protective layer from the external environment. By its very nature, clothing imposes a barrier to heat transfer and evaporative cooling from the skin surface when heat is generated during exercise. Extreme athletes and professional risk takers make huge demands on their bodies in order to withstand the rigors of extreme exertion and environmental factors. These physical and environmental factors require support from garment systems that will sustain the body's endurance capabilities.

The body responds to exertion by constantly regulating its internal temperature in order to maintain equilibrium. When the body is cold, shivering is the natural response to keep muscles warm and the body temperature stable. The opposite of this is when the body becomes hot and sweating occurs in order to cool the body via the evaporative cooling process.

The choice of an appropriate technical garment system can support the body's natural temperature and humidity regulation system, which in turn will work in synergy to support the wearer's endurance.

PREVIOUS OPTIONS

(LIMITATIONS OF OTHER FIBRES)

Any article of clothing worn during exposure to high temperatures and/or during periods of exertion will inhibit the body's natural thermoregulation efficiency. Nothing that can be worn next to the skin or on the body will speed the body's cooling systems as fast as bare skin. However, shedding clothing is often not a viable alternative due to both modesty and occupational protection. In addition, when multiple risks occur simultaneously, such as extremely high temperatures and the risk of exposure to fire, explosion or electric arc, we invite a greater risk of burn injury in solving excessive heat by the removal of clothing.

Historically, the textile industry has relied on many natural and commodity fibres with exceptional absorption properties. For example, a 100 percent cotton T-shirt will absorb very large amounts of moisture. But even in summertime, 100 percent cotton garments remain wet for hours. The poor wicking and evaporative qualities of all-cotton solutions can actually raise the risk of heat stress. Water, after all, is a very good insulator, which means when the body is effectively wrapped in, or insulated by, water the body's objective of cooling itself is inhibited (Cone, 2009).

Apparel systems used for extreme athletes and professional risk takers have commonly relied on technical synthetic products such as polyester constructions that are marketed as having excellent wicking, durability and quick dry performance. While the garment knit or weave structure can have the ability to transfer moisture away from the skin via wicking, these synthetic materials do not have the ability to retain moisture within the fibre structure. Such retention properties allow the transfer of moisture to the external environment and in doing so give off heat to provide a temperature and humidity buffering mechanism.

Heat of sorption is an important attribute in a textile that supports endurance performance by giving off heat when water vapour is absorbed. Heat of sorption is the rise in temperature that occurs when a material absorbs moisture vapour, the vapour is transformed from gas to liquid, and the phase change produces a rise in temperature. Synthetic fibres produce negligible heat of sorption because they do not have good moisture absorption properties (Figure 1).

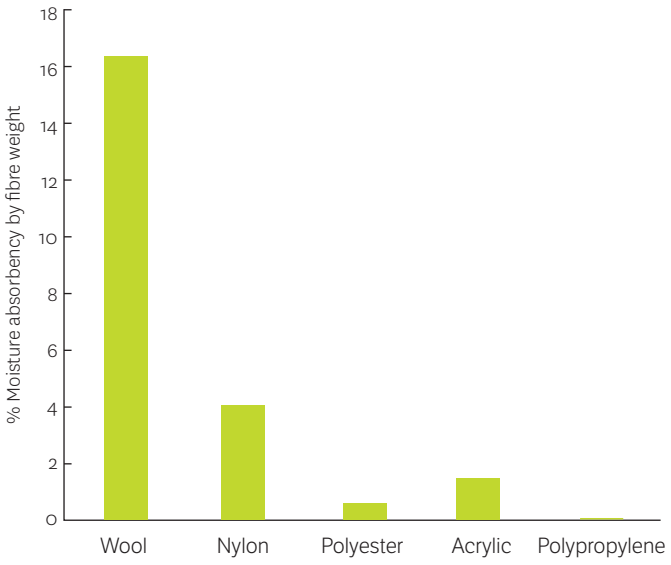

Figure 1. Moisture absorbance of wool and synthetic fibres (Collie and Johnson, 1998)

MERINO WOOL SOLUTION

Usage of merino sports and extreme active wear is growing rapidly worldwide. This is supported by both strong consumer endorsement and objective evidence of performance. Merino apparel and hosiery offer a means of enhancing the wearer's physical performance and comfort when engaged in physical activity, while avoiding the use of non-sustainable synthetic fibres.

In addition to normal textile characteristics, the following attributes are particularly important for fabrics utilised in active wear:

- An ability to actively manage heat and moisture flows from the body under a variety of conditions (hot, cold, dry and wet)
- Suppression of odour
- A low heat of combustion
- High abrasion resistance and durability
- Ease of laundering
- Softness and flexibility

Merino fibres' ability to manage heat and moisture flows allows it to have a major influence on the thermal state of the body, on human performance, and on a user's perception of their physical condition.

With respect to thermal comfort, the required attributes of fabric differ greatly depending on the intended end use. For example, sedentary activity in a cold environment will have fabric insulation and moisture transfer requirements quite different to those of a garment designed for sporting use in a warm or temperate climate, and even more different to garments designed for endurance type activities. In general, the fabrics used for active wear are designed to promote heat and moisture flows away from the body.

A study carried out by Laing et al (2007) compared physiological responses of athletes exercising while wearing single layers of merino or polyester, or 50/50 merino/polyester active wear (237+/-16g/m2), under hot and cold conditions. The study revealed the following statistically significant differences between the fabrics:

- A longer time to onset of sweating whilst wearing merino single jersey fabric (Figure 2)
- Lower heart rate during resting and walking whilst wearing merino in hot conditions (Figure 3)
- Lower heart rate during running and walking while wearing merino in cold conditions
- Greater heat content of the body when wearing polyester interlock fabric (under both hot and cold conditions)
- Greater stability of skin temperature under Merino fabric
- Greater stability in core temperature whilst running, walking and resting in Merino (hot and cold conditions)

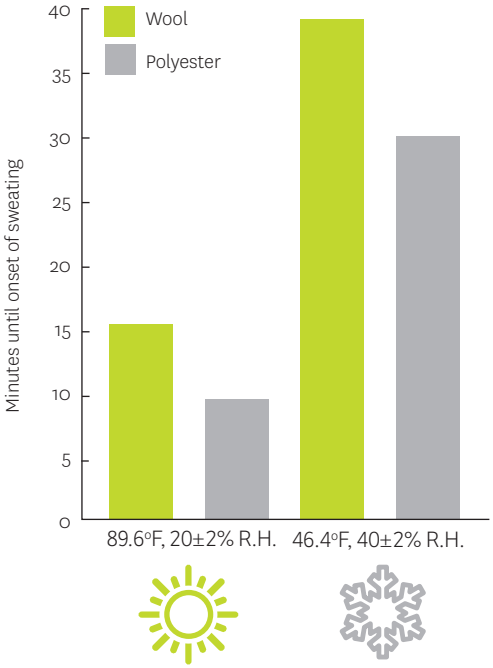

Figure 2. Time to onset of sweating when exercising wearing merino vs polyester base layer product

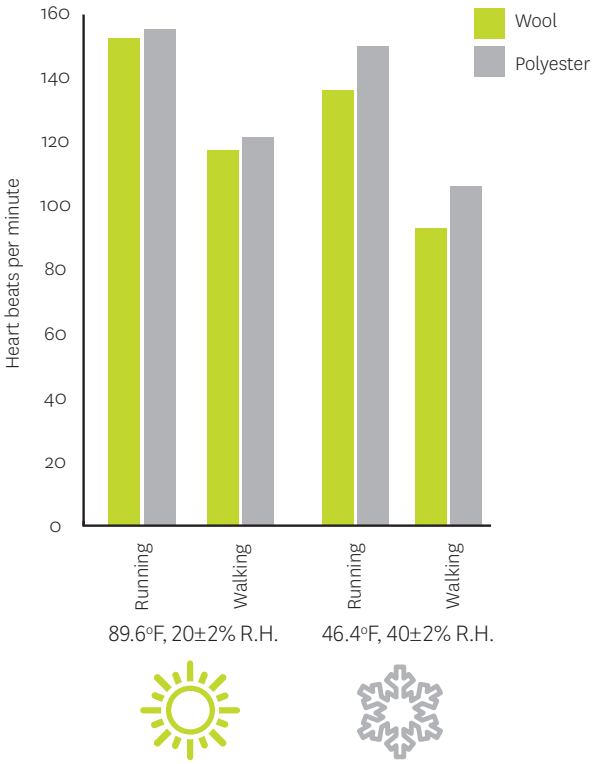

Figure 3. Change in heart rate when exercising wearing merino vs polyester base layer product

SUMMARY

A fabric's ability to allow the transmission of water vapour through its structure will significantly affect the comfort of the wearer. The ability of merino wool to do this surpasses that of synthetics.

The chemical structure of merino fibre means that it has the ability to absorb and desorb moisture, and to gain and release heat depending on the external and internal environment. This provides a buffer for the wearer against environmental changes.

As it absorbs moisture, merino fibre releases a small but perceptible amount of heat. In an apparel or hosiery application this prevents the wearer from chilling in wet, cool conditions. In hot conditions the reverse effect occurs, affording a natural means of regulating the body's microclimate.

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