Soft shells first appeared in the late 1990s and were initially promoted as a new, multifunctional single-layer garment merging the thermal and outer shell of protective apparel. Since then, the concept has evolved into a vast and versatile family of fabrics and garments that defies categorisation.

The many facets of soft shells

Everyone seems to have their own idea of what a soft shell is or is not. The term, which is used to describe both a multi-layered textile and an item of clothing made in the fabric, covers a wide variety of materials and styles. In spite of, or maybe due to its lack of definition, the category has thrived since its inception, which the sportswear industry tends to place in the late 1990s.

There are several ways to make a soft shell fabric, which is one reason why the category is so diverse. The multilayered material can be manufactured on double knitting or double-weaving machines. It can also be obtained by bonding two fabrics together. Whatever the manufacturing process, these double-face materials require specific machinery and expertise, but they are in no way recent additions to the world of textiles. Regular fleece and polar fleece, archetypal sports basics, are technically double knit fabrics. Each side of the knit can be 'engineered' to offer different functions, which can include warmth, wicking, softness, resistance, and so on. In the late 1980s and early 1990s, fleece manufacturers experimented with different face and back yarns to combine several properties in a single knit fabric.

A common denominator of soft shells is that they present multiple properties, though these come in widely varying combinations. Abrasion resistance, breathability, elasticity and thermal insulation make up one set of features. This is the configuration of first-generation soft shells that sought to infuse traditional polar fleece with new properties. Rock climbers quickly adopted the item, and they are arguably the first users of soft shell garments. Later on, in response to consumers' requests for additional weather protection, waterproof-breathable membranes were added to the soft shell product mix. To this day, the debate remains open as to whether a soft shell should be waterproof or not.

"Soft shells are an open category: you can put anything in it, except waterproofness," says Jorgen Jorgensen, Norrona CEO and a staunch advocate of soft shell jackets and pants. Like many high-tech sportswear brands, Norrona soft shells tend to favour breathability over waterproofness. For many, the point at which a soft shell becomes a hard shell is when the composite material is waterproofed. This definition is not as simple as it sounds. "We are seeing hard shells evolve towards soft shells with face fabrics that have nicer hand feels," says Matt Page, Mountain Hardwear's VP of global product. He, like others in the industry, points out that a soft shell fabric or clothing becomes a hard shell when it goes from silent to noisy, or crunchy, a term used by Mr Page. A soft shell could then also be called a 'quiet' shell.

Designed to offer abrasion resistance, Invista's Cordura fabrics are often used as the face fabric of soft shells. For those looking for a silent face fabric, Tim Anson, Cordura marketing and development manager, recommends calendered or, better yet, multi-calendered finishes: "Silicone and polyurethane coatings can be noisy, which is why we favour calendering. This technique is used for parachute fabrics to close the interstices of the weave and reduce its air permeability."

The introduction of elastic membranes and development of new adhesives further contributed to blurring the lines between soft and hard shells. Italian soft shell specialist Pontetorto claims that soft shells with membranes are far more popular than those without. For Sympatex product manager Isabel von Lösecke, a truly waterproof garment needs to be seam-sealed, which can be tricky on the brushed backs of many soft shells (see panel). "If you can't tape the seams, you don't need a waterproof-breathable membrane. However you do need some thermal production, and therefore windproofness, which makes the

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Icebreaker calls its soft shells RealFleece, a triple-layer material combining a water-resistant polyester face fabric, a polyurethane membrane and a pure merino fleece back. A bluesign-certified nano finish provides water-repellent and stain-release properties.

Icebreaker

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Tim Emmett wore Mountain Hardwear's Drystein soft shell jacket and pants on an expedition to Helmcken Falls in Canada.

Mountain Hardwear

Sympatex WindMaster a perfectly suitable option," she says. Sympatex membranes, which measure 5 to 15 microns depending on the references, are among the finest on the market. This makes Sympatex an ideal option for soft shells, says Hervé Clerbout, the brand's sales director.

"There is a grey zone between the soft and the hard shell," says Cécile Nomdedeu, Paris-based marketing manager for Gore-Tex in Europe. Gore has developed soft shells in both its WindStopper (launched in 2002) and Gore-Tex ranges (in 2005). But the WindStopper category is the stronger of the two, says Ms Nomdedeu. WindStopper soft shells target snow sports end uses and are offered in a wide array of back fabrics to address different needs in terms of thermal insulation.

An ever-evolving family

The versatile nature of soft shells is what makes it such a dynamic family of fabrics. The sportswear industry tends to promote soft shells as being suited to 90% of outdoor user needs, effectively relegating hard shells to a meagre 10% and leaving a comfortable margin of development for soft shells. The item is increasingly considered a year-round product, suited for jackets and possibly even more appropriate for pants, and ideal for active sports as well as everyday urban uses. "Fashion brands like the product's clean and modern look, compared to traditional fleece," says Enrico Banci, president of Pontetorto.

The evolution of the Power Shield product category at Polartec highlights the many directions soft shells have taken. Polartec introduced Power Shield fabrics in 1998, and Arc'teryx was the first brand to adopt the concept. The multi-layered bonded fabric had a durable stretch woven face fabric (made by Schoeller), a fleece back, and a membrane in between. It blocked wind, resisted water penetration and offered a level of air permeability ranging from 7 to 12 cfm, says Allon Cohne, global marketing director. In 2007, the company introduced Power Shield 02, which offered higher breathability levels due to the presence of an air-permeable membrane (30-50 cfm), and again Arc'teryx was the first to use the fabric. In 2010, with the introduction of Power Shield Pro, Polartec shifted to focus more on waterproofness. This soft shell group was made with a new membrane offering a decent level of waterproofness (5,000 mm water column) combined with low air permeability (2 cfm). Polartec NeoShell, the latest soft shell group, presented in the fall of 2011, closes in on the hard shell category by offering 10,000 mm waterproofness and 0.5 cfm air permeability (0 cfm being the standard for hard shells). By Polartec's standards, a soft shell can therefore be anything from highly air permeable to nearly windproof and from water repellent to truly waterproof.

New-Zealand merino sportswear brand Icebreaker introduced soft shells a few seasons back, opening the category to merino fabric manufacturers. "We've seen merino migrate slowly from the base layer to the mid and outer layers," says Malcolm Walkinshaw, chief executive of Designer Textiles International, a supplier, although not of any laminated fabric, to Icebreaker. The company's soft shell fabrics include traditional double-knit merino fabrics with a jersey face and brushed back that look and feel like sweatshirt fabrics, to bonded, multi-layered materials combining a durable nylon filament face with a single-knit merino back.



Pants are Norrona's strongest soft shell category.

Norrona

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Breathability and thermal insulation

Bonding several types of materials together requires high-tech machinery and know-how that is attracting new European companies to the soft shell category. Limonta Fabrics, part of the diversified Limonta Group based in the Como region of Italy, has developed a series of soft shell fabrics within its Energy Fabrics range, launched at Performance Days in May. The collection includes two- and three-layer bonded textiles, with or without a membrane, and in stretch or non-stretch qualities. "We have developed a varied array of options for the face and back fabrics, and clients can also choose from a selection of membranes offering different performance levels," says Daniele Locatelli, Limonta Fabrics sales manager.

In response to demand for lighter weight fabrics, Pontetorto has chosen very fine face fabrics (of the 7 den/10 den type) to make soft shells that are more compressible. The company is also working on a new, highly breathable membrane. "This item could have a breathability level as low as 5 Ret, which will make soft shells even more comfortable to wear," says Mr Banci. Lightness is also a key trend for Sympatex, whose upcoming collection will feature styles weighing less than 105 g/m^2, its current lightest 3-layer soft shell.

Thermal insulation is another area of new soft shell developments. At Polartec, the Power Shield High Loft reference is said to be 25% warmer and 25% lighter than the company's standard soft shells. The multilayered material combines a lightweight face fabric with a high-loft, partially brushed back.

Corkshell, a new range of cork-lined soft shells introduced by Schoeller, is also said to be warmer than standard soft shells. "Corkshell has been tested by Empa and the results indicate that the thermal insulation of a corkshell fabric is 50% higher than a soft shell of the same weight," says Dagmar Signer, Schoeller spokesperson. The Corkshell collection consists of two- and three-layer composite fabrics in mono or bistretch styles and in weights ranging from 235 g/m^2 to 290 g/m^2.

Schoeller sources the cork from Portuguese oak farms. The natural material's insulating properties are due to its dense bubble-form structure, with up to 40 million cells per cubic centimetre (cork has been compared to microscopic bubble wrap). In addition to warmth and elasticity, cork is also said to possess antimicrobial properties, a feature that helps preserve wine. "With the spread of plastic stoppers in wine bottles, cork producers are looking for new end-uses for their material," says Ms Signer. The natural material is also considered environmentally friendly: it is harvested without cutting down trees, cork oak trees have a lifespan of 150 to 200 years and their bark can be harvested 16 times on average.



Schoeller's corkshell soft shells are lined with a layer of natural cork, a renewable resource that is said to be elastic, insulating and antibacterial.

Schoeller

As the term soft shell is used to describe an ever wider variety of materials, its lack of a clear definition may be a blessing more than a curse. For knitters, weavers and converters, there are innumerable options to work with. If cork growers can now also contribute to this product category, who knows what other suppliers will come along to introduce new options to the versatile world of soft shells?

The challenge of seam-sealing soft shells

The fleece backs of many soft shells make taping the seams a tricky task. One way to seam seal a fleecy surface is a process called skiving, in which the fleece pile is shaved off to allow for taping. This painstaking operation not only implies two separate operations, shaving and taping, but can also be visible on the finished garment. Macpi, an Italian manufacturer of seam-sealing machines, is currently testing a new machine that could bring soft shell taping down to a single-step process. Macpi's system "burns" through the fleece layer to expose the membrane, forming two "bared" lines on either side of the seam to which the seam-sealing tape can be glued. This one-step operation has the potential to reduce manufacturing time and cost, says Luca Mosso, director of Macpi's bonding division. For now, the method can only be applied to soft shells made with PTFE membranes and the membrane needs to be at least 25 microns thick, says Mr Mosso. This rules out Sympatex (whose thickest version measures 15 microns) and Macpi has yet to start working on a polyurethane-compatible process.

Taping manufacturers strive to create items that can be used on soft shells without compromising the fabric's multiple properties. For Chris Parlee, at Bemis, a defining feature of a soft shell is elasticity and she believes the company's TL 644 tapes offer the best combination of stretch and recovery.

Korean taping manufacturer Sealon has developed special soft shell tapes with a brushed finish. Another option is to apply tapes to the outside of the garment. "Ornamental tapes help differentiate a brand's products and designs," says Geza Maklary, European agent for Sealon.

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