



Textiles
Intelligence

Performance Apparel Markets

Business and market analysis
of worldwide trends in high
performance activewear and
corporate apparel

No 16 1st quarter 2006



Inside this issue:

- Fast track: environmental issues for performance apparel: earth first, profits second
- Product developments and innovations
- Seamless knitting and stitch-free seaming technologies in performance apparel: less chafing, more comfort
- Profile of Bemis: a leader in bonded seam technology for stitch-free apparel
- Business update: corporate restructuring; corporate strategy; counterfeit goods; financial results; investments; joint ventures, cooperation and distribution agreements; markets; mergers, acquisitions and divestments; patent and trademark disputes; trade fairs and conferences
- Glossary: terms and definitions



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Planned for forthcoming issues ...

Cleanroom textiles; chemical protection; corporate wear; flame retardants; footwear fabrics; high performance socks; next-to-skin wear; organic clothing; radiation protection; sensory technology; stain repellency; weather- and water-resistant technologies

... **plus regular features:** Fast track; Corporate profiles; Product developments and innovations; Business update

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Details from

Textiles Intelligence Limited
International Subscriptions
10 Beech Lane, Wilmslow SK9 5ER
United Kingdom

Telephone +44 (0)1625 536136
Facsimile +44 (0)1625 536137
Email info@textilesintelligence.com

The editor

This issue of *Performance Apparel Markets* has been researched, compiled and edited by Virginia Thorp, a freelance editor who also works for the Economist Intelligence Unit.

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Fast track

ENVIRONMENTAL ISSUES FOR PERFORMANCE APPAREL: EARTH FIRST, PROFITS SECOND

Investment in environmentally cleaner technology will accelerate growth for General Electric

ENVIRONMENTAL

“We are investing in environmentally cleaner technology because it will increase our revenue, our value and our profits ... Not because it is trendy or moral, but because it will accelerate our growth and make us more competitive” said Jeff Immelt, the chairman and chief executive officer of General Electric—one of the world’s largest companies.

Pressure for “green” products is also forcing other companies to consider the environment

Growing pressure from consumer action groups and governments, combined with growing consumer demand for “green” products, is forcing other companies to consider their environmental impact too—including ones in the textile industry.

The textile industry is taking measures to eliminate or reduce the presence of harmful substances

Harmful substances associated with textile production can have a detrimental effect on human health or the environment. Consequently, the textile industry is taking measures to eliminate or reduce the presence of these harmful substances and finding ways to prove its environmentally-friendly credentials.

Environmental concerns include the effects of pesticides—

Environmental concerns in relation to performance apparel include:

—pollutants—

- the effects of pesticides used during the cultivation of raw materials such as cotton;
- pollutants emitted during production;
- the use of dangerous substances in textiles;
- the use of substances in textiles which may become dangerous in response to environmental stimuli;
- the emission of pollutants at the time of textiles disposal;
- the biodegradability of substances;
- waste disposal; and
- the bioaccumulation of substances.

—dangerous substances—

—biodegradability, waste disposal and bioaccumulation

“Greenhouse gases” are emitted during polyamide production

During the production of polyamide (nylon), nitrous oxide—one of the “greenhouse gases” which contributes to global warming—is emitted.

Potentially hazardous substances in textiles, such as antimony, are another concern

Another concern is with substances in textiles which pose a potential hazard to health or to the environment. The heavy metal antimony is typically found in textiles made from polyester because it is used as a catalyst during manufacture and is sometimes used as a flame retardant.

Antimony has been linked with health problems and can be dissolved out of fabrics and into sweat, saliva and blood

Antimony has been linked with a number of health problems. For example, antimony trioxide (a widespread catalyst) is on the European Unions's list of dangerous substances because of its carcinogenic properties. Although there is no danger from the general use of polyester textiles, it has been shown that antimony can be dissolved out of fabrics at relatively low temperatures and into sweat, saliva and blood.

Teijin has developed an antimony-free polyester production method which uses titanium-based catalysts

Ever wary of environmental and health concerns, the large polyester producers are searching for alternatives to antimony. The Japanese company Teijin—faced with strict environmental controls on the use of antimony in its home country—has developed an antimony-free polyester production method which uses titanium-based catalysts.

Producers who do not use antimony can label their products as being antimony-free

In relation to the production of polyester, the EU Eco-label (see below) requires that the amount of antimony present should not exceed 260 ppm (parts per million). However, to encourage the use of alternatives, producers who do not use antimony are allowed to label their products as being antimony-free.

The number of specialist coatings, laminates, finishes and membranes in performance apparel is giving cause for concern

While there are environmental issues relating to the production of these fibres, there are also concerns given the number of specialist coatings, laminates, finishes and membranes in the performance apparel market. Garments which are affected by these issues include those with waterproof, breathable, windproof, anti-microbial or UV-protection finishes. In particular, a proliferation of garments made from textiles which have anti-microbial properties has heightened the debate about the use of biocides.

The industry needs a universal system of standards for consumers and manufacturers

RAISING ENVIRONMENTAL STANDARDS

It is necessary for the industry to have a universal system which:

- enables consumers to identify those products that are environmentally-safe; and
- provides manufacturers with a set of guidelines to which they must adhere.

The EU's Eco-label is available for a range of industries and product categories, including clothing, although it has been criticised

In 1993 the European Union launched the Eco-label. This uses a green flower symbol which is awarded to companies that pass various criteria. The EU's label is available for a wide range of industries and product categories including one specifically for clothing. However, it has been criticised because the process of obtaining the label is long winded, labour intensive, and expensive.

Switzerland-based Oeko-Tex exists specifically for the textile industry

Another organisation, Switzerland-based Oeko-Tex (International Association for Research and Testing in the Field of Textiles Ecology), exists specifically for the textile industry. In the early 1990s it set itself up as an independent certification body to ensure that consumers and manufacturers know that what they are making or buying poses no perceivable health risks.

The Oeko-Tex label is internationally registered

The organisation developed the Oeko-Tex label which is an internationally registered trade mark, and—it is claimed—the most commonly found label of its type. With environmentally-friendly criteria set out for manufacturers to follow, a company may achieve certification stating that its products are “clean” of harmful substances. Such certification is known as Oeko-Tex Standard 100 and is granted in the form of 12 month licences.

Textiles carrying the Oeko-Tex Standard 100 label are guaranteed to conform to certain criteria

Textiles carrying the Oeko-Tex Standard 100 label (see Figure 1) are guaranteed to conform to the following:

- they do not contain allergenic or carcinogenic dyestuffs;
- chlorine-free bleaching techniques have been used in their manufacture;
- they are free from formaldehyde or contain only trace amounts (significantly lower than legal limits);
- a selection of pesticide-free and metal-free materials have been used in their manufacture;
- they have a skin-friendly pH; and
- textiles used in garments are free from biologically active finishes.



Figure 1
Oeko-Tex label

Source: Oeko-Tex

Oeko-Tex has four classes of product—

For certification standards, Oeko-Tex has four classes of product according to their intended use.

—Class I covering goods for babies—

- Class I includes all articles, materials and accessories (with the exception of leather clothing) for babies up to 36 months old.

—Class II covering garments in direct contact with the skin—

- Class II includes garments in direct contact with the skin—defined as those which have a large part of their surface in contact with the body. Examples include shirts and underwear.

—Class III covering products which are not in direct contact with the skin, and—

- Class III includes products which are not in direct contact with the skin—defined as those which may have only a small part of their surface area in direct contact. Examples include stuffings and linings.

—Class IV covering decoration material

- Class IV includes decoration material—defined as all articles including initial products and accessories which are used in decoration. Examples include table cloths, floor coverings,

mattresses and furnishing fabrics.

Oeko-Tex 100 also covers fibres, textiles and accessories As well as finished garments, components such as fibres, yarns, fabrics and accessories may be certified with Oeko-Tex 100.

Oeko-Tex also runs an accreditation system, and has issued 50,000 certificates to around 6,500 companies Oeko-Tex also runs an accreditation system for environmentally-friendly factories, known as Oeko-Tex 1000. Since 1992 Oeko-Tex has issued 50,000 certificates to around 6,500 companies. Almost two-thirds of these companies are based in Europe and many of the remaining third are based in Asia. Moreover, Oeko-Tex reports that interest in certification is growing fastest in Asia.

The organisation has embarked on a campaign to publicise its environmental services to the US market The organisation has recently embarked on a campaign to publicise its environmental services to the US market. These include a seminar for textile manufacturers which was held in New York in November 2005. At the seminar, Patricia Aburdene, the author of *Megatrends 2010*, introduced the term “values-driven consumer” to describe the 63 mn consumers in the USA which she estimates feel strongly about the environment.

Environmental issues will become more important in the USA Ms Aburdene predicts that, over the next few years, environmental issues will become more important in the USA in a way which will be similar to the developments experienced in Europe in the late 1990s.

USA-based outdoor apparel specialist Patagonia is renowned for its dedication to environmental issues **PATAGONIA—AN ENVIRONMENTAL LEADER** Patagonia is a USA-based outdoor apparel specialist. The company, founded by Yvon Chouinard, is renowned for its dedication to environmental issues. In November 2004 *Fortune* magazine named Yvon Chouinard as one of its “innovation entrepreneurs”. Mr Chouinard summarises his philosophy as “earth first, profits second”.

Patagonia is also a founding member of “1% For The Planet” Patagonia is a founding member of “1% For The Planet”—an alliance of companies which contribute 1% of their net annual sales to environmental groups. The alliance was founded in 2001 and now has 235 members.

Mr Chouinard is always looking for eco-friendly ways to make sportswear Mr Chouinard is always looking for eco-friendly ways to make sportswear—for example, by using pesticide-free cotton and using recycled bottles to make jackets.

The most damaging apparel fibre is industrially grown cotton, which has a high concentration of pesticides Patagonia conducted an analysis in the mid-1990s of all the different fibres it used in making apparel. The most damaging was found to be industrially grown cotton, which had a high concentration of pesticides. Indeed, 10% of all agricultural chemicals consumed in the USA are used to produce cotton. Such chemicals include synthetic fertilisers, soil additives, defoliant and pesticides.

In 1996 Patagonia converted its entire sportswear line to 100% organically-grown cotton

In 1996 Patagonia started making its entire sportswear line from 100% organically grown cotton which is cultivated without harmful chemicals. According to Mr Chouinard, moving in this “eco-direction” has made the company more profitable because it has put it in a unique position.

Gap, Nike and Levi Strauss have been influenced by Patagonia’s lead

Other companies have taken notice. Indeed some larger and higher profile companies—such as Gap, Nike and Levi Strauss—have been influenced by Patagonia’s lead.

Patagonia also uses PCR products in its garments

Patagonia also uses post-consumer recycled (PCR) products in its garments.

It was the first to make fleece from PCR plastic bottles

Indeed, in 1993 it was the first outdoor clothing company to make fleece from PCR plastic bottles. In 2006 it began using PCR filament yarn sourced from Teijin.

The company is working to create a fully recyclable garment

PCR filament yarn contains between 30% and 50% post-consumer feedstock—in the form of plastic bottles, polyester uniforms, tents and garments—and post-industrial feedstock from yarn and polymer factory waste products. In fact, Patagonia is working to create a fully recyclable garment but until it achieves this goal it will continue to make clothes out of recyclable materials.

The office buildings themselves are also designed with the environment in mind

The company’s office buildings themselves are also designed with the environment in mind. In 1996 Patagonia built a new service centre using recycled and reclaimed materials as well as energy efficient lighting systems.

Companies are under pressure regarding ethical practices in their manufacturing

THE BIGGER PICTURE

Environmental concerns are just one of a number of key issues affecting apparel companies globally. Many companies are under pressure from consumers, governments and the media on the question of ethical practices in their manufacturing.

Consequently they have been forced to develop and implement sets of ethical standards

These ethical issues include workplace regulations, factory conditions and labour standards. When these have been substandard, they have attracted a lot of negative media attention. As a result companies have been forced to develop and implement sets of ethical standards.

WRAP principles were developed to remove inconsistencies and provide one set of standards

In order to remove inconsistencies which might occur between companies, and to provide one set of standards, the Worldwide Responsible Apparel Production (WRAP) principles were developed in the mid-1990s by the American Apparel Manufacturing Association.

WRAP is an independent, non-profit organisation which promotes and certifies lawful, humane and ethical manufacturing

Today WRAP is an independent, non-profit making organisation which exists for the promotion and certification of lawful, humane and ethical manufacturing. Factories apply (for a fee of US\$825) to go through the certification process which involves self-assessment followed by an independent evaluation when the factory is ready.

Certification is founded on 12 guiding principles which address labour practices, factory conditions, the environment and customs compliance

Certification is founded on 12 guiding principles—under the headings labour practices, factory conditions, environment and customs compliance—namely:

- compliance with workplace laws and regulations;
- prohibition of child labour;
- prohibition of forced labour;
- prohibition of harassment and abuse;
- compensation and benefits;
- hours of work;
- prohibition of discrimination;
- health and safety;
- freedom of association and collective bargaining;
- environment standards;
- customs compliance and;
- security.

Although borne out of the USA, WRAP is becoming globally accepted

Although borne out of the USA, WRAP is becoming globally accepted and has been endorsed by groups representing apparel manufacturers in 18 countries.

Currently there are WRAP monitors in 20 countries who visit factories

Currently, there are WRAP monitors in 20 countries who visit factories and ensure that they are meeting the criteria. Certification is valid for 12 months, during which time a WRAP monitor may revisit the factory unannounced.

WRAP's aims are not to cause undue stress each year but to change mindsets

However, WRAP promotes the line that compliance should not cause undue stress each year—its principles represent a change of mindset rather than a set of criteria which have to be met annually. Much the same can be said for environmental issues.

Product developments and innovations

FABRIC TREATMENTS

A new version of Purista can be applied to synthetics	<p>ARCH CHEMICALS: PURISTA ANTI-MICROBIAL TREATMENT FOR SYNTHETICS</p> <p>USA-based Arch Chemicals—a speciality chemicals company—has developed a version of its branded anti-microbial treatment, Purista, which can be applied to synthetics.</p>
Until now it has been used only on cotton	<p>Since its launch in 2001, Purista has been applied only to cotton. The treatment has been used on items such as socks and suit linings.</p>
But demand has grown for an anti-microbial treatment for synthetic fibre sportswear and activewear	<p>But, with the rise in sportswear and activewear made from synthetic fibres (such as football shirts and fleeces), demand has risen for an anti-microbial treatment which is as effective for garments made from synthetics as for those made from natural fibres.</p>
The Purista treatment for synthetics is an important technical breakthrough	<p>A spokesman from the company describes the Purista treatment for synthetics as an important technical breakthrough. It took the company two years to develop a treatment which could be applied to 100% synthetic fibres or to majority blends which contain a high percentage of polyester or nylon.</p>
It can be applied directly to fabric and used with other finishing treatments and technologies	<p>Unlike some anti-microbial treatments, Purista is applied directly to the fabric. It can also be applied with other finishing treatments such as non-iron and easy-care finishes, and can work alongside other performance technologies such as Coolmax, anti-static and Lycra.</p>

HEALTH PROMOTING APPAREL

DermaSmart provides relief from various skin conditions	<p>MILLIKEN: ANTI-ITCH CLOTHING</p> <p>The USA-based textile and chemical company Milliken has launched DermaSmart—a range of garments designed to provide relief to those suffering from various skin conditions.</p>
It reduces itching, dryness, peeling and scaling	<p>The company claims that DermaSmart reduces itching, dryness, peeling and scaling, which can be associated with skin conditions such as eczema, atopic dermatitis and psoriasis.</p>

The garments are made from lightweight and breathable fabric

DermaSmart garments are made from a silky, soft, jersey knit microfibre polyester which is lightweight and breathable. The fabric reduces friction or drag against the skin, which can lead to irritation in sensitive skins.

DermaSmart contains silver which has anti-microbial properties

The fabric absorbs excess moisture and disperses it so that the garment dries quickly. DermaSmart also contains silver which has anti-microbial properties and prevents the growth of odour-causing bacteria.

Other features such as smooth seams and tagless labels are designed to minimise irritation

DermaSmart garments also have other features which are designed to minimise irritation. These are:

- shirts and trousers which are made with smooth flat seams;
- garments which have tagless size labels; and
- trousers which have covered waistbands.

DermaSmart demonstrates statistically significant improvements in skin conditions and decreased itching

Laboratory tests in 2003 and a clinical study in 2006 have shown that wearing DermaSmart demonstrates statistically significant improvements in skin conditions and decreased itching. As a result, Milliken concludes that DermaSmart is a better choice of fabric than the traditionally recommended 100% cotton, both for comfort and for the relief of symptoms.

PERFORMANCE FOOTWEAR

Under Armour has launched a range of performance footwear

UNDER ARMOUR: PERFORMANCE FOOTWEAR

The USA-based company Under Armour—which specialises in performance apparel with moisture wicking capabilities in particular—has launched a range of performance footwear. It will be available in retail outlets from June 2006.

It will have—

The range will have the following features.

—moisture management and breathability—

- **Moisture management and breathability:** Under Armour HeatGear technology in the uppers and meshes throughout the shoe aids moisture transport and evaporation, thereby keeping feet dry and cool.

—dual plate technology—

- **Dual plate technology:** this is a design which splits the outer sole into two components in order to reduce bulk, minimise weight, and complement the foot's natural motion.

—and progressive traction

- **Progressive traction:** a built-in directional blade positioned on the base of each stud. According to Under Armour, the round portion penetrates the ground and maintains rotational capability, while the blade offers additional directional traction.

The chairman, CEO and president of Under Armour says the footwear is “... a true game changer ...”

Kevin Plank, the chairman, chief executive officer and president of Under Armour, says “these cleats [studs] are a true game changer for the industry. This is technology that does something for you—it makes you [perform] better.”

PERSONAL PROTECTIVE APPAREL

	EXTREME CLOTHING SOLUTIONS: PROTECTIVE UNDERWEAR
Extreme Clothing Solutions plans to produce protective underwear	UK-based Extreme Clothing Solutions is a new company which has been set up in 2006 with plans to focus on producing a range of protective underwear.
It will make thermal and flame retardant undergarments	The company will make thermal and flame retardant undergarments—a sector of the protective clothing market which, it believes, is under-represented. It will also extend its workwear line to protective polo shirts, jackets, fleeces, and trousers.
Two items have met European standards	Two of its items of underwear have met European standard EN 531 for protective clothing.

SMART FABRICS

	IMPACT PROTECTION TEXTILE SYSTEM
Active Protection System hardens on impact	USA-based Dow Corning, a specialist in silicone-based products, has launched Active Protection System—a new, intelligent textile which hardens upon impact.
It is made of a three-dimensional spacer textile treated with a coating	Active Protection System is made of a three-dimensional spacer textile treated with a coating. Under normal conditions the textile is soft and flexible. But upon impact it hardens instantly. The material returns to its soft state once the force of the impact is removed.
It has a number of benefits	The textile has a number of benefits for high performance apparel.
It can be stitched directly into garments—	● It can be stitched directly into garments, in contrast to rigid systems which require the use of removable components.
—it is breathable, flexible and lightweight—	● It is breathable, flexible and lightweight—which means that it is also comfortable and allows freedom of movement.
—it is washable—	● It is washable.
—and it exceeds European Standards	● It exceeds European Standards EN 1621-1:1997 (2 layers) and EN 1621-2:2003 (3 layers) for impact protection requirements of motorcycle clothing.

Dow Corning envisages a range of applications, including fabrics for protective motorcycle apparel

Dow Corning envisages a range of applications in the textile industry for its new material. In the first instance, it will be marketed to manufacturers of protective motorcycle apparel. Beyond that, the company looks forward to interest from other high performance apparel sectors and other markets such as life sciences, civil and military defence, and construction.

Microsoft has chosen Eleksen to design and make peripherals—

ELEKSEN AND MICROSOFT: FABRIC BASED INTERFACES FOR ULTRA-MOBILE COMPUTERS

UK-based smart fabrics company Eleksen has been chosen by software giant Microsoft to design and manufacture the peripherals for a new Ultra-Mobile personal computer.

—using Eleksen’s ElekTex fabric

The peripherals, which will be made using Eleksen’s ElekTex fabric, include a Bluetooth fabric keyboard, a USB (Universal Serial Bus) keyboard and a carrying case with an integrated keyboard and multimedia controls.

ElekTex is a fabric sensor which has no hard components

ElekTex—the company’s core technology—is a fabric sensor which has no hard components. Because it is made entirely from fabrics it is lightweight, flexible, thin, breathable, durable, and semi-transparent.

Peripherals for the Ultra-Mobile market must be portable, compact and lightweight

Peripherals designed for the Ultra-Mobile market must be portable. A single interface made from fabric which doubles as a keyboard and a media player controller confers the benefits of being compact and lightweight.

Eleksen says the deal is the most important commercial milestone for the company since its foundation in 1998

Eleksen considers this deal to be the most important commercial milestone for the company since its foundation in 1998. Commenting on the agreement, the chief executive officer at Eleksen, Robin Shephard, stated: “[This] is an unprecedented opportunity for us to participate in the birth of an entirely new breed of computing and entertainment devices.”

SPORTS APPAREL

Nike’s chlorine resistant swimwear is soft, comfortable and retains its shape

NIKE: SOFT AND COMFORTABLE, CHLORINE RESISTANT SWIMWEAR

Global sportswear giant Nike claims to be the first sports brand to introduce swimwear which is not only chlorine resistant but is also soft, comfortable and able to retain its shape.

The new collection is made using Dow XLA fibres combined with polyamide

The new Nike swimwear collection is made using Dow XLA fibres combined with polyamide (nylon). Dow XLA fibres are resistant to degradation from chemicals such as chlorine. When combined with polyamide, the fabric has a soft and comfortable feel compared with the current chlorine resistant fabrics used in swimwear.

Current professional swimwear is made of PBT which is chlorine resistant, but is not soft and has limited stretch

Professional swimmers currently use swimwear made of polybutylene terephthalate (PBT) which is 100% polyester with no elastane. The lack of elastane means that this swimwear is chlorine resistant and durable but it is not soft and has limited stretch. Elastane provides stretch to fabrics used in non-professional swimwear.

The new swimwear offers both qualities and will be available from August 2006

The new swimwear—which includes styles for men, women and children—appears to offer both chlorine resistance and comfort. It will be available from August 2006.

Adidas-Salomon has launched the first ever modular football boot

ADIDAS-SALOMON: MODULAR FOOTBALL BOOT

Germany-based Adidas-Salomon—the second largest sporting goods company in the world—has launched the first ever modular football boot.

The +F50 Tunit can be customised and adapted

The +F50 Tunit can be customised and adapted to suit the weather, the pitch and the wearer.

It is made from three interchangeable components

It is made from three interchangeable components. Each is available in a variety of styles and functions.

- The upper is available in a range of colours.
- The chassis is lightweight and made with a ClimaCool upper. The type of chassis determines fit and comfort. Players may choose from a Comfort chassis or an Orthopaedic chassis.
- The studs may be adjusted to suit the pitch.

The boots can be “tuned” to personal requirements

A player can choose the various components and “tune” their own footwear to suit their personal requirements.

TEMPERATURE REGULATING MATERIALS

A consortium is employing heat protection technology used in space suits to improve firefighters’ suits

SPACESUIT TECHNOLOGY TO PROTECT WORKERS FROM HEATSTROKE

A consortium of companies is working on a project to develop improved protective suits for firefighters and others working in extremely hot conditions by employing heat protection technology used in space suits.

The consortium originated in ESA’s Technology Transfer Programme and receives EU funding

The consortium originated in the Technology Transfer Programme of the European Space Agency (ESA) and consists of six small and medium-sized enterprises from Italy, Belgium and Poland in cooperation with Italy-based Grado Zero Space and CIOP-PIB. It is coordinated by Italy-based D’Appolonia and receives funding from the European Union.

The project, known as Safe&Cool, aims to develop a protective material with a built-in cooling system

Space suits are designed to protect astronauts from overheating when carrying out space walks in direct sunlight. One aim of the Safe&Cool project is to develop a protective material with a built-in cooling system similar to that used in the space suits.

Existing protective clothing can hinder a worker's ability to stay cool, resulting in heatstroke—

According to the research team, existing protective clothing can in many cases hinder a worker's ability to stay cool. In Europe, there are over 1,500 cases of heatstroke each year as a result of workers being unable to shed excess heat and moisture through clothing.

—and heat stress

Another more common, but less serious, problem is heat stress, which affects around 50,000 workers each year and may increase the risk of injury due to loss of concentration.

The objective is to develop a high quality thermal and moisture management layer using three technologies—

The objective for Safe&Cool is to develop a high quality thermal and moisture management layer based on a three-dimensional warp-knitted fabric coated with a water binding polymer. Its structure will mimic the physical mechanisms for thermoregulation in the human body. To achieve this, the consortium will use three technologies.

—a three-dimensional textile structure for the thermal and moisture management layer—

- First, a three-dimensional textile structure is used for the thermal and moisture management layer. The materials in this layer will be a combination of hydrophobic thermal comfort fibres and hydrophilic fibres. These ensure that the body feels dry as moisture is transported away from the skin.

—the cooling apparatus based on that designed for space suits and—

- Second, a cooling apparatus is used, based on that designed for space suits. It consists of tubing inserted into cavities in the three-dimensional textile structure. The tubes have liquid circulating through them and remove heat in a similar manner to blood vessels in the body (see Figure 1).



Figure 1
Cooling tubes woven into the textile

Source: Safe&Cool Project Consortium

—a water-binding polymer which absorbs excess moisture migrating through the semi-permeable membrane to maintain the temperature below a given threshold

- Third, a water-binding polymer is applied as a coating or in powder form dispersed inside the fabrics. It absorbs excess moisture migrating through the semi-permeable membrane to maintain the temperature below a threshold controlled by the cooling apparatus.

If a sudden increase in temperature occurs and the cooling system cannot remove heat fast enough from the body, the polymer will release the liquid accumulated and reproduce the natural sweating

process through evaporative cooling.

Other applications include sportswear and passenger seats in vehicles Besides its function for workers in extremely hot conditions, other applications have been identified for this technology. These include its use in sportswear and in passenger seats in vehicles.

WATERPROOF BREATHABLE TECHNOLOGY

Breathable Storm Denim is a breathable water repellent finish which protects against cold and damp **COTTON INCORPORATED: WATER REPELLENT DENIM** USA-based Cotton Incorporated, a research and marketing organisation funded by the US cotton industry, has launched Storm Denim—a water repellent denim finish which provides protection from the cold and damp while remaining breathable.

Because it is applied to made-up garments, almost any denim finish can accept the technology Unlike previous water-repellent denim finishes which were applied to the fabric, Storm Denim is applied to made-up garments. According to Cotton Incorporated, this means that almost any denim can accept the technology, regardless of any finish which has been applied to it.

Garments treated with Storm Denim provide more breathability and durability than synthetics Garments treated with the Storm Denim finish compare well with those made from synthetics in terms of water repellency, and are better in terms of breathability. Interestingly, the finish also provides more durability when tested against unfinished denim.

Denim accounts for nearly one-third of the US apparel market Cotton Incorporated considers the potential for this product to be good. Denim accounts for nearly one-third of the US apparel market, and jeans account for 80% of this one-third.

WEARABLE TECHNOLOGY

Maier's prototype ski jacket can generate 2.5 watts of solar generated power— **MAIER SPORTS: SOLAR POWERED SKI JACKET** Germany-based Maier Sports, an outdoor sports apparel company, has produced a prototype ski jacket which is capable of generating up to 2.5 watts of solar generated power.

—using flexible solar cells in exposed areas on the jacket The power is generated by flexible solar cells or “photovoltaic elements” which are positioned in exposed areas such as the shoulders and the back of the jacket.

The current is carried via washable ultra-thin micro-cables sewn into the jacket The electrical current generated is carried via washable ultra-thin micro-cables which are sewn into the jacket. The cables carry the current to a universal point where electronic devices such as MP3 players, mobile phones or batteries can be charged.

Maier worked with partners from the Solartex project

In developing this jacket, Maier worked with partners from the Solartex project which was set up and funded by the state of Baden-Württemberg in Germany.

Because they are thin and flexible, the solar cells are comfortable for the wearer

The project partners used a flexible solar cell which is made of amorphous silicon and is just 0.5 mm thick. Because they are so thin and flexible, the solar cells are comfortable for the wearer.

Seamless knitting and stitch-free seaming technologies in performance apparel

SUMMARY

Apparel with a seamless appearance is gaining in popularity. The benefits—greater comfort and durability, combined with reduced bulk—are finding favour in different sectors of the apparel market, including performance apparel. In the performance apparel sector there are two main reasons for the growing popularity of garments with a seamless appearance. One is that close fitting active wear—such as running or cycling apparel—needs to feel as smooth as possible when worn next to the skin in order to minimise the possibility of chafing. The other reason is that technical outerwear is becoming less bulky and more form-fitting while retaining the latest advances in waterproof and breathable capability.

Apparel which has a seamless appearance is produced using two different approaches: seamless knitting, and welding. Seamless knitting involves the production of a whole garment in one piece on a knitting machine such that little or no sewing-up is required. Welding involves the fusing together of layers of fabric by applying heat and pressure—using technologies such as ultrasonic heating or high frequency radiation. In addition, thermoplastic films or tapes—which are sometimes referred to as adhesive films—are commonly used to reinforce the weld or to bond non-thermoplastic materials such as cotton.

Using seamless knitting or welding, a garment without any stitched seams can be made. Some commentators are going so far as to predict the gradual demise of the needle and thread. But seamless and stitch-free seaming technologies still have some way to go in terms of capability, quality control and market penetration before they replace sewing.

INTRODUCTION

The apparel sector is seeking to remove bulky sewn seams from garments—

The apparel industry is working to find ways of making garments without the bulky sewn seams which have characterised traditional assembly techniques.

—through seamless knitting and stitch-free seams using welding	In doing so, it is adopting a two-pronged approach involving: <ul style="list-style-type: none"> ● seamless knitting; and ● stitch-free seams using welding.
Seamless garments have no seams while welded seams give a seamless appearance	Seamless knitting results in garments which have no seams at all. Welding results in garments which do have seams, but which nonetheless have a seamless appearance.
Seamless knitted garments require minimal or no sewing for completion	Seamless knitting uses a form of circular knitting process. This results in a garment which has no side seams, and which requires minimal or no sewing to complete its make-up.
Garments can be produced faster because cutting and sewing are reduced	Seamless knitting enables complete garments to be produced more quickly than when using traditional methods because a smaller amount of labour intensive cutting and sewing is required.
Special knitting machines are pre-programmed to produce an entire garment	Seamless knitted garments are made using purpose-built computer controlled knitting machines which are pre-programmed to produce an entire garment.
Several patterns can be combined in a garment	Using this technique, it is possible to combine a variety of patterns within one garment.
In welding, fabrics are bonded without sewing	Using welding techniques, the fabric panels are made first and then bonded or fixed together without the need for sewing.
Welding techniques include ultrasonic heating and high frequency radiation	Welding requires the application of heat and pressure using a heated roller, a heated mould, hot air, ultrasonic heating or high frequency radiation.
A thermoplastic material is required, which can be part of the fabric, its coating, or a tape or film	The use of ultrasonic heating or high frequency radiation requires the presence of a thermoplastic material to form the bond. The thermoplastic material can be either a constituent of the fabric itself or a fabric coating, or it could be in the form of a tape or film ¹ .
Heat and pressure are used to melt it and form a bond	To form a bond between the fabric layers, the thermoplastic material is melted by subjecting it to heat and pressure.
Ultrasonic heating involves mechanically generating heat while high frequency radiation uses dielectric heating via electrodes	Ultrasonic heating involves the mechanical generation of heat through the vibration of an ultrasonic head. High frequency radiation uses electrodes to raise the temperature by means of dielectric heating (see page 18).

¹ Commercially, the term “adhesive film” is often used to describe thermoplastic films or tapes although, strictly speaking, these are not true adhesives.

Seamless knitting and welding are favoured in underwear, performance wear and now fashion and lifestyle garments

Seamless knitting and welding technologies have found particular favour in the underwear and performance wear markets. Indeed it was in hosiery and underwear manufacture that these methods were first employed. They were then used in sportswear and technical outerwear, and are now penetrating markets for fashion and lifestyle garments.

The spread of these technologies is “revolutionary” although few garments have no sewn seams at all

The spread of seamless and welding technologies is heralded by the industry as nothing short of a revolution. Many garments now make use of these technologies, although only a relatively small percentage have no sewn seams at all.

Seamless and welded garment constructions have grown phenomenally in the last five years—

Seamless and welded garment constructions have grown phenomenally in the last five years as manufacturers, retailers and consumers learn about the benefits. One estimate puts the average annual growth of the seamless performance apparel market at 112% between 2000 and 2005.

—driven by consumer demand for comfort, a sleek appearance and a good fit

Growth is being driven by increasing demand from consumers who want garments which are more comfortable, and which have a sleek appearance and a good fit.

Traditional needle and thread sewn seams may even become a minority

If such technologies continue to develop at their current pace, traditional needle and thread sewn seams may even become a minority.

Patagonia makes soft and hard shell jackets using its own trademarked welding system

The founder of the USA-based company Patagonia, Yvon Chouinard, thinks that the sewing machine may even become a “dinosaur” as seamless technology and stitch-free seams become more popular. Patagonia produces soft and hard shell jackets using its own trademarked welding system (see page 30).

Others too see such technology as offering benefits and sales potential

However, Patagonia is not alone. A growing number of outerwear and other garment manufacturers are adding this technology to their repertoire as they too see its benefits and the potential for more sales.

In spite of their higher costs, producers and retailers favour seamless garments and those with welded seams

At retail, welded garments typically cost about 10% more than their equivalents made with traditional stitched seams. Nonetheless, manufacturers and retailers alike are turning to garments made with welded seams and seamless knitting techniques.

Apparel with a seamless appearance feels smooth when worn next to the skin, has a slimmer profile, and chafes less

Benefits of using seamless knitting and welded seams

The use of seamless knitting and welding eliminates the need for sewn bulky seams. The result is apparel with a seamless appearance which feels smooth when worn next to the skin. Also, garments made using these methods have a slimmer profile. The absence of bulky seams means that garments are more comfortable because there is less chafing or rubbing against the body.

Welding is often used for aesthetic reasons, but it also leads to weight reduction as there is less overlapping material and no seam sewing thread

Welding is often used for aesthetic reasons, but it is also beneficial for technical reasons. For example, it can reduce the weight of an item, and it is claimed that garments made with welded seams are up to 15% lighter in weight than their sewn equivalents. The basis for such claims is that there is less overlapping material and no seam sewing thread in a welded seam. However, the extent of the weight saving does depend upon the type of sewn seam to which the welded seam is being compared.

Welding can also improve a garment's waterproof capability and breathability

Manufacturers also claim that welding can improve the waterproof capability of a garment by eliminating overlapping layers of fabric. But, again, these claims depend on the type of sewn seam to which the welded seam is being compared.

Welding and seamless knitting can shorten the time taken to produce garments and reduce fabric waste

From a manufacturing perspective, welding and seamless knitting can shorten the time taken to produce garments and reduce fabric waste. Being able to weld several components together in one step means that less labour is required. Fewer steps are required to make a bonded garment and fewer components are needed to construct some garments.

Seamless knitted garments take 30-40% less time to make, which also reduces lead times for new products

Seamless knitted garments take about 30-40% less time to make than cut and sew articles. A whole garment such as a small sweater can be produced in about 20 minutes. This also helps to reduce lead times for new product development as the time taken to produce samples is reduced.

One challenge lies in quality control as there are fewer stages and hence fewer opportunities for quality checks

One of the perceived challenges of seamless knitting lies in quality control. The manufacture of garments with seams involves far more stages, and each stage provides an opportunity for quality to be checked. But with seamless garments there are fewer production stages and hence fewer opportunities for quality checks.

Faulty panels can not be replaced so any fault in a seamless garment means the whole garment is faulty

For example, faulty panels in a seamless garment can not be discarded and replaced. Thus the presence of any fault in a seamless garment means that the whole garment is faulty. The presence of faults in seamless garments therefore has expensive consequences, and manufacturers must work hard at avoiding faults during knitting.

Another benefit is that different yarns can be combined in different sections

A further benefit of seamless knitting is that it allows manufacturers to combine different yarns in different sections of a garment to provide different features. It is also possible to use different techniques alongside each other.

Manufacturers say welded seams are just as strong as sewn seams

As far as strength is concerned, manufacturers claim that welded seams can be just as strong as sewn seams. In tensile strength tests, the fabric should break before the welded seam does².

² Sewn seams can be engineered so that the fabric breaks before the seam does. By using twin-needle stitching, it is possible to spread the loads and further increase strength. Welded seams too can be engineered to be as strong as the fabric. Above all, the seam construction needs to be engineered to achieve the desired strength.

Seamless knitting and welding can be used complementarily, even though the technologies differ While the two technologies of seamless knitting and welding are quite different, they can nonetheless be used complementarily. Garments made on seamless knitting machines can be finished using welding to produce an item with no stitching or needle holes.

DEVELOPMENT OF SEAMLESS KNITTING AND STITCH-FREE SEAMING TECHNOLOGIES

Uses have grown from intimate apparel to performance apparel and sportswear Seamless knitting and stitch-free seaming technologies were first used in intimate apparel. Today they are also used in performance apparel and sportswear.

The techniques are seen as an added-value feature Companies are now promoting the technologies as an added-value feature.

Seamless knitting grew out of V-bed in the 1970s The forerunner of the seamless knitting machine was borne out of V-bed knitting in the 1970s.

A key development was the invention of presser foot knitting, which was launched in 1975 A key development was the invention of presser foot technology, which was launched in 1975. This facilitates tension-free knitting instead of traditional take-down knitting, where tension is maintained.

The first commercial whole garment knitting machine came on to the market in 1995 from Shima Seiki At first the technology was used to produce novel stitches and knitted motifs. By 1980 it was capable of producing prototype whole garments. However, these garments proved to be too plain to catch on commercially. The first commercial whole garment knitting machine was launched in 1995 by the Japanese company Shima Seiki.

Welded tapes started to be used more widely following major developments in the 1990s Although welded tapes were first used in garment construction prior to the 1990s, the applications for such tapes were at that time specialised. Welded tapes started to be used more widely following significant developments in the 1990s.

Welded seams first appeared in intimate apparel, notably bras Welded seams first appeared in intimate apparel as a means of bonding fabrics over elastics in bras and to keep seams as flat as possible for a smooth appearance.

Success caught the attention of outerwear makers, and welding technology is now used to incorporate pockets, zips, pleats and hems Success in intimate apparel caught the attention of outerwear manufacturers. The benefits of weight reduction, a slim profile, and increased water resistance appealed to them.

Welding technology is now used to incorporate pockets, zips, pleats and hems without the need for cut and sew methods.

In the outdoor technical wear market, welded seams in waterproof garments avoided needle holes which can let water in

Within the outdoor technical wear market, welded seam technologies were applied to waterproof garments to avoid the problems caused when needle holes resulting from stitching let water in. Bemis and Arc'Teryx claim to have pioneered the use of taped seams in outerwear in 1998. In 2004 Australia-based surfwear company Rip Curl launched Rip Curl STL (stitch-free) boardshorts on to the market. Burton Snowboards and O'Neill introduced welded garments for the winter 2004/2005 season.

The concept is now spreading to form-fitting and performance apparel

The concept of welded seams and their seamless appearance is now permeating all types of form-fitting and performance apparel. The USA-based company Gap, for example, now sells seamless T-shirts.

Outdoor specialists such as Patagonia are keen to explore their own stitch-free and seamless technologies

Other outdoor apparel specialists have also been keen to explore stitch-free and seamless technologies. In 2005 USA-based outerwear specialist Patagonia launched a range of garments branded Element. This features the company's own stitch-free technology, which it calls Composite Seam System.

Helly Hansen has Sonic Seam Technology (SST)

Helly Hansen—a Norway-based outerwear company—also has its own stitch-free system, called Sonic Seam Technology (SST). The company claims that the SST process ensures that its garments are waterproof because it eliminates the pinholes which are made by traditional stitching. SST is used in the company's Virtue jacket.

By 2003 seamless garments accounted for 18% of global underwear sales, up from 2% in 1998

Over the last five years, seamless garments have become far more widespread. According to Santoni, an Italian manufacturer of seamless knitting machines with a huge market share, in 1998 just 2% of global production of underwear was seamless. By 2001 this share had risen to 9%, and by 2003 it had grown to 18%.

By 2007 this share is likely to reach 35%

The company's forecast for 2007 is that seamless underwear will account for 35% of the total market.

Penetration is lower for sportswear and performance wear but is growing

Market penetration is not as high for sportswear and performance wear as yet. Nonetheless, seamless and stitch-free sportswear and performance wear represent an important and growing market.

STITCH-FREE SEAMING METHODS AND SEAMLESS KNITTING

Stitch-free garment construction by welding two fabrics together can be divided into three categories according to the process or equipment used

WELDED JOINING TECHNOLOGIES

Methods of constructing stitch-free garments by welding fabrics together is referred to in a number of ways, according to the process or equipment used.

Generally, the most commonly used technologies are:

- welding using a thermoplastic film;
- welding by ultrasonic heating; and
- welding by high frequency radiation.

All require energy to activate and create a bond between the two fabrics

Regardless of the technology used, joining technologies have one thing in common—energy is required to activate and create a bond between the two fabrics.

Welding using a thermoplastic film employs the melting and adhesive properties of the film

Welding by using a thermoplastic film—a process frequently referred to as welding by adhesive or thermoplastic adhesive—utilises the melting and adhesive properties of the film to bond two fabrics together.

It may also be used to supplement other methods if insufficient thermoplastic is present

This method may also be used in addition to welding using ultrasonic heating or welding using high frequency radiation if there is insufficient thermoplastic material present in the fabrics to be welded.

The polyurethane coating of some performance fabrics aids welding

Some performance apparel fabrics are made with a polyurethane coating which provides sufficient thermoplastic material for welding to be effective.

WELDING USING A THERMOPLASTIC FILM

Welding with a thermoplastic film involves melting the film by applying heat and pressure so that the fabric is penetrated and a bond created

Welding with thermoplastic films uses a combination of chemical and mechanical bonding. Heat and pressure are applied to a film to activate it. The film melts in response to the right temperature or pressure and the molten substance subsequently penetrates the fabric. Penetration helps to create a bond between the melted film and the fibres.

The films may be called adhesive films although they are not true adhesives

Welding with thermoplastic films is also commonly referred to as welding using adhesive tapes or adhesive films—although, by definition, such films are not true adhesives.

Seam bonding can be performed using a specially adapted sewing machine

Seam bonding can be performed by using a specially adapted sewing machine. In fact it is possible to adapt almost any type of sewing machine with seam bonding equipment.

Thermoplastic tape is fed between two layers of fabric and a heated foot applies heat and pressure to melt the film

Once the sewing machine has been adapted, fabric is fed into it and folded to make the seam. Thermoplastic tape is fed between the two layers of fabric to be bonded. A heated foot (platen) applies the necessary heat and pressure to melt the film. A good bond is created if the thermoplastic film has penetrated both fabrics.

Each type of film has specific properties, including—

Each type of thermoplastic film has a specific combination of properties, and the choice of film depends on the combination required for the fabric being used. The properties are detailed below.

—the polymer from which it is made—

- One property is the polymer from which the film is made. The correct polymer must be selected to achieve a good bond. Typical

polymer types include polyurethane, polyester, nylon and polyolefin.

—the thickness or gauge—

- A second property is the thickness or gauge of the film, which helps to determine its weight. Heavier fabrics require a thicker film for optimum bonding while lighter weight fabrics require a thinner film.

—the film’s softening point, at which it begins to melt and flow—

- A third property is the film’s softening point—or the temperature at which it begins to melt and flow. As a general rule, the minimum set temperature to activate a thermoplastic film is 15°C above its softening point. Importantly, the film should have a lower melting temperature than the fabrics being bonded.

—and the melt flow index, indicating how an adhesive flows once it has melted

- A fourth property is the melt flow index. This is an indication of how the thermoplastic flows once it has melted. A thermoplastic with a high melt flow index will flow rapidly after melting (similar to water) whereas one with a low melt flow index will flow more slowly (more like honey). High melt flow thermoplastics penetrate more quickly into fabrics than do low melt flow thermoplastics, resulting in a better mechanical bond.

A heat seal press may be used

In order to activate thermoplastic films, a heat seal press may be used.

During production three key factors must be met precisely and monitored—

During the production process, three key factors must be met precisely and monitored to ensure a strong and durable bond: heat, pressure and time.

—heat—

- **Heat:** during production the critical temperature is the glue line temperature (GLT)—which is the temperature at the interface between the two fabrics.

—pressure—

- **Pressure:** this is usually applied by a pneumatic cylinder.

—and time

- **Time:** for the thermoplastic to melt and flow into a fabric adequately, heat and pressure need to be applied for a precise amount of time.

Ultrasonic welding involves channelling high frequency vibratory waves to build up heat in fibres

WELDING BY ULTRASONIC HEATING

Ultrasonic welding involves channelling high frequency vibratory waves (typically 20 KHz or more) so that they cause a rapid build-up of heat in synthetic fabrics. The heat can be used to weld or cut the fabrics.

It is fast, accurate and fabrics stay soft and breathable

Proponents claim that ultrasonic welding is fast, accurate and efficient. Also, fabrics retain their softness and breathability.

Ultrasonic welding can be used on nylon—

Ultrasonic welding can be used to cut or weld materials such as:

- nylon;

—polyester, polyethylene, polypropylene, urethanes and PVC

- polyester;
- polyethylene;
- polypropylene;
- urethanes; and
- polyvinylchloride (PVC).

At least 60% of the material must be thermoplastic, although thermoplastic tape or film can be used

Normally, at least 60% of the material to be ultrasonically welded must consist of thermoplastic materials. If not, seams produced using ultrasonic welding have to be reinforced with thermoplastic tape or film.

Some use tape or film to ensure seam integrity

However, some manufacturers use thermoplastic tape or film in any event during ultrasonic heating in order to ensure seam integrity.

Welding takes place as a result of the high frequency mechanical motion of a vibrating horn and compression between it and a drum

Materials are placed between a vibrating horn and a rotary drum which has a pattern of raised areas. Welding takes place as a result of the high frequency mechanical motion of the vibrating horn and compression between the horn and the drum. This action creates frictional heat at the point where the horn is in contact with the materials.

WELDING BY HIGH FREQUENCY RADIATION

Welding by high frequency radiation uses electrodes to raise the temperature by dielectric heating

Welding by high frequency radiation uses electrodes to raise the temperature by dielectric heating. Dielectric heating is the heating of an insulator—in this context the insulator is the fabric or the thermoplastic film—by a high frequency electric field. Such welding uses a frequency of 27.12 MHz.

But not all materials can be heated in this way

Not all materials can be heated in this way, however. The process relies on certain properties of the fabrics which cause the generation of heat in a rapidly alternating electric field.

The electricity causes molecules in dipolar materials to oscillate

The electricity causes the molecules in dipolar materials, such as some thermoplastics, to oscillate. This oscillation may then be converted into heat, which facilitates the welding of the materials.

PVC and polyurethanes are the best

Materials such as polyvinylchloride (PVC) and polyurethanes are the best types for this technique.

Other terms are dielectric or radio frequency welding

High frequency welding is also known as dielectric welding, or radio frequency welding.

SEAMLESS KNITTING

Seamless knitting enables garments to be made with no or minimal sewing-up

Overall, seamless knitting is an important development in and for the knitting industry. It provides the wherewithal to manufacture whole garments with no, or minimal, sewing-up.

This facilitates cost savings and faster production

This means that cost savings and time savings can be made. Also, because of the time savings, production is quicker than traditional manufacturing (Table 1).

Table 1: Potential benefits of seamless knitting

Minimising or eliminating labour intensive cutting and sewing processes
 Savings in production times and costs
 Minimal yarn consumption
 Higher productivity
 Multi-gauge knitting
 Lightness and softness
 No bulky and irritating stitches and seams
 More constant product quality
 Better trimmability for finished edge lines
 Better look, better fit and greater comfort
 More creative possibilities for knitwear designers
 Quick response production for size and pattern changes
 Just-in time production
 Mass customisation

Source: *Journal of Textile and Apparel Technology and Management*, Volume 4, Issue 3, Spring 2005.

Seamless knitting is used for underwear, lingerie, nightwear and sportswear

Seamless knitting is used to produce underwear, lingerie, nightwear and sportswear. The biggest sector for seamless knitting is the lingerie market.

A complete garment can be produced on two types of knitting machines

A complete garment can be produced on two types of knitting machine:

- seamless circular knitting machines; and
- seamless flat V-bed knitting machines.

Seamless circular machines create a single tubular garment whereas V-bed machines can make multiple tubular pieces at the same time and then join them together

The difference between the two types of machine is that seamless circular machines can be used to create a single tubular garment whereas V-bed machines are able to produce multiple garment panels and tubular pieces at the same time and then knit them together on the machine.

Complete garments produced on circular machines are therefore not strictly seamless because they require some sewing-up.

Santoni is the largest producer of seamless circular knitting machines

Companies which produce knitting machines for seamless knitting include the Italy-based companies Santoni and Sangiacomo. Santoni is the largest producer of seamless circular knitting machines.

Shima Seiki and Stoll produce machines allowing different patterns to be combined in one garment

Companies which produce whole garment knitting machines include Japan-based Shima Seiki and Germany-based Stoll. Both of these companies' machines allow different patterns to be combined in one garment. An example might be a jersey knit next to a mesh knit, next to a rib knit.

The range of end uses has expanded from lingerie to include gloves, sweaters, dresses, trousers and skirts

When seamless knitting was introduced by Shima Seiki in 1995, its applications were confined to the lingerie sector. Since then, the range of end uses has broadened out to include the production of gloves and sweaters, as well as dresses, trousers and skirts.

By 2007 Santoni estimates that seamless underwear will account for 35% of the total market

In terms of market penetration, seamless knitting technology was estimated to be used by just 1% of underwear manufacturers globally in 1997. But by 2007, Santoni estimates, seamless underwear will account for as much as 35% of the total underwear market.

Polyamide microfibrils are the most common yarns in seamless knitting and offer a number of benefits

YARNS FOR SEAMLESS KNITTING

The most commonly used yarns in seamless knitting are polyamide microfibrils. These high performance fibres result in garments which are breathable, quick drying, and durable through multiple home wash cycles.

Nylstar produces a range of high performance microfibrils developed for seamless knitting

Italy-based Nylstar produces a range of high performance microfibrils which it has developed for seamless knitting (Table 2).

Table 2: Nylstar yarns for seamless knitting

Yarn	Properties
Meryl Skinlife	Has a bacteriostatic action which prevents unpleasant odours. Suitable for sportswear
Meryl Nateo	Has the appearance of a natural fibre but with a higher capacity to absorb perspiration and the ability to dry out four times more quickly than cotton. Good for activewear and bodywear
Meryl Nexten	Ultra-light due to its hollow core. Provides weather protection and temperature regulation. Ideal for use in sports wear and outdoor protective wear
Meryl Satiné	Similar to silk but also highly resistant to pilling
Meryl UV protection	Provides protection from the sun. Is twice as strong as cotton but has the same soft hand
Elité	A fibre which distributes elasticity evenly throughout the garment, thereby providing a comfortable fit

Source: Nylstar.

THE MARKET FOR SEAMLESS AND STITCH-FREE APPAREL

Welding technology facilitates the creation of more durable, but lighter weight products for the performance outerwear market

“The biggest quest in the performance outerwear market is to create more durable, but lighter weight product. [Welding technology] allows us to do that. It reduces layers of fabric in the seam, lowering weight and height, which leads to less abrasion. Plus it’s durable, it has good flow at a low temperature and it has excellent stretch and recovery”, explained a designer at The North Face.

But seamless and welding technology can help in many other sectors

However, it is not only in performance outerwear where improvements in fit and comfort are being sought. Today’s tighter clothes and stretch fabrics mean that seamless and welding technology can help in many

sectors such as underwear and sportswear.

A host of leading performance apparel brands are using the technology

A host of leading brands in the performance apparel market use seamless or welding technology in their product ranges. These include Adidas, Arc'Teryx, Fila, Helly Hansen, Nike, O'Neill and Patagonia.

The market for seamless compression apparel is worth around US\$1 bn

Currently, the global market for seamless compression apparel—a type of apparel made by seamless knitting—is estimated to be worth around US\$1 bn. This includes performance apparel and lingerie.

Stitch-free performance apparel, including welding technologies, will be worth US\$200 mn in 2006

The global market for stitch-free performance apparel—including both knitting and welding technologies—will be worth US\$200 mn in 2006, according to the Israel-based seamless apparel company Zensah Performance Apparel (see page 34).

Stitch-free performance apparel will grow by 60%-80% over the next five years as prices drop

Ryan Oliver of Zensah expects the market for stitch-free performance apparel—including knitting and welding technologies—to grow by 60% to 80% over the next five years as prices drop and there is more consumer awareness of the benefits.

But seamless knitting alone for performance apparel will grow by a lesser 25% to 35%

However, the market for seamless knitting alone for performance apparel is predicted to grow by a lesser 25% to 35% over the next five years because it is a more mature market than that for stitch-free seamed performance apparel.

Growth will be driven by organic growth and gains from cut and sew

Growth in performance apparel made without stitched seams is expected to be driven partly by organic growth but also by the gaining of market share from the conventional cut and sew market.

KEY PRODUCERS

Key producers include firms specialising in adhesives, thermoplastic films and tapes, seamless knitting machine manufacturers and those making finished garments

Key producers within the seamless knitting and welding market include:

- companies which specialise in the production of adhesives and thermoplastic films and tapes used in bonding;
- manufacturers of seamless knitting machines; and
- a wide range of companies which produce finished garments.

Bemis makes a range of thermoplastic films designed to replace stitched seams in outerwear and other apparel

BEMIS

USA-based Bemis produces a range of thermoplastic adhesive films specifically designed to replace stitched seams in outerwear and other apparel. Its products can be used not only for seams in garments but also for inserting and creating zips, pockets, cuffs, hems and draw-string channels.

Products are lighter, washable and dry clean resistant, and retain a soft hand	Garments made with the company's films are lighter in weight than stitched garments, are washable and dry clean resistant, and retain a soft hand.
Bonded seams do not need to be colour matched	Bonded seams do not need to be colour matched, unlike conventional sewing thread. One batch of film may be used on a variety of colours.
Sewfree, made of elastic polyurethane, can join almost any combination of fabrics together—	In 2002 Bemis launched Sewfree elastic polyurethane, which is designed specifically for stitch-free bonded garments. Sewfree can be used to join almost any combination of fabrics together, including cotton, nylon, polyester and polyester/cotton blends.
—including those coated with polyurethane, vinyl or durable water repellent (DWR) coatings	It is also able to weld fabrics which have been coated with polyurethane, vinyl or durable water repellent (DWR) coatings. (See pages 38-47 for a full profile of Bemis and its products.)
Italy-based Cifra is well known in the hosiery market although it also makes swimwear, sportswear and lingerie	CIFRA Italy-based Cifra is a leading company in seamless garment knitting. It is especially well known in the hosiery market and manufactures products for a variety of well known brands, including Sara Lee and Marks & Spencer. Cifra also produces swimwear, sportswear and lingerie.
In swimwear it uses a warp knitting seamless technique which makes the garments ladderproof	For swimwear it uses a WKS (warp knitting seamless) technique which makes the garments ladderproof. This, it claims, is an advantage over garments made using circular knitting machines which are not ladderproof.
Helly Hansen was established in 1877 by a Norwegian fisherman who set out to find better rainwear	HELLY HANSEN Helly Hansen—a Norway-based outerwear company—is one of the oldest performance outerwear specialist companies. Helly Hansen was a Norwegian fisherman who established the company in 1877. Mr Hansen was dissatisfied with the garments of the day and set out to find better rainwear for his fellow fishermen.
It makes high quality technical apparel	The company produces a range of high quality technical apparel for work, sports and survival.
Its Sonic Seam Technology bonds all seams with high frequency sound waves and forms a waterproof seal	It has developed its own stitch-free system called Sonic Seam Technology (SST) which, it claims, ensures that its garments are waterproof. In common with other welded technologies SST eliminates pinholes made by traditional stitching. The technology bonds all seams with high frequency sound waves to form a waterproof seal.
SST was used in the fully welded Virtue jacket for winter 2005, which had no stitched seams	SST was used in Helly Hansen's Virtue jacket which was produced for the 2005 winter season. The Virtue jacket was fully welded, and had no stitched seams.



Figure 1
Helly Hansen Virtue jacket

Source: Helly Hansen

Now the company is planning to use SST in other garments for other seasons

Now the company is planning to use SST in other garments for other seasons. One such example is new a new swimming trunk, RFT, for men. The garment is completely stitch-free, which makes it lighter and more comfortable.

Memteks is Turkey's first manufacturer of seamless intimate apparel

MEMTEKS

Istanbul-based Memteks claims to have been Turkey's first manufacturer of seamless intimate apparel. It was founded in 1996 and exports mostly to Europe and the USA. Its biggest market is Germany but expansion in the USA may change this.

It uses Sangiacomo seamless knitting machines to produce collections and private label garments

Memteks uses Sangiacomo seamless knitting machines to produce collections and private label garments for customers. Products include intimate apparel, swimwear, active wear, maternity wear and yoga wear. Garments include bras, T-shirts, athletic briefs and shorts.

"Dry & Seamless" performance garments reduce chafing and pressure marks, and keep the wearer feeling cool and dry

One of the company's product lines is called "Dry & Seamless". This is a range of advanced, seamless performance garments which reduce chafing, cause fewer pressure marks, and keep the wearer feeling cool and dry. The garments are made from a fabric which wicks perspiration away from the skin to the outside of the garment where it evaporates more effectively.

Patagonia, a specialist in outdoor apparel and accessories, has embraced welding technology

PATAGONIA

USA-based Patagonia, founded in 1964, specialises in outdoor apparel and accessories. It is one of a number of outdoor apparel companies which has embraced welding technology as a way of improving its garments.

Its own Composite Seam System (CSS) technique is used to sonically weld laser cut panels for its soft and hard shells

Patagonia developed its own technique called Composite Seam System (CSS), which is used in its soft and hard shells. The aim was to remove stitched seams which were more bulky and stiffer than the lightweight fabrics used in the company's garments. For CSS, fabric pieces are laser cut and welded sonically.

CSS eliminates seam tape and thread crown abrasion, and leaky needle holes

Stitch-free seams made using CSS are also claimed to improve a garment's performance by eliminating seam tape and thread crown abrasion and the needle hole—an area of potential leakage.

In soft shells, CSS uses a strong adhesive to create a seam of two overlapping fabrics

In soft shells, CSS uses a strong adhesive to create a seam of two overlapping fabrics. The narrow seam reduces fabric bulk and is softer than would be the case using traditional sewn seams. It is also claimed that it improves water resistance because there are no needle holes—in effect the seam is as waterproof as the fabric.

CSS offers reduced bulk, a softer hand and more compressible garment, improved water resistance, and quick drying

The benefits of CSS are reduced bulk and a softer hand which mean the garment is more compressible. Water resistance is improved by the removal of thread—which can act like a wick—and the elimination of needle holes which can allow water to collect in the seam. According to Patagonia, soft shells made with CSS dry three to four times more quickly than those made with stitched seams.

In hard shells, CSS uses closely butted seams which are sonically welded

In hard shells, CSS uses closely butted (non-overlapping) seams which are sonically welded precisely enough to use lighter and narrower reinforcement tape to lock the seam.

The CSS hard shells are claimed to be 27% lighter

Patagonia's CSS hard shells are claimed to be 27% lighter than those made using conventional cut and sew methods.

From autumn 2006 CSS will be known as Welded Seam Technology

In autumn 2006, Patagonia is renaming CSS. From then it will be known as Welded Seam Technology.

Portugal-based Petrutex uses ultrasonic welding

PETRUTEX

Portugal-based Petrutex uses ultrasonic welding technology to manufacture its clothing.

High profile sportswear companies such as Nike and Adidas have contracted Petrutex

A number of high profile sportswear companies have contracted Petrutex to produce lines of clothing for them. These include Nike and Adidas. Petrutex supplied Nike with 100,000 stitch-free items for professional soccer teams in 2005.

A polyurethane tape lines the edges of the fabric which form the seams, and heat is applied to melt the tape and bond the edges

Petrutex uses a tape made of polyurethane to line the edges of the fabric which form the seams.

Heat is applied to melt the tape and bond the two edges of the fabrics together.

High performance athletic wear uses ultrasound to bind fabrics together and the seam is then taped for further integrity

In the case of high performance athletic wear, ultrasonic heating is used to bind the fabrics together.

Tape is then applied along the seams and the tape heated to provide additional integrity to the seams.

The process can take 15 minutes longer than when using a sewing machine

Interestingly, Petratex estimates that the whole process can take 15 minutes longer than when using a sewing machine to perform the same task.

Various items have been made using these techniques

The company has made shorts, shirts, trousers, work-out clothes, swimwear and designer dresses using ultrasonic welding.

But denim was found to be too thick for the process

However, when it investigated the possibility of making stitch-free jeans using this technology, it found that the denim fabric was too thick.

SANTONI

Santoni considers the development of the seamless knitting market to be strongly linked with its own development

Founded in 1919 Italy-based Santoni considers the development of the seamless knitting market to be strongly linked with its own development as a company. The firm began as a manufacturer of sock machines and in 1988 it became part of the Lonati Group, which makes hosiery machines.

Today it meets most of the world's demand for seamless knitting machines

In 1997 Santoni began to develop and produce electronic circular knitting machines for seamless apparel. Today it claims to meet the bulk of the world's demand for seamless knitting machines.

Santoni's sales have been growing in tandem with the seamless market and it now has a 98% share of the market

The company's sales have been growing in tandem with the seamless market. Between 1988 and 1996, Santoni sold 900 machines, between 1997 and 1999 it sold 3,100 machines, and between 2000 and 2005 it sold 13,000 machines. In total, it has over 450 customers in 80 countries and claims to have a 98% share of the market for seamless garment machinery.

Its machines can make tubular fabrics with laid-in elastic yarns and areas of gradual compression

Santoni machines are capable of making seamless tubular fabrics which incorporate laid-in elastic yarns inserted in welt bands, and areas of the fabric with gradual compression. These areas are produced by gradually reducing the length of yarn going into each knitted loop using electronic control. The reduction changes the geometry of the fabric by reducing its area in places, and alters its stretch properties by reducing extensibility.

It is claimed that these processes save 40% in costs

All of these processes are claimed to result in fabrics which cost 40% less than those using a traditional system.

Garments with different stitches can be made, as can pre-shaped structures and hidden supports

The company's circular knitting machines are capable of making garments with different stitches such as rib, net, jacquard, piquet, stripes and laces, as well as pre-shaped structures, hidden supports, pockets, collars and hoods.

Santoni offers 18 different types of knitting machine in its product range and it also produces Santoniwear 3D software

There are 18 different types of knitting machine in Santoni's product range. The company also produces software such as Santoniwear 3D—a design tool which allows users to view a 3D virtual dummy on a computer screen. A range of garments can be viewed in this way, including underwear, sportswear, swimwear, nightwear and medical wear.

The Santoni SM4 TL2 and Santoni SM4 TR2 are four feed single jersey electronic circular machines

Examples of Santoni's machines include the SM4 TL2 and SM4 TR2, both of which are four-feed single jersey electronic circular machines. Both are capable of knitting single seamless garments including underwear, outerwear, swimwear and sportswear.

The company's fastest growing markets are in Asia, particularly China

The company's fastest growing markets are in Asian countries, particularly China. More than one quarter of sales in 2005 were made in Asia—which was not far behind sales in the company's largest market, Europe.

The Santoni School offers training courses in seamless technology

The Santoni School provides training courses in seamless technology.

Selectra uses Santoni machines to make seamless apparel for sportswear, activewear and intimate apparel manufacturers

SELECTRA INDUSTRIES

Selectra Industries is a California-based manufacturer of seamless apparel. The company is a major supplier to a variety of sportswear, activewear, and intimate apparel manufacturers in the Americas and Europe, and uses Santoni seamless knitting machines to produce its garments.

Selectra claims that its success is due partly to its versatility

Selectra grew quickly after its establishment in 2000, and claims that its success has been due partly to its versatility. The company works for the intimate apparel, branded sportswear, activewear and private label sectors. Unlike some other companies it does not focus on one specific market.

Shima Seiki started making automated seamless glove knitting machines in 1965

SHIMA SEIKI

The Japan-based company Shima Seiki has been a pioneer in seamless knitting since it was founded in 1962. It set out to make the first automated knitting machine capable of making seamless gloves which required no post-production sewing. It fulfilled this ambition in 1965.

In 1995 it launched Wholegarment knitting machines capable of making an entire sweater in 30 minutes which did not need sewing-up

In 1995, 30 years later, it launched Wholegarment knitting machines. These were capable of producing in 30 minutes an entire sweater which did not need sewing-up. Typically, a sweater knitted the traditional way would have consisted of a front, back and sleeves sewn together after being knitted. At the time of the launch, one journalist gushed that this invention was going to change the face of the knitting industry.

It now produces a range of computerised Wholegarment machines

Today Shima Seiki produces a range of computerised Wholegarment knitting machines, each of which has different specifications and can be used for different purposes.

Germany-based Stoll was founded in 1873	<p>STOLL Germany-based Stoll was founded in 1873. Its founder invented the first purl stitch hand flat knitting machines.</p>
Its Knit and Wear machines are capable of knitting garments which are ready to wear	<p>Today, Stoll's Knit and Wear complete garment knitting machines are capable of producing garments which are ready to wear. Its products are found in more than 70 countries around the world.</p>
Zensah Performance Apparel is a leader in seamless performance apparel and was one of the first to transfer technology to the sportswear market	<p>ZENSAH PERFORMANCE APPAREL Zensah Performance Apparel is an Israel-based seamless apparel company which was founded in 2003. It is a leader in the field of seamless performance apparel and claims to be the only performance apparel company which focuses solely on developing and selling seamless garments. It was one of the first companies to transfer the technology from the hosiery and lingerie market to the sports wear market.</p>
The company uses a proprietary technology for its seamless compression knitting	<p>The company uses a proprietary technology for its seamless compression knitting and has manufacturing facilities in Europe, the USA and Israel. It also maintains a sales and marketing office in Miami, USA, and a development office in Tel Aviv, Israel.</p>
Garments made with silver-infused yarns provide lifetime moisture management	<p>Zensah introduced its seamless performance apparel to the market at the 2004 Athens Olympics. Its range includes garments made with silver-infused yarns which confer moisture management properties for the life of the garment.</p>
Target customers include professional athletes	<p>Products are targeted at professional athletes as well as the mass market.</p>
Garments are produced with FreeSeam technology	<p>The company develops functional sportswear which it describes as a "second skin". The garments are produced using Zensah's FreeSeam technology.</p>
Zensah's product range is divided into three categories—	<p>Zensah's product range is divided into three categories:</p>
—men's—	<ul style="list-style-type: none"> ● men's; ● women's; and ● tactical.
—women's—	<p>The men's category includes shorts, shirts (short sleeved, long sleeved, and turtle-neck), tights, socks and neck gaiters.</p>
—and tactical wear	<p>The women's category includes tights, shirts (short sleeved and long sleeved), cami (camisoles) and shorts.</p>
	<p>The tactical range—which is worn by US and Israeli soldiers—is designed to be worn under body armour and includes various shirts, tights, socks, neck gaiters and shorts. It is light, durable, seamless, breathable and anti-odour, and has moisture management capabilities.</p>

Zensah’s loose fitting garments are made in the same way as compression apparel

Zensah also produces loose fitting garments which are made in the same way as compression apparel. During the manufacture of the garments, the yarns and tension of the fabric are manipulated to achieve a looser fit.



Figure 2
Zensah seamless shirt

Source: Zensah Performance Apparel

OUTLOOK

The future looks good as seamless knitting and welding technology penetrate other apparel sectors

The future looks good for seamless knitting and welding technology. As consumers learn about the benefits of seamless and stitch-free apparel, demand for these garments will continue to increase, and the technology will penetrate more deeply into all types of apparel—beyond the lingerie and performance apparel sectors.

The seamless movement is a trend, not a fad

It is apparent from evidence in the retail market that the seamless movement is a trend, not a fad. Key players see growth ahead and are optimistic about the future.

New developments will bring about growth

As developments in technology and yarns bring about new opportunities, so the seamless sector will continue to grow.

The latest developments offer opportunities for “mass customisation”

The latest developments in technology—such as computer-aided design (CAD)—now offer opportunities for “mass customisation”, according to Dr Sanjay Gupta of the National Institute of Fashion Technology in New Delhi, India.

The product remains in digital form until it reaches the factory

The product remains in digital form until it reaches the manufacturing plant. Communicating digitally, says Dr Gupta, offers the potential to completely change the concept of a factory.

The machines could even be distributed in multiple locations, such as retail stores

In place of 150 machines working in one location, it is even possible to distribute these same machines in multiple locations, such as retail stores, throughout a city.

Shima Seiki was involved in setting up Knit Factory Boutique in Japan, offering “an original sweater just for you”

Japan-based Shima Seiki, which makes knitting machines, tested this concept in Japan when it was involved in setting up Knit Factory Boutique—a production factory and retail shop combined in one facility. The shops offer “an original sweater just for you”. The sweaters are priced from ¥15,000 to ¥30,000 (US\$128-US\$256). Shima Seiki considers this project to be one of the most promising forms of retail fashion, alongside Internet shopping.

Stitch-free processes are more expensive but costs will come down

Stitch-free processes are currently more expensive than traditional cut and sew. However, developments in equipment will bring machinery costs down and make the products more competitively priced.

Seamless knitting is also suitable for smart fabrics and wearable technology

Seamless knitting also has a role to play in smart fabrics and wearable technology. It has already been used for integrating electronics into fabrics with the purpose of monitoring the body.

In the NuMetrex heart monitoring bra, it offers a tighter fit and thus allows sensors to be in close contact with the body

For example, the NuMetrex heart monitoring bra from Textronics is a seamless garment. Seamless knitted garments are particularly suitable for this purpose because sensors incorporated into the garment need to be in close contact with the body. Seamless knitting enables garments to be made with greater compression in places where a tighter fit is needed.



Figure 3
NuMetrex seamless heart monitoring bra

Source: Textronics

Protective wear and medical garments can also be served by seamless technology

Protective wear and medical garments represent further sectors which can be served by seamless technology. Removing seams offers opportunities to provide greater protection—because the seam of a garment is often the first component to fail. Research into protective wear and medical garments made with seamless technology is currently receiving attention.

And the special support hose needs variable compression to be precisely fitted to the body

Also under focus is special support hose, which needs to be precisely fitted to the body. By incorporating variable rates of compression in the garment, the hose can be made tighter in areas where more support is required.

But there is a lack of widespread technical knowledge, little generic product development work and a lack of formal documentation—

Although there are solid reasons for optimism about the future of stitch-free seaming, technical knowledge is not widespread and little, if any, generic product development work is being undertaken. While sewn seam technologies are widely documented, there is a lack of formal documentation to support the claimed benefits of welded seams.

—to help companies ensure that seams are fit for their intended purpose

For companies wishing to enter the market, there is little information to help them ensure that the seams they are proposing to bond are fit for their intended purpose. Any failures resulting from a lack of knowledge may lead to consumer discontent.

Seamless knitting may not hold all the answers to reducing costs but it does reduce the amount of labour required

Within the world of seamless knitting, much effort has gone into finding ways of reducing costs associated with labour intensive cut and sew knitting processes. For many textile and garment firms, reducing such costs is vital to their survival as production in lower cost countries continues to grow and competition intensifies. Seamless knitting may not hold all the answers, but it does cut down on the amount of labour required to produce a garment and may therefore offer opportunities for struggling Western firms.

Seamless knitting and welding will be used more complementarily in performance apparel

Ultimately, the two main types of making garments with a seamless appearance—seamless knitting and welding—will be used more complementarily. Manufacturers will use both techniques to produce performance apparel which has no sewn seams.

Ultimately, sewn seams may be in the minority

Ultimately, sewn seams may be in the minority in performance apparel.

Profile of Bemis: a leader in bonded seam technology for stitch-free apparel

SUMMARY

USA-based Bemis specialises in thermoplastic adhesives, coatings, tapes and speciality film products which are designed to bond various materials together. The company is small—but well known—and has remained privately owned since it was founded. Its sales are growing, and are now approaching US\$100 mn.

Bemis's products are found in a wide range of items, including bras, ski jackets, car headrests and ready-to-assemble furniture. The company makes products for a variety of industries but those designed for use in apparel with a seamless appearance have the greatest market prominence.

Bemis was originally founded in 1910 to make an adhesive base for chewing gum. But soon afterwards it turned its attention to fabric coatings and footwear adhesives. In 2002 it launched Sewfree film, which was made of elastic polyurethane and designed specifically for stitch-free bonded garments. Sewfree is capable of bonding almost any combination of fabrics and utilisation of the product eliminates the need for sewing in garment construction. Originally, it was aimed at the intimate apparel sector. But it also soon found favour in technical outerwear.

Exponential growth in Asia holds further opportunities for Bemis, but the company can also expect more competition from this region. Bemis's response is to diversify and look for alternative markets in which to apply its knowledge of adhesives.

INTRODUCTION

Bemis is a leader in thermoplastic adhesives, coatings, tapes and speciality film products

Bemis is a leading manufacturer of thermoplastic adhesives, coatings, tapes and speciality film products. Its headquarters and main manufacturing facilities are based in Shirley, Massachusetts, in the USA, but it also has regional facilities in the UK and Hong Kong.

Its products are used in a variety of industries from textiles to buildings

The company's products are used in a variety of industries including textiles and apparel, automotive interiors, laminates for woodworking, and architecture.

In textiles they are used in a range of items from intimate apparel to technical outerwear

Within the textile industry, Bemis products are used in a range of items from intimate apparel and bodywear through to technical outerwear. The company has over 50 years of experience in the apparel industry and its profile is particularly prominent in this sector.

Its films are used in the automotive industry—

The company has also been producing bonding materials for other industries during this time. In the automotive industry, its films are used in such areas as convertible tops, seats, door panels, carpets and headliners.

—and in woodworking

In woodworking, its films are used for sealing decorative laminate to cabinets, doors and ready-to-assemble furniture.

Solid thermoplastic adhesives are also used to fabricate advanced composite products

The company's solid thermoplastic adhesives are also used to fabricate stronger, lighter-weight advanced composite products.

Table 1: Bemis: applications for products

Market	Application
Apparel	Embroidery, appliqué attachment, label attachment, seam construction, fabric fusing
Automotive	Adhering fabrics to foams in headrests, attaching textile to plastics in door panels, adhering foil to high temperature fabric in heat shielding assemblies
Composite panels	Adhering polyethylene or polypropylene sheet to different metals in architectural building panels, tractor trailer bodies
General/industrial	Adhering metal to foam in buffing pads, various electronic assemblies
Labels	Attaching labels to backs of carpets, attaching mattress labels
Woodworking	Sealing decorative laminates to cabinets, ready-to-assemble furniture and store fixtures

Source: Bemis.

Bemis began with chewing gum and moved to fabric coatings and footwear adhesives

Bemis was founded in 1910 as a supplier of an adhesive base for chewing gum. A few years later the company took its knowledge of adhesives and switched to producing coatings for fabrics and adhesives for footwear.

In the mid-1980s the company invested in die extrusion equipment

In the mid-1980s Bemis invested in die extrusion equipment and developed the capability to produce adhesive films for a variety of industries.

Bemis has grown into a significant privately-held company which employs 210 people and has sales of US\$100 mn

Today, Bemis has grown into a significant privately-held company. It employs 210 people and its sales are approaching US\$100 mn. Over the last five years its sales have grown by more than 40%. Growth rates have been especially high in Asia, where sales almost doubled between 2004 and 2005.

Its popular Sewfree products are designed for stitch-free bonded garments

One of the company's most popular brands in the apparel industry is its Sewfree range which was first introduced in 2002. Sewfree products are made of elastic polyurethane film and are designed to facilitate the manufacture of stitch-free bonded garments.

They were originally designed for use in intimate garments to eliminate bulky seams

Sewfree was originally designed for use in the intimates sector to eliminate bulky and uncomfortable seams and provide good stretch and recovery properties. It has since been used in a variety of high performance apparel, including technical outerwear.

Bemis is keen to work with customers as "partners"

The company makes much of its commitment to customer service—believing this to be the backbone of the company. Bemis says that it is keen to work with customers as "partners"—which makes sense at a time when it is persuading people to change from the tried and tested format of cut-and-sew to a new stitch-free bonding approach.

It encourages prospective customers to send samples of fabric for evaluation and analysis and runs a "Partners in Progress" programme

Bemis encourages prospective customers to send samples of fabric to the company for evaluation and analysis prior to purchasing its products. And it runs a "Partners in Progress" programme which includes the following:

- a fabric/seam tape analysis service;
- on-site technical support anywhere in the world—technicians are despatched to any location;
- access to its laboratories in the USA, Europe and Asia;
- on-site seam sealing application training; and
- seam tape training programmes for staff of customer companies.

PRODUCTS

Bemis makes eco-friendly adhesive and thermoplastic films and tapes for a range of fabric end uses

Bemis produces a range of adhesive and thermoplastic films and tapes, and boasts that they are eco-friendly and free of solvents. Its products are found in a wide range of items manufactured from fabrics—such as ski jackets and car head rests—as well as in architectural panels in buildings and product labelling.

Some are designed to eliminate stitches in garments

Within the apparel sector, many of the company's products are designed to replace the need for stitched seams in garments.

Adhesive films are made from five polymer types

ADHESIVE FILMS

Bemis adhesive films are made from polyurethane, nylon (polyamide), polyester, polyolefin and vinyl.

Within the product range are adhesive films which stick to most substrates

Within its product range, Bemis has adhesive films which are capable of sticking to most substrates—including fabrics (see Table 3), foams, plastic sheets, composites and multiple layer combinations.

Table 2: Bemis: product categories

Product	Description
Adhesive films	Single layer thermoplastic films available in various widths, thicknesses and formulations. They are activated by heat and pressure to penetrate fabrics, thus creating a chemical and mechanical bond
Seam tapes	Tapes applied to sewn seams in waterproof fabrics to prevent water entry through seams. Seam tapes are available in 2-layer and 3-layer constructions
Seam reinforcing tapes	Tapes designed to cover an ultrasonic line bond and complete the seam. The tapes add strength, stability and, in some cases, waterproofness
Overlay tapes	Tapes bonded to the outside of the garment for decorative purposes or for preventing the fraying of a raw edge. They are available in a variety of colours and patterns
Abrasion patches	Patches identical to overlay tapes but supplied in wider widths (up to 142 cm or 56 inches). They can be cut into any shape and heat sealed to the outside of the garment in order to improve abrasion resistance in a specific area (eg elbows or shoulder area)
Edge banding tapes	Tapes with a three-layer construction where a thermoplastic elastic is sandwiched between two adhesive films. They are used in hem construction with an edge banding machine

Source: Bemis.

Bemis's films can adhere to a wide range of materials Among the many different materials to which Bemis's films can adhere are: acetate, acrylic, aluminium, cotton, elastane (spandex), epoxy, fibreglass, glass, leather, neoprene, nylon, paper, polycarbonate, polyester, polyester/cotton, polyethylene, polypropylene, polystyrene, polyurethane, PVC, rayon, rubber, steel, wood and wool.

Table 3: Bemis: adhesive films suitable for fabrics

Product	Composition	Sewfree ^a	Fabric applications (excellent) ^b	Fabric applications (good) ^c
3206D	Polyurethane	Yes	Cotton, nylon/Lycra, polyester/cotton, polyester, wool	Acetate, acrylic, nylon
3218	Polyurethane	No	Nylon, polyester	Acrylic, cotton, wool, polyester/cotton
3287	Polyurethane	No	Nylon/Lycra, polyester	Acrylic, cotton, nylon, polyester/cotton, wool
3405	Polyurethane	Yes	Cotton, polyester/cotton, polyester	Acrylic, nylon/Lycra, nylon, wool
3410	Polyurethane	Yes	Nylon/Lycra	Cotton, polyester/cotton, nylon
4220	Nylon	No	Acetate, acrylic, cotton, nylon/Lycra, polyester/cotton, nylon, polyester, wool	n/a
5214	Polyester	No	n/a	Cotton
5250	Polyester	No	Acetate, cotton, nylon, polyester	Acrylic, wool
5290	Polyester	No	n/a	Cotton, polyester/cotton, polyester
6218	Polyolefin	No	Cotton	Acetate, acrylic, nylon, polyester, wool
6343	Polyolefin	No	n/a	Cotton, polyester/cotton
6344	Polyolefin	No	n/a	Acetate, cotton, polyester, polyester/cotton
6371	Polyolefin	No	n/a	n/a
6385	Polyolefin	No	Cotton, polyester/cotton	Wool
9383	Vinyl	No	Cotton	Acrylic, polyester, wool
9385	Vinyl	No	n/a	Cotton, wool

^a Sewfree is the brand name of Bemis's range of adhesive products specifically designed for fabrics. ^b The product is described by Bemis as "excellent" for applications using these types of fabrics—as determined by Bemis testing. ^c The product is described by Bemis as "good" for applications using these types of fabrics—as determined by Bemis testing. Source: Bemis.

Adhesive films are made in a range of thicknesses and softening temperatures

Adhesive films are made in a range of thicknesses and softening temperatures (from 66°C to 147°C) so that they can be selected to suit individual jobs and different fibres. Products are produced in mono or multi-layered films using different polymers. Each different type of polymer family has products which have specific thermal or mechanical properties.

They are produced in uniform thicknesses and are capable of being remelted several times

Adhesive films are produced in uniform thicknesses and are capable of being remelted several times. The adhesives have an unlimited shelf lives. Adhesive films have a plastic feel. They are provided either on rolls of widths of up to 147 cm (58 inches) or on release paper, or are pre-applied to fabrics specified by the user (see Figure 1).

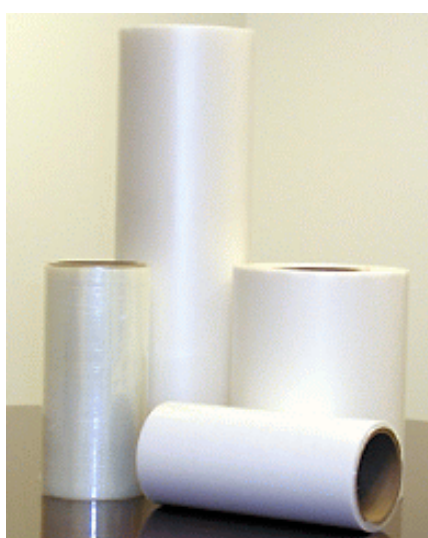


Figure 1
Rolls of Bemis adhesive films

Source: Bemis

Table 4: Bemis: characteristics of adhesive films

Type	Characteristics
Vinyl coatings and films	Washable and dryer-safe—bond to cotton fabrics and felts
Polyolefin films	Enable low surface-energy materials to be combined. For example, they enable polypropylene and polyethylene to be joined to metals, rubber, fabrics and foam
Polyurethane films	Strong, tough, and bond to a variety of substrates—such as soft hand and high elasticity materials
Nylon/polyamide transparent films	Form excellent bonds to nearly all fabrics made from natural or synthetic fibres. Resistant to dry cleaning solvents and home wash cycles
Polyesters	Good heat resistant bonds which are activated at moderate to high sealing temperatures

Source: Bemis.

Sewfree bonds any combination of fabrics and eliminates sewing

SEWFREE FILMS

Sewfree is the brand name of a group of soft and elastic films which bond almost any combination of fabrics together. It eliminates the need for sewing in garment construction.

It can bond coated and uncoated fabrics

Sewfree can bond cotton, nylon, polyester and polyester/cotton blends. It is also able to bond fabrics which have been coated with polyurethane, vinyl or durable water repellent (DWR) coatings.

It is designed for undergarments, activewear and intimate apparel where stretch and recovery are required

Sewfree was introduced in 2002 and is designed for use in undergarments, activewear and intimate apparel where stretch and recovery are required. It has been used by a number of high profile technical outerwear manufacturers including Arc’Teryx, Marmot, Mountain Hardwear and The North Face. In addition, Nike ACG has incorporated Bemis bonded seam technology into its NoSew garments.

Its use in performance apparel results in a lightweight garment which appears sleek and seamless, and performs better

The use of Sewfree in performance apparel has a number of benefits. For example, it results in a garment with a sleek and seamless appearance. Also, the weight of the garment is reduced because there is no stitching and there are no bulky seams. Furthermore, it improves the garment’s performance.

Sewfree bonds withstand more than 50 wash cycles

Sewfree bonds are said to be durable and capable of withstanding more than 50 wash cycles.

In outerwear the bond is waterproof and permanent

Another benefit of particular relevance for outerwear is that Sewfree provides a waterproof and permanent bond.

In intimate apparel there is less abrasion, a slimmer profile and more seam stretch

For intimate apparel, there is the added benefit that a stitch-free bond causes less abrasion, has a slimmer profile and allows seams to stretch.

Sewfree can also incorporate zips, pockets, cuffs, hems and draw-string channels

Besides eliminating the need for stitched seams, Sewfree can be used to incorporate zips, pockets, cuffs, hems and draw-string channels.



Figure 2
Mountain Hardwear jacket made with Bemis Sewfree elastic polyurethane film

Source: Mountain Hardwear

The strength comes from a resolidified fluid

Sewfree is applied using a combination of heat and pressure. This melts the film to produce a fluid which wets the surface. The fluid is allowed to cool and resolidify to form enough cohesive strength to attach two fabrics.

Sewfree offers many benefits over stitched seams

Bemis claims that the features of its Sewfree range of products and garments made with bonded seam technology have a number of benefits over traditional stitched seams (see Table 5).

Table 5: Bemis: features and benefits of Sewfree products

Feature	Benefit
Pre-applied to fabric or release paper	Confers greater flexibility for manufacturing
High heat resistance adhesion	Results in a durable bond with good wash durability and dry clean resistance
Superior stretch and recovery capabilities	Bonded seams closely mimic the stretch and recovery characteristics of the fabric being bonded. Seams remain unwrinkled and smooth
Highly pliable polyurethane film	Confers a soft hand in a variety of fabrics
Non-yellowing	Maintains original appearance
Inherent anti-fray properties	Helps to extend the life of the garment
Transparent film	There is no requirement for colour matching as there is with sewing threads, hence the film can be used in multiple product runs
Film repels liquids	Improves the water resistance of a fabric
Continuous film	Provides consistent adhesion throughout the seam
Sleek bonded seam	Slimmer profile of garments using less fabric and thread which means a garment may weigh up to 15% less. Seams are non-abrasive

Source: Bemis.

SEAM TAPES**Heat seal seam tapes prevent water from leaking through sewn seams**

Bemis produces heat seal seam tapes to prevent water from leaking through sewn seams. Seam tapes are made of thermoplastic adhesive film and are applied using a hot air taping machine.

The tapes are designed to work for the life of the garment

The heat seal seam tapes are designed to work for the life of the garment. Applications for these products include activewear (such as apparel for skiing, sailing, paddling sports, golfing and hiking), footwear, outerwear, rainwear, industrial work wear, military gear, hazardous material protective suits, tents and waders.

Co-extrusion results in a stronger molecular bond between the two layers

Bemis uses a co-extrusion machine to produce its two-layer seam tapes. Co-extrusion means that the adhesive layer and the barrier layer are created simultaneously, which results in a stronger molecular bond between the two layers. This, it claims, makes for a better performing tape than that produced by separate extrusion processes.

Table 6: Features of Bemis tapes

Two-layer tapes adhere well to a wide variety of fabric coatings
Tapes are 100% solvent free and eco-friendly
Tapes can be made with polyurethane, polyester, polyamide and ethylene vinyl acetate adhesive layers
All tapes are washable and some are fully resistant to dry cleaning
Tapes can be slit to any width from one quarter of an inch to 60 inches (0.6 cm to 152 cm) and in any gauge (3-8 mm)
The adhesive layer has a broad melt flow rate curve, resulting in good adhesion over a wide range of temperatures
Tapes have a soft hand

Source: Bemis.

High viscosity polyolefin film tapes are designed to eliminate the problem of seam puckering caused by shrinkage during wash cycles

PUCKER-FREE SEAM TAPE

Pucker-free seam tapes are made from high viscosity polyolefin films. They are designed to eliminate the problem of seam puckering caused by shrinkage during wash cycles.

The tapes are lightweight and rigid and have a uniform thickness and smooth edge, making them snag-free.

They are suitable for a number of applications

Applications include front and back yokes, armhole side seams and sleeve seams.

Seam reinforcing tapes are designed to reinforce seams created by ultrasonic line bonding (USLB)

SEAM REINFORCING TAPES

Seam reinforcing tapes are designed to reinforce seams created by ultrasonic bonding.

Ultrasonically line bonded (USLB) seams are becoming more popular as they offer a way of producing a low profile, sleek and less abrasive seam, for which very little seam allowance is required in the fabric.

USLB seams are weak and need reinforcement tapes

USLB seams can be produced at the same rate as those made using traditional cut and sew methods. The downside, however, is that USLB seams are weak, they can be pulled apart easily, and they are not waterproof. For this reason, tapes must be used to reinforce USLB seams and make them waterproof. The seam reinforcing tapes are applied using hot air sealers.

Table 7: Bemis: seam reinforcing tapes

Product	Applications	Composition	Typical seam strength
SRT 1001	Soft shells, sportswear	Polyurethane adhesive on stretch fabric	70+ lb/inch (12.3 N/mm)
SRT 2002	Two-layer waterproof hard shell fabrics	Polyurethane adhesive on grey fabric	50 lb/inch (8.8 N/mm)
SRT 3001	Three-layer waterproof fabrics	Polyurethane adhesive on polyester tricot	25 lb/inch (4.4 N/mm)
SRT 3003	Three-layer waterproof stretch fabrics	Polyurethane adhesive on woven fabric	70+ lb/inch (12.3 N/mm)
SRT 3004	Three-layer waterproof hard shell fabrics	Polyurethane adhesive on woven fabric	30+ lb/inch (5.3 N/mm)

Source: Bemis.

Decorative overlay films and fabrics enhance design and appearance

DECORATIVE OVERLAY FILMS AND ABRASION PATCHES

Decorative overlay films and fabrics are used to enhance the design and appearance of apparel. They are pre-applied with adhesive film.

Overlay materials come in two forms:

OT-100 is a two-layer polyurethane film with good adhesion qualities

- OT-100 is a two-layer polyurethane film laminated to a polyurethane adhesive film. It has good qualities of adhesion to a variety of fabrics, including water-repellent nylons.

OT-200 is made from microfibre nylon, has a soft feel and can be embossed

- OT-200 is made from microfibre nylon laminated with polyurethane adhesive film. It has a soft feel and can be used on a variety of fabrics such as soft shells. This material may be embossed in either a diamond pattern or a basket pattern.

Overlay materials may be cut to tape widths for use over seams

Overlay materials may be cut to tape widths for use over seams for decorative purposes or to enhance water resistance. They can also be produced in wider widths for specific design requirements such as abrasion patches.

Bemis also produces decorative adhesives for use as brand labels, emblems, patches or lettering

Bemis also produces decorative adhesives for use as brand labels, emblems, patches or lettering which are bonded permanently to the fabric without the need for stitching. They may be used, for example, in sports uniforms.

Two types of elastic films are made for edge banding

EDGE BANDING TAPES

Bemis manufactures two types of elastic films which can be used as edge banding tapes:

- Sewfree EB adhesive tape; and
- Clareense.

Sewfree EB adhesive tape is used to finish a leg or arm opening—

Sewfree EB adhesive tape is generally used for edge banding garments such as underwear. It is typically used to finish the edge of a leg or arm opening.

—and Clareense is used as an elastic and for decoration

Clareense is the brand name given to the company's thermoplastic urethane film which can be used as an elastic and for decoration. It is durable and chemical resistant and is used in lingerie.

Clareense is thinner than traditional knitted or woven elastics and offers more design flexibility

If used as an elastic, Clareense can improve the wear or fit of a garment if it is sewn into critical seams for reinforcement. It is thinner than traditional knitted or woven elastics, and offers more design flexibility.

Bemis has produced a range of speciality films

SPECIALITY FILMS

Bemis has produced a range of speciality films, each of which has been designed for a specific purpose.

Aliphatic films are used for logo protection and security windows

Aliphatic films have been designed for applications such as logo protection and security windows. Characteristics of such films are optical clarity, weather durability, scratch resistance and flexibility.

Staticade electrostatic discharge (ESD) film has been developed for the clean room environment

Another speciality is Staticade electrostatic discharge (ESD) film. This has been developed for the clean room environment in which anti-static capability is critical. Staticade is a clear film which is capable of dissipating static electricity. Its uses include various clean room applications, including garments, soft walls, hard walls, mats and general packaging.

OUTLOOK

Bemis is proud of its leading role in the bonded seamless technology market

Bemis is proud of its leading role in the bonded seam market. It is also proud of the fact that, as a manufacturing company in the north-east of the USA, it has seen strong growth while other companies have struggled and moved production to cheaper countries. The company's marketing manager, Chris Parlee, says: "our success [is] with only 210 employees around the globe, that's proof alone. For me, it is a great feeling to know that a small company in small-town USA has shaken up the apparel industry."

It is particularly optimistic about the future and considers growth in the bonded seam market to be a long-term trend, although competition will increase

The company is particularly optimistic about the future. It considers growth in the bonded seam market to be a long-term trend, not a fad, and sees the prospects for Sewfree as being excellent. However, as the stitch-free seaming market grows, so will the number and size of Bemis's competitors. Many of them, especially in Asia, are firms that produce thermoplastic polymers for other applications which have decided to emulate Bemis by turning their attention to the apparel market.

But in response to increasing competition Bemis is diversifying

In response, Bemis is diversifying. It is turning its attention to other markets and to other products as it did many years ago—when it switched from the chewing gum market to fabric coatings. Chris Parlee sums up the company's approach for the future by saying: "we seek opportunities across the globe and are not unwilling to change direction or processes to sustain our growth".

It is developing new fire-retardant and PTFE-based coatings—

Bemis is developing a new formulation for fire-retardant coatings, as well as coatings based on PTFE (polytetrafluoroethylene) which confer breathable and waterproof capabilities on fabrics.

—and extrusion capabilities for non-apparel sectors

The company is also investing in the development of extrusion capabilities for non-apparel sectors which will include a wider range of coatings or lamination applications in areas such as agriculture and construction.

The biggest opportunities lie in Asia, but so do the biggest threats

Perhaps the biggest opportunity for the company lies in Asia. Bemis has just taken on 18 new staff in the region as a result of the explosive growth it is experiencing. But here, too, lies its biggest threat. Asia is where Bemis is likely to see most of its future competitors arise.

Business update

CORPORATE RESTRUCTURING

Russell has announced plans for restructuring—

—which will cost US\$45 mn-US\$52 mn but save US\$22 mn-US\$26 mn annually after tax

There are three main facets to the restructuring but the biggest savings will be through shifting manufacturing offshore

2,300 jobs will be lost worldwide, of which 1,700 will go in the USA, but 1,200 of the lost US jobs will be replaced in Honduras and Mexico

The changes will result in fewer, larger facilities which will enable Russell to remain competitive

RUSSELL CORPORATION

USA-based Russell Corporation, a manufacturer of athletic wear, has announced restructuring plans to improve the company's financial performance.

The restructuring is expected to cost between US\$45 mn and US\$52 mn after tax but it will save the company between US\$22 mn and US\$26 mn annually after tax. The full impact of the costs and savings will be felt by 2008.

There are three main facets to the restructuring:

- a continued shift offshore of textile and apparel manufacturing;
- the completion of operational changes to Huffy Sports; and
- a reorganisation of sales and marketing within Russell Athletic.

The biggest savings will be made through the shift of manufacturing to offshore locations.

On a worldwide basis, Russell expects around 2,300 positions to be lost.

Of the worldwide total, 1,700 jobs will be lost in the USA. However, 1,200 of the US positions will be replaced in Honduras and Mexico.

Russell's chairman and chief executive officer, Jack Ward, explained the need for the restructuring by saying: "We are making these structural changes in our businesses to remain competitive in today's global market place. These changes will result in our having fewer, larger facilities. We must move quickly to achieve lower costs, both in our operations and in our support areas."

CORPORATE STRATEGY

Adidas has raised its revenue and earnings targets for the 2006-08 period

ADIDAS GROUP: POST-REEBOK INTEGRATION STRATEGY

Germany-based Adidas—the second largest sporting goods company in the world—has raised its targets for revenues and earnings for the three year period 2006-08.

It now expects percentage sales growth to be in the high single digits—	The group expects sales growth, in percentage terms, to be in the high single digits for the 2006-08 period, compared with a previous expectation of mid-single digit growth to high single digit growth.
—and net income to grow at double-digit rates	Net income is expected to increase at double-digit rates over the three-year period—and by at least 20% in 2007.
The cost savings expected from the integration of Reebok have been raised to Euro175 mn and revenue gains to Euro500 mn	In relation to the integration of Reebok into the Adidas Group, the expected cost savings (or cost synergies) have been raised to Euro175 mn (US\$210 mn) from an original estimate of Euro125 mn. Similarly the gains in revenue have been estimated at Euro500 mn which will be fully realised in 2009.
The Adidas brand will see expansion in four areas	The group's largest brand, Adidas, will see future expansion in four specific areas: basketball, football, running, and Originals.
Adidas has formed an 11-year global merchandising partnership with the NBA	Adidas has recently formed an 11-year global merchandising partnership with the National Basketball Association (NBA), making it the official apparel provider for the NBA starting from the 2006/07 season.

COUNTERFEIT GOODS

	THE NORTH FACE WINS MILLION DOLLAR COUNTERFEIT CASE
The North Face has been awarded US\$1 mn in a counterfeit case	USA-based outdoor apparel specialist The North Face has been awarded a US\$1 mn judgement in a counterfeit case at the US District Court for the Southern District of New York.
The award was made against the Salehs who adopted a range of corporate aliases to sell counterfeit jackets	The award was made against three people—Nabil Saleh, Ibrahim Saleh and Toufic Saleh—who adopted a range of corporate aliases to operate a business selling counterfeit jackets bearing The North Face trademark. The corporate aliases included #1 Spot of NY, Broadway Outlet, TriStar Wholesale, F&H Fabric Enterprise, and Bare USA.
Fake jackets were sold to wholesalers and retailers throughout New York and the rest of the USA	Fake jackets were sold to wholesalers and retailers throughout New York and the rest of the USA. The North Face first became aware of this particular counterfeit operation during 2003 when it was investigating the source of jackets seized from multiple locations of Reliance, a chain store in New York.
The initial investigation led to the discovery of thousands more jackets	The initial investigation led to the discovery and confiscation of thousands more jackets—including ones from various online retail stores which were thought to have been supplied by the Salehs.

The court eventually granted The North Face's motion for summary judgement and entered a permanent injunction against the Salehs

Following a preliminary injunction against the Salehs, The North Face asked for a summary judgement¹ on its claims for trademark counterfeiting and infringement. After months of briefing, the court granted The North Face's motion for summary judgement and awarded US\$1 mn against the Salehs. The court also entered a permanent injunction against the Salehs.

The North Face has a zero tolerance policy for trademark counterfeiting

Commenting on the outcome, Steve Rendle, president of The North Face, said: "We have a zero tolerance policy for trademark counterfeiting. The court's decision in our favour shows that taking on the counterfeiters directly through legal actions like this one does work."

FINANCIAL RESULTS

Adidas has had an eventful year but its biggest challenge is to get Reebok back on track

ADIDAS

The 2005 financial year (January to December) was fairly eventful for Germany-based Adidas—the world's second largest sporting goods company. It divested Salomon, acquired Reebok and exceeded its financial targets. However, there are challenges ahead—the biggest of which is how to get Reebok back on track.

In the fourth quarter of 2005 the company recorded a net loss of Euro4 mn, in spite of 27% sales growth

For the fourth quarter of 2005, sales rose by 27% to Euro1,521 mn from Euro1,196 mn in the fourth quarter of 2004. All regions saw sales increases in double digit figures. However, the company recorded a net loss of Euro4 mn for the fourth quarter of 2005 compared with a Euro20 mn profit in the fourth quarter of 2004. The loss was predominantly due to the costs associated with the integration of Reebok.

Reebok's sales fell by 5% to US\$930 mn

Reebok's sales for the fourth quarter declined by 5%, from US\$975 mn in 2004 to US\$930 mn in 2005.

But full year sales rose by 13% and net profits by 22%

For the whole of 2005, Adidas saw sales rise by 13%, from Euro5.86 bn in 2004 to Euro6.64 bn in 2005. Net profits for the year rose by 22% to Euro383 mn compared with Euro314 mn in 2004, despite a loss of Euro44 mn from the sale of Salomon.

European sales rose by just 3% but sales in Asia increased by 28%

On a regional basis (see Table 1), sales in Europe rose by just 3%. Within the European total, there were declines in the UK and Iberia. Sales in Asia, by contrast, rose by 28%, having been driven by strong performances in China and Japan.

¹ A summary judgement is a judgement rendered by the court prior to a verdict because no material issue of fact exists and one party or the other is entitled to a judgement as a matter of law.

Table 1: Adidas: breakdown of sales by region, 2004 and 2005

	2004 (Euro mn)	2005 (Euro mn)	2005/04 (% change)
Europe	3,068	3,166	3
North America	1,332	1,561	17
Asia	1,192	1,523	28
Latin America	224	319	43
Total continuing operations^a	5,860	6,636	13

NB: percentage change calculations are based on unrounded data.

^a Numbers do not sum to totals indicated; the balance in each case is attributed to HQ/consolidation.

The order backlog increased by 15%

The order backlog at the end of the year increased by 15% with strong performances in North America and Asia.

Priorities will be the World Cup and Reebok

Herbert Hainer, the chief executive of Adidas, says that the company's two biggest priorities for 2006 will be the World Cup football tournament and Reebok.

Football is Adidas's most important product category and the company has a 35% share of the global football market

The World Cup takes place in June 2006 in Germany—the group's home country. Football is Adidas's most important product category. Indeed, the company estimates that it has 35% of the global market for this category. Therefore Adidas will be making the most of the opportunities which this high share affords through, for example, high profile sponsorship of the events.

The more challenging task is to get Reebok back on track

On the downside, Adidas has the more challenging task of getting Reebok back on track. Sales were down by 5% in the fourth quarter of 2005 and the order backlog for this period declined by 24%. Analysts are predicting short-term problems for Adidas but the situation is expected to improve from 2007 onwards.

Columbia's sales grew by 4.1% to US\$301.8 mn for the fourth quarter of 2005

COLUMBIA SPORTSWEAR

USA-based Columbia Sportswear, a manufacturer of athletic wear, has reported sales of US\$301.8 mn for the fourth quarter of 2005 which ended on December 31, 2005. This represents an increase of 4.1% compared with the fourth quarter of 2004.

But outerwear, its strongest category, fell by 4.7% to US\$147.4 mn

Despite the rise in overall sales, outerwear—the company's largest product category—suffered a 4.7% drop in sales to US\$147.4 mn for the fourth quarter of 2005.

This decline was offset by strong sales of sportswear and footwear

This decline was offset by strong sales of sportswear and footwear—which were the second and third largest categories respectively. Compared with the fourth quarter of 2004, sportswear sales were up by 11.5% to US\$90.0 mn. Over the same period, sales of footwear increased by 19.9% to US\$63.3 mn.

Geographically the largest percentage increase was in “other international” where sales rose by 17.5%

In geographical terms, the largest percentage increase for the fourth quarter was seen in “other international” where sales grew by 17.5% to US\$51.8 mn. European sales increased by 14.3% to US\$50.3 mn. However, sales in the company’s largest region, the USA, rose by just 2.4% to US\$185.4 mn.

Net income dropped by 7.1% to US\$36.6 mn

Columbia’s net income dropped by 7.1% from US\$39.4 mn in the fourth quarter of 2004 to US\$36.6 mn for the fourth quarter of 2005.

For 2005 as a whole, sales grew by 5.5% to US\$1,155.8 mn but net income fell by 5.7%

For the whole of the 2005 financial year, sales amounted to US\$1,155.8 mn, representing a 5.5% increase on 2004 sales. Nonetheless, the net income decreased by 5.7% from US\$138.6 mn in 2004 to US\$130.7 mn in 2005.

Table 2: Columbia Sportswear: breakdown of sales by region, 2005

	Sales (US\$ mn)	Change ^a (%)
USA	676.9	1.5
Europe	184.4	8.3
Other international	179.7	27.1
Canada	114.8	-1.8
Total	1,155.8	5.5

^a Over previous year.

Source: Columbia Sportswear.

Table 3: Columbia Sportswear: breakdown of sales by product category, 2005

	Sales (US\$ mn)	Change ^a (%)
Sportswear	450.3	13.6
Outerwear	440.0	4.4
Footwear	211.2	14.4
Equipment	9.1	15.2
Accessories	45.2	-2.0
Total	1,155.8	5.5

^a Over previous year.

Source: Columbia Sportswear.

The company believes that current strategies will lead to continued long-term growth

Commenting on these results, Tim Boyle, the president and chief executive officer, said: “During the last few years, we have made significant infrastructure investments to support future growth plans.

“While we are disappointed with our 2005 revenue results, sales came in as projected, and we are generally satisfied with our expense management.

“We believe the initiatives we are implementing to drive international expansion and footwear and sportswear product category growth, as well as the improvements being made to stabilise our North American outerwear business, position us for continued long-term growth.”

Nike sales grew by 9% to US\$3.6 bn during the third quarter ending February 28, 2006	NIKE Global sportswear giant Nike has reported results for the third quarter of its 2005/06 financial year, which ended on February 28, 2006. Sales increased by 9% to US\$3.6 bn during the third quarter compared with US\$3.3 bn in the third quarter of the previous year.
In the USA sales grew by 14%, driven by athletic footwear	A geographical breakdown of sales for the third quarter of 2005/06 shows that in the USA sales rose by 14% to US\$1.4 bn. Athletic footwear was the driving force behind this increase with sales in this category increasing by 18%. Sales of equipment dropped by 3% to US\$70.3 mn.
In Europe fluctuations in exchange rates reduced revenues by 9%	Sales in Europe dropped by 5% to US\$980.1 mn from US\$1,034 mn in the same quarter during the previous year. The results were affected by fluctuations in exchange rates which reduced revenues by 9%.
Asia Pacific saw sales grow by 13% to US\$532.3 mn	In contrast, Asia Pacific saw sales revenue grow by 13% to US\$532.3 mn in the third quarter of 2005/06 compared with US\$472.8 mn in the previous year. Fluctuations in exchange rates reduced sales revenue by 4%. Despite this, footwear sales revenue grew by 19%.
The Americas saw strong growth of 41% to US\$203.1 mn	Similarly, the Americas (excluding the USA) saw sales grow by a strong 41% to US\$203.1 mn. Changes in exchange rates for the region increased revenue growth by 11% for 2005/06.
Nike's "other businesses" grew by 17% to US\$454.4 mn	Nike's "other businesses"—which include Converse, Nike Golf, Bauer Hockey, Cole Haan, Hurley International and Exeter Brands—grew by 17% to US\$454.4 mn in the third quarter of 2005/06.
Profits for the whole company rose by 19% to US\$325.8 mn	Profits for the whole company rose by 19% to US\$325.8 mn compared with US\$273.4 mn in the third quarter of the previous year.
Global future orders for athletic footwear and apparel schedules were up by 2.9%	Global future orders for athletic footwear and apparel scheduled for delivery between March 2006 and July 2006 were up by 2.9% year-on-year to US\$5.4 bn. This small increase reflects modest growth in all regions except Europe which showed a drop of 2% in future orders.
Perry Ellis has reported record sales for 2005/06	PERRY ELLIS USA-based Perry Ellis International—an apparel manufacturer with a large family of brands—has reported record sales for its 2005/06 financial year, which ended on January 31, 2006.
Sales rose by 29% after the purchase of Tropical Sportswear	Sales rose by 29% to reach US\$849.4 mn compared with US\$656.6 mn for the previous year. This increase was predominantly due to the acquisition of Tropical Sportswear in early 2005.

But swimwear sales fell by 4%

A 30% increase in sales from Tropical Sportswear and a 3% increase in Perry Ellis's core menswear were offset by a 4% drop in swimwear sales and a small decrease in royalty income.

Net profits rose by 8.1% to reach a record level of US\$22.7 mn

Net profits for the year also reached a record level of US\$22.7 mn. This represents a rise of 8.1% compared with the previous year's profit of US\$21.0 mn.

2006/07 revenues are likely to be between US\$860 mn and US\$870 mn

The company predicts that revenues for the forthcoming year, 2006/07, will be in the region of US\$860 mn to US\$870 mn.

Puma has once again reported record results in 2005**PUMA**

Germany-based sportswear company Puma has reported another set of record results for the fourth quarter of 2005 and for the full financial year, which ended on December 31, 2005.

Consolidated sales for the fourth quarter of 2005 rose by 27.7% to reach Euro349.2 mn

Consolidated sales for the fourth quarter of 2005 reached Euro349.2 mn (US\$415.2 mn), representing a rise of 27.7% compared with Euro273.4 mn for the same period of 2004. Strong growth was recorded by all three of Puma's segments during the fourth quarter. Sales in footwear rose by 25.8%, in apparel by 31.8%, and in accessories by 28.9%.

For the full financial year they grew for the 11th time, with an increase of 16.2% to Euro1,778 mn

Consolidated sales for the whole of the 2005 financial year showed an increase of 16.2% to Euro1,778 mn from Euro1,530 mn in 2004. This was the 11th consecutive year of growth. The company's smallest product segment, accessories—which consists mainly of bags, balls and sport accessories—showed the highest increase in sales at 25% to reach Euro129 mn.

Footwear, the largest segment, was up by 16.2%

Puma's largest segment, footwear, showed an increase of 16.2% in the 2005 financial year, to Euro1,175 mn. Sales of apparel increased by 13.9% to Euro474 mn.

Table 4: Puma: breakdown of sales by region, 2004 and 2005

	2004 (Euro mn)	2005 (Euro mn)	2005/04 (% change)
EMEA ^a	1,046.8	1,104.9	5.6
Americas	302.6	476.3	57.4
Asia/Pacific Rim	181.0	196.3	8.5
Total	1,530.3	1,777.5	16.2

NB: numbers may not sum precisely due to rounding.

^a Europe, Middle East and Africa.

Source: Puma.

Europe dominated Puma's sales in 2005 with 62.2% of the total

A geographical breakdown of sales shows the dominance of the European market in Puma's sales (see Table 4). Europe, Middle East and Africa (EMEA) accounted for 62.2% of sales in 2005. However, this figure was down from 68.4% in 2004 as sales in the Americas grew at a much faster rate than those in EMEA, and therefore

accounted for a larger percentage of overall sales.

Worldwide brand sales were up by 18% to Euro2.4 bn

Worldwide brand sales, ie consolidated sales plus licence sales, reached Euro2.4 bn in 2005—representing an increase of 18% compared with 2004. Within this figure, licensed sales increased by 25.4% to reach Euro610 mn.

Puma expanded its own retail operations with the addition of 20 new stores

Puma expanded its own retail operations during 2005. The addition of 20 new stores brought the total number to 66. Sales from these stores increased by 47.2% to Euro247 mn during 2005.

Its gross profit margin rose by 52.3% to reach a new record high for Puma and for the entire sporting goods industry

Puma's gross profit margin rose to 52.3%, a new record high for Puma and for the entire sporting goods industry according to the company. Another first for the company came when its pre-tax profit rose above the Euro400 mn mark to Euro404.1 mn, representing an increase of 10.8% compared with 2004.

Net profits grew by 10.5%, representing the seventh year of double digit growth

Meanwhile, its net profit grew at a rate of 10.5%—representing the seventh consecutive year of double digit growth—to Euro285.8 mn, from Euro258.7 mn in 2004.

Future orders reached the Euro1 bn mark

Future orders as at December 31, 2005, reached the Euro1 bn mark for the first time, having risen by an impressive 30% compared with the figure for 2004.

Puma has raised its sales targets as it enters the first year of Phase IV

Partly as a result of the strong future orders, Puma has raised its sales targets as it enters the first year of Phase IV of its long-term development plan, which was initiated in 1993.

Sales should reach Euro2.3 bn in 2006

The company now expects consolidated sales to reach Euro2.3 bn during 2006.

The chief executive officer expects record sales in 2006 and 2007

Puma's chief executive officer, Jochen Zeitz, commented that, following better than expected results in 2005 and a positive start to Phase IV, he was confident that the company would achieve record sales in 2006 and 2007.

Quiksilver, a surfing related apparel specialist, says that its sales grew by 58% in the first quarter of 2005/06

QUIKSILVER

The USA-based company Quiksilver—which specialises in surfing related apparel—has released the results for the first quarter of its 2005/06 financial year, which ended on January 31, 2006. Sales for the first quarter increased by 58% to US\$541.1 mn compared with US\$342.9 mn in the first quarter of the previous year.

Sales from the acquisition of Rossignol amounted to US\$192 mn

Sales from the company's acquisition of Rossignol in July 2005—which included Cleveland Golf—amounted to US\$192 mn during the first quarter of 2005/06.

In the Americas, overall sales rose by 39% and in Europe by 97%

In geographical terms, overall sales in the Americas rose by 39% to US\$220.7 mn in the first quarter of 2005/06 compared with the previous year. European sales rose by 97% to US\$261.2 mn reflecting the European bias of Rossignol. Sales in Asia Pacific rose by 16% to US\$58.3 mn.

Profits grew by a strong 31% to US\$18.6 mn

Profits also increased strongly—by 31% to US\$18.6 mn, from US\$14.2 mn in the first quarter in the previous year.

Sales for 2006/07 are likely to be US\$2.25 bn-US\$2.27 bn

Quiksilver expects sales for its 2006/07 financial year to be in the range of US\$2.25 bn to US\$2.27 bn.

Russell's results for 2005 were disappointing

RUSSELL CORPORATION

USA-based Russell Corporation, a manufacturer of athletic wear, has reported disappointing results for the fourth quarter and for the whole of 2005. The company's financial year runs from January 1 to December 31.

Sales for the fourth quarter rose by 6.2% to US\$354.6 mn

Sales for the fourth quarter, which ended on December 31, 2005, rose by 6.2% to US\$354.6 mn from US\$334.0 mn in the same quarter of 2004. Fourth quarter sales for 2005 included US\$27 mn sales from Brooks, the only acquired business which Russell has owned for less than one year².

Sales for the whole of 2005 rose by 10.5% to US\$1,435 bn

Sales for the whole of 2005 rose by 10.5% to US\$1,435 bn from US\$1,298 bn in 2004. If sales from acquisitions owned for less than a year are excluded, sales were US\$1,271 bn in 2005.

But sales in Sporting Goods were disappointing overall

Commenting on the results, Jack Ward, the chairman and chief executive officer, said: "Despite certain areas of our business having record performances, such as international apparel and Brooks, we did experience disappointing sales overall in our Sporting Goods segment." Brooks is a performance footwear company.

Net profits fell by 28% to US\$34.4 mn

The net profit for the 2005 financial year was US\$34.4 mn compared with US\$47.9 mn in 2004. This figure represents a drop of 28%.

Nevertheless, the company is optimistic about its future

Despite the latest results, however, the company is optimistic about the future. The benefits of Russell's various initiatives for cost reduction and lean manufacturing which were outlined earlier in 2006 are beginning to be felt.

For 2006 Russell expects sales to be just under US\$1.5 bn

For 2006, Russell expects sales to be in the range of US\$1.45 bn to US\$1.48 bn. The first quarter, however, is expected to result in a loss as approximately half the 2006 restructuring charges affect the quarter.

² Sales for the fourth quarter of 2005 include sales generated by Brooks while those for the fourth quarter of 2004 do not. This is because Brooks was acquired in December 2004.

Umbro is a supplier of football related products	UMBRO Umbro, a UK-based supplier of football related products, has reported the results for its 2005 financial year, which ended on December 31, 2005.
Sales in 2005, a non-tournament year, were 1.2% down on 2004	At £351.9 mn (US\$639.6 mn), total sales were 1.2% down on 2004. The company claims that this is a good achievement given that 2005 was a non-tournament year.
But profits before tax rose to £31.4 mn compared with a loss of £7.15 mn in 2004	In fact profits before tax rose to £31.4 mn compared with a loss of £7.15 mn in 2004. Umbro explained that underlying growth in non-tournament activities and greater efficiencies had helped to secure the improvement in profitability.
The 2006 World Cup will benefit sales	The company expects to benefit from sales linked to the FIFA World Cup in 2006.
Umbro is launching year-round branded products to iron out annual peaks and troughs related to tournaments	However, it is also seeking to iron out those peaks and troughs in its financial results which are directly related to whether or not there is a tournament in the year. To this end, it is launching branded products which can be sold all the year round. The company is also expanding in other countries such as China and Russia.
It also hopes for higher sales from new fashion-oriented ranges	In addition, it is hoping for higher sales from the launch of fashion-oriented ranges aimed at a younger market. These include U by Umbro and a line of clothing designed by Philip Treacy.
VF Corporation has reported record results for 2005	VF CORPORATION USA-based clothing company VF Corporation has reported record results for the fourth quarter of 2005 and for its full financial year, which ended on December 31, 2005.
Sales in the fourth quarter rose by 4%, driven primarily by 23% growth in the company's outdoor category	Sales in the fourth quarter of 2005 rose by 4% to US\$1.65 bn from US\$1.58 bn in the same quarter of the previous year. The increase was driven primarily by strong growth in the company's outdoor category which includes brands such as The North Face and Vans. Sales in this category rose by 23% to US\$343.9 mn in the fourth quarter of 2005.
For the full financial year sales rose by 6.2%	For the full 2005 financial year, sales increased by 6.2% to US\$6.50 bn, from US\$6.12 bn in 2004 (Table 5).
Sales in the outdoor sector rose 43.8% but fell in jeans-wear, intimate apparel and other business categories	Once again sales in the outdoor sector performed strongly—having risen by 43.8% to US\$1,454.9 mn compared with US\$1,011.5 mn in 2004. But sales in the jeanswear, intimate apparel and other business categories saw decreases.
Net profits grew by 6.7% to US\$506.7 mn	The net profit for VF in 2005 was US\$506.7 mn compared with US\$474.7 mn in 2004, representing a rise of 6.7%.

The company anticipates that 2006 will be another record year in terms of sales

The company anticipates that 2006 will be another record year in terms of sales and a rise of 4%-5% is predicted. Much like the results in 2005, this growth is expected to be driven by sales in the outdoor category.

Table 5: VF Corporation: breakdown of sales by product category, 2004 and 2005

	2004 (US\$ mn)	2005 (US\$ mn)	2005/04 (% change)
Jeanswear	2,706.4	2,697.1	-0.3
Outdoor apparel and equipment	1,011.5	1,454.9	43.8
Intimate apparel	906.5	848.2	-6.4
Imagewear	770.3	805.8	4.6
Sportswear	618.8	650.8	5.2
Other	111.1	45.6	-59.0
Total	6,124.6	6,502.4	6.2

Source: VF Corporation.

YUE YUEN**Yue Yuen, the world's largest maker of athletic shoes, has announced results for the first quarter of 2005/06**

Hong Kong-based Yue Yuen Industrial Holdings—the world's largest maker of athletic shoes—has announced the results for the first quarter of its 2005/06 financial year, which ended on December 31, 2005.

Sales rose by 17.6% to US\$878.0 mn

Sales for the first quarter rose by 17.6% to US\$878.0 mn from US\$746.4 mn in the first quarter of the previous year. A breakdown of sales by product category shows that athletic shoes—the company's largest category—grew by 9.6%.

Retail sales operations, driven by growing consumption in China, rose by 142%

The fastest growth came from the company's retail sales operations which rose by 142%, driven by growing consumption in China.

Table 6: Yue Yuen: breakdown of sales by product category, 1 qtr 2004/05 and 1 qtr 2005/06 (US\$ mn)

	1 qtr 2004/05	1 qtr 2005/06	% change ^a
Athletic shoes	476.0	521.5	9.6
Casual/outdoor shoes	120.0	151.7	26.4
Sports sandals	14.6	20.1	37.7
Soles and components	100.9	106.2	5.3
Retail sales (shoes and apparel)	26.9	65.1	142.0
Others	8.0	13.4	67.5
Total sales	746.4	878.0	17.6

^a 1 qtr 2005/06 compared with 1 qtr 2004/05.

Source: Yue Yuen.

First quarter profits rose by 16%

Profits in the first quarter of 2005/06 also rose strongly—by 16% to US\$85.9 mn, compared with US\$74.0 mn in the first quarter of the previous year.

Nevertheless Yue Yuen is cautious about the future

Despite these encouraging results, Yue Yuen is cautious about the future, given the potential impact of the trade dispute with China and an increase in production costs.

INVESTMENTS

Columbia Sportswear has acquired Montrail for US\$15 mn**COLUMBIA SPORTSWEAR AND MONTRAIL**

USA-based Columbia Sportswear, a manufacturer of athletic wear, has acquired Montrail—a premium footwear company based in Seattle, USA. Columbia paid US\$15 mn for substantially all of the assets of Montrail.

Montrail sells high performance trail running, hiking and climbing footwear in 30 countries

Montrail was established in 1993. It sells high performance trail running, hiking and climbing footwear in 30 countries around the world. Its proprietary fit technology, IntegraFit, was developed in 1996 to improve the comfort and fit of footwear.

The two companies believe they will both benefit from the deal

The two companies believe they will both benefit from the deal. Commenting on the acquisition, Tim Boyle, the president and chief executive officer of Columbia, said: “we believe we can leverage our sourcing, logistics, and capital strength to develop even more opportunities for the Montrail product. Leveraging the performance and fit characteristics of the Montrail branded products will improve the fit and quality of our other footwear brands as well.”

JOINT VENTURES, COOPERATION AND DISTRIBUTION AGREEMENTS

Perry Ellis has agreed with Levi Strauss that it will make and distribute Dockers men’s outerwear**PERRY ELLIS AND LEVI STRAUSS**

USA-based Perry Ellis International, an apparel manufacturer with a large family of brands, has reached an agreement with Levi Strauss to manufacture and distribute the latter’s Dockers brand men’s outerwear in the USA and Mexico.

The deal will last through 2009 but can be renewed

The agreement will last until December 2009, although there is an option to renew it until 2012.

Delivery will begin by June 2006, and the outerwear will be distributed to select chain stores and speciality stores

Perry Ellis will begin to deliver Dockers outerwear lines such as men’s jackets, coats and fleeces by June 2006.

The outerwear will be distributed to select chain stores and speciality stores.

The deal will start to affect Perry Ellis’s earnings after January 31, 2007

The agreement will not affect earnings for Perry Ellis’s 2006/07 financial year, which ends on January 31, 2007. However, it is expected to benefit the company’s financial performance in future years.

Perry Ellis will run Dockers as a separate business unit although production will be coordinated with other operations Perry Ellis plans to operate the Dockers apparel line as a separate business unit. However, it is believed that it also plans to coordinate production of Dockers apparel with existing manufacturing operations—notably swimwear—in order to reduce cyclical peaks and troughs and hence optimise production capacities.

MARKETS

A report says that China exported over 475 mn outerwear jackets in the first ten months of 2005

CHINA EXPORTS 475 MN OUTERWEAR JACKETS

Global Sources, a Hong Kong-based media and marketing company, has published a report which has found that mainland China exported over 475 mn outerwear jackets, such as parkas and windbreakers, during the first ten months of 2005.

The export volume is equivalent to 30% of global supplies

The report—entitled “China Sourcing Report: Parkas and Windbreakers”—claims that this export volume is worth US\$3.8 bn and is equivalent to approximately 30% of global supplies.

The largest importer of jackets was the European Union followed by the USA and Japan

The largest importer of jackets was the European Union, which purchased 183 mn jackets worth US\$1.6 bn in total. The USA purchased 63.8 mn jackets worth US\$591 mn. The third largest importer was Japan, which purchased 40 mn jackets worth US\$438 mn.

Buyers can expect more functional products from China but low-end models will continue to be its mainstay

An editor at Global Sources commented: “Buyers can expect more functional products from mainland China in the coming months. Breathability, odour-resistance and anti-bacterial features will all be available. However, while many companies are shifting to value-added designs, we foresee low-end models continuing to be mainland China’s mainstay for the next several years.”

The report contains details of 72 manufacturers and the most popular export products

Global Sources collected data for its report through factory visits and personal interviews with manufacturers in mainland China. The report contains details of 72 manufacturers and the most popular export products.

USA-based OIA has released its State of the Industry Report 2006

OUTDOOR INDUSTRY ASSOCIATION: 2006 STATE OF THE INDUSTRY REPORT

The USA-based Outdoor Industry Association (OIA)—a national trade association for the outdoor industry—has released its State of the Industry Report 2006.

The US\$33 bn outdoor industry is facing significant changes

The outdoor industry has developed into a US\$33 bn business which, the report says, is facing significant changes. Among these are the changing needs of the consumer, and increasing competition in the retail sector. However, the outdoor lifestyle is gaining in popularity as Americans are encouraged to tackle obesity and sedentary lifestyles.

The report looks at the outdoor industry through four main themes

The report looks at the outdoor industry through four main themes which it describes as:

- who's playing;
- who's selling;
- where we're playing; and
- where we're headed.

The two largest segments of the population are—

Under the “who's playing” section, the report identifies two of the largest segments of the population and their influence on the industry.

—baby boomers—

- Baby boomers (born between 1946 and 1964) will remain a strong foundation for the industry, participating in a broader range of activities and mixing adventure with comfort.

—and millennials

- Millennials (born between 1978 and 2003) are predicted to change the way in which the outdoor industry does business. They are said to embrace adrenalin sports such as moto-cross and wakeboarding, and respond to activities they see in the media and which are easily accessible.

Americans want more activities which can be “done before dinner”

The “where we're playing” section states that Americans are increasingly looking for activities which can be “done before dinner”. The report describes these as “close to home recreation opportunities”.

SIA says that US sales for the winter sports market rose 13% in August-December 2005

SNOW SPORTS APPAREL SALES

USA-based SnowSports Industries America (SIA)—a not-for-profit industry trade group—has reported that US sales for the winter sports market increased by 13% to US\$1.5 bn for the period from August to December 2005 compared with the same period in 2004.

Consumer confidence surged in December to its highest level

Commenting on the rise in sales, Christine Martinez of SIA said: “Consumer confidence surged in December to its highest level since August due in part to economic strength, falling gas prices and job growth.”

Speciality apparel sales rose by 14% in August-December to US\$375.9 mn, which equalled 52% of all snow sports apparel sales

Speciality apparel sales such as tops, bottoms, suits, and snowboard wear rose by 14% to US\$375.9 mn during August to December 2005 compared with the same period in the previous year. This figure represented 52% of total snow sports apparel sales during the same period.

Men's snowboard tops have outsold women's by almost double

Interestingly, men's snowboard tops have so far outsold women's snowboard tops by almost double, giving an indication of the predominance of men participating in this sport.

Sales of softshell parkas rose by 45%, and women's softshell parkas by 83%

Sales highlights for the August to December 2005 season included softshell parkas, which increased by 45% compared with the previous year. Women's softshell parkas alone increased by 83%, albeit from a low base.

SNOW SPORTS: HELMET USE REDUCES RISK OF HEAD INJURY

A new study says wearing a helmet while skiing or snowboarding can reduce the risk of head injury

A study published in the February 22, 2006, issue of *The Journal of the American Medical Association (JAMA)* found that wearing a helmet while skiing or snowboarding can reduce the risk of head injury.

Head injuries are common among alpine skiers and snowboarders

The article reported that head injuries are common in alpine skiers and snowboarders. They are the most frequent reason for hospital admission and the most common cause of death among skiers and snowboarders. Of those admitted to hospital with a head injury, there is an 8% fatality rate.

The study was conducted on the basis that it had been assumed that a helmet reduced the risk of head injuries in alpine sports, but it was not certain to do so

The study was conducted by researchers at the Norwegian School of Sport Sciences in Oslo on the basis that it had been assumed that a helmet would reduce the risk of head injuries in alpine sports, but it was not certain to do so. The survey took place at eight Norwegian alpine resorts during the 2002 skiing season and involved 3,277 injured skiers and snowboarders, and a control group comprising 2,992 uninjured skiers and snowboarders.

Wearing a helmet reduced the risk of a head injury by 60%, and of a severe head injury by 57%

Out of the 3,277 injured individuals, 578 (17.6%) had suffered head injuries. However, by analysing the numbers who had worn a helmet and those who had not, the researchers deduced that wearing a helmet reduced the risk of a head injury by 60%, and diminished the risk of a potentially severe head injury by 57%.

Snowboarders are at greater risk of head injury

Interestingly, the risk of a head injury was 53% higher among snowboarders than alpine skiers.

Helmet use is only mandatory for children in certain countries

Currently, the use of helmets is only mandatory for children in certain countries such as Italy, Norway and Slovenia.

NEOPRENE SUIT COULD SAVE LIVES

A neoprene suit can help to save the lives of women who are haemorrhaging during childbirth

The results of a pilot study by researchers at the University of California in San Francisco have shown that a simple neoprene suit can help to save the lives of women who are haemorrhaging during childbirth.

A non-pneumatic anti-shock garment (NASG), similar to the bottom half of a wetsuit, was evaluated

The research—conducted in Egypt—evaluated the use of a non-pneumatic anti-shock garment (NASG). The garment is similar to the bottom half of a wetsuit and is a variation of a suit used in the USA by the emergency services for patients with lower body trauma.

The NASG suit is designed to push blood back up to vital organs

During childbirth, blood may pool in the mother's abdomen and legs, thereby reducing the flow of blood and oxygen to the brain, heart and lungs. The NASG suit is made from five segments which are tightened with hook and loop fasteners, and is designed to push blood back up to vital organs from the lower extremities and abdominal areas.

Consciousness can be regained within minutes of application of the suit

According to the research team, a haemorrhaging woman can regain consciousness within minutes of application of the suit. It is designed to keep a woman alive until she can be treated in hospital.

The suit is low-tech, reusable and lightweight and can be applied by anyone

The suit is low-tech, reusable and lightweight, and it could help to save many lives. Haemorrhaging accounts for about 30% of the 500,000 maternal deaths which occur annually during childbirth worldwide and mostly in developing countries. One of the other benefits of the NASG suit is that it can be applied by anyone—no medical training is required.

Of the 364 women tested, the 206 treated with the suit lost 50% less blood

The Egyptian study consisted of 364 women. The 206 who were treated with the suit lost half as much blood as the 158 who received the standard treatment for bleeding.

Further studies are planned

The results of the study appeared in the *British Journal of Obstetrics and Gynaecology* on February 27, 2006. Further studies are planned.

SIA says US sales for the winter sports market rose 6% to US\$2.2 bn in August 2005 to February 2006**SALES OF WINTER SPORTS APPAREL**

SnowSports Industries America (SIA) has reported that overall US sales for the winter sports market rose by 6% to US\$2.2 bn for the period August 2005 to February 2006, compared with US\$2.1 bn in the corresponding period of the previous year.

SIA monitors and reports sales in the snow sports market in the USA during the snow season

SIA—a not-for-profit industry trade group—monitors and reports sales in the snow sports market in the USA during the snow season, which runs from August through to March in the following year. SIA has observed that gains which were made during a strong early season were slowing down as warm weather set in.

Apparel helped to drive sales at speciality stores during the period with an 8% increase

According to the report, apparel had helped to drive sales at speciality stores during the August 2005-February 2006 period. At the end of February 2006, apparel sales at speciality stores amounted to US\$540.3 mn. This was 8% higher than in the equivalent period of the previous year.

Apparel sales at chain stores were also up by 8%

Apparel sales at chain stores were also up by 8% during the August 2005-February 2006 period, to US\$196.2 mn.

Strong growth came from soft shell jackets and snowboarding apparel

In particular, strong growth came from soft shell jackets—especially women's and children's—and from snowboarding apparel.

The US Marines have banned the use in Iraq of synthetic athletic clothing made from polyester and nylon because of a burn risk**US MARINES BAN CERTAIN PERFORMANCE APPAREL FIBRES**

A concern that synthetic athletic clothing made of polyester and nylon may present a burn risk has led the US Marines to prohibit the wearing of this type of clothing during operations in Iraq. Marines in hot climates have been attracted to performance apparel specifically designed with moisture wicking capabilities, which is sold at military clothing stores.

Some materials may melt and stick to the skin and cause terrible burns	Clothing made from synthetic materials—such as that produced by Nike and Under Armour—may, when exposed to extreme heat and flames, melt and stick to the skin and cause terrible burns.
Melted synthetic material on top of a burn makes the burn much worse	A Marines' surgeon explained: "If you're throwing [a melted synthetic material] on top of a burn, basically you have a bad burn with a bunch of plastic melting into your skin".
In one case, burn injuries covering 70% of the body were made worse by the melting of a polyester shirt on to the victim's skin	According to a report on www.military.com, an incident in which a Marine suffered from burn injuries covering 70% of his body was made worse by the melting of his polyester shirt on to his skin. The injury occurred despite the fact that he was wearing a protective vest over the shirt.
The new ban extends an existing one on polyester materials for service personnel who are at high risk of exposure to flames	A ban on polyester materials is already in place for service personnel who have jobs which put them at high risk of exposure to flames. However, the Marines have now extended this ban to all personnel on operations because of the heightened risk of improvised explosive devices in Iraq.
This concern addresses problems caused by the Marines' own clothing	While there are ranges of synthetic clothing already designed and used by the military, this particular concern addresses problems caused when Marines wear their own (non-issue) clothing.
Some firms are working to make safer under-garments	Some apparel companies are already working with the military to produce under-garments which are safer.

MERGERS, ACQUISITIONS AND DIVESTMENTS

Russell is to be acquired for US\$598.3 mn by Berkshire Hathaway	RUSSELL CORPORATION AND BERKSHIRE HATHAWAY USA-based Russell Corporation, a manufacturer of athletic wear, is to be acquired for US\$598.3 mn by Berkshire Hathaway—a USA-based diversified insurance and investment company led by billionaire Warren Buffett.
The acquisition is expected to be finalised during the third quarter of 2006	The acquisition is expected to be finalised during the third quarter of 2006, subject to shareholder and regulatory approval. Under the terms of the agreement, Russell shareholders will receive US\$18 cash per share.
The chairman and CEO says Russell will be better positioned against its worldwide competitors	The chairman and chief executive officer of Russell, Jack Ward, has said of the acquisition: "Russell will be better positioned against our worldwide competitors in all three segments of our business and that includes apparel, sports equipment and athletic shoes".

PATENT AND TRADEMARK DISPUTES

Nike has filed a complaint against Adidas-Salomon over its use of Nike's Shox technology

NIKE SUES ADIDAS OVER SHOX PATENT INFRINGEMENT

Global sportswear giant Nike has filed a legal complaint against its rival Adidas-Salomon in the USA. The complaint concerns products that infringe Nike's Shox cushioning technology, which is protected by 19 separate patents.

Nike claims Adidas is using Nike's technology for the Adidas a3 cushioning system

The Adidas products listed as infringing Nike's patented technology are those which use the Adidas a3 cushioning system—including the company's computerised shoe, Adidas 1. Nike claims that Adidas has built these shoes using Nike's technology.

TRADE FAIRS AND CONFERENCES

ISPO held its winter trade fair in Munich in January 2006

ISPO WINTER 2006

ISPO (International Trade Fair for Sports Equipment and Fashion) held its winter trade fair at the New Munich Trade Fair Centre in Germany from January 29 to February 1, 2006.

There was a 13% increase in exhibitor numbers

The fair attracted a record 1,806 exhibitors from 49 countries. This figure represented a 13% increase on the number of exhibitors at the fair compared with the previous year.

Visitor numbers were up by 10%, and 60% came from outside Germany

Visitor numbers rose too. Over 60,000 trade visitors attended the fair, representing a 10% increase compared with 2005. Around 60% of the trade visitors were from countries other than Germany. Significant increases in visitor numbers were seen from East European countries as well as from Austria, France, Italy, Spain, and Switzerland.

The industry was in a euphoric mood and has high expectations for 2006

Against a backdrop of record exhibitors and visitors, ISPO reported that the sports equipment and fashion industry was in a euphoric mood. The industry has high expectations for 2006, especially with an eye on the two big sporting events—the Winter Olympics in Turin and the FIFA World Cup in Germany.

The main focus was on—

The main points of focus for ISPO winter 2006 were on the following topics:

—safety, products lines, Nordic fitness, innovations, mountain lifestyle, and electronics and technology

- safety;
- product lines especially for women;
- Nordic fitness;
- technological innovations in skiing and snowboarding;
- mountain lifestyle fashion collections; and

- the integration of electronics and technology in sports equipment.

44 awards for innovation were presented

A total of 44 awards were presented during the course of the fair. These were awarded for innovation and went to designers, fashion and footwear companies, producers of hardware, safety equipment and accessories, and newcomers.

ISPO held its first winter event in Russia in February 2006

ISPO RUSSIA WINTER 06

ISPO (International Trade Fair for Sports Equipment and Fashion) has held its first winter event in Russia. ISPO Russia Winter 06 took place on February 20-23, 2006, at the Crocus Center in Moscow.

It attracted 230 exhibitors from 21 countries

The event attracted 230 exhibitors from 21 countries who were housed in an 11,000 m² exhibition area.

6,823 visitors came from 69 of Russia's 89 provinces and from 23 other countries

A total of 6,823 visitors attended the show, from 69 of the 89 provinces of Russia and from 23 other countries. The greatest number of visitors, after Russia, came from Kazakhstan, Ukraine and Belarus.

Product presentations were accompanied by side events

Besides product presentations, ISPO Russia provided a range of side events such as seminars, workshops and fashion shows.

ISPO Russia summer 06 will be held in Moscow on September 20-23, 2006

The ISPO Russia summer 06 event is due to be held in Moscow on September 20-23, 2006. It will be the second ISPO Russia summer event.

Glossary: terms and definitions

Absorbency under load:	the weight of fluid in grams which can be absorbed by 1 gram of fibre , yarn or fabric which has been subject to a pressure of 0.25 lb/inch ² before wetting.
Acetate:	a type of fibre chemically derived from cellulose.
Acquisition layer:	an absorbent layer close to the coverstock in a nonwoven hygiene product (such as a diaper) through which fluid enters. Typically, the fluid is then transmitted to a distribution layer .
Anti-bacterial:	resistance against bacteria.
Aramid:	the generic name for a special group of synthetic fibres (aromatic polyamide) having high strength; examples are Kevlar from DuPont and Twaron from Teijin Twaron.
Artificial fibres:	see cellulosic fibres .
Ballotini:	small glass beads which are normally used in reflective paints but which can also be incorporated into fabrics.
Bicomponent fabric:	a fabric with two layers.
Bicomponent yarn:	a yarn with two different continuous filament components.
Bi-shrinkage yarn:	a yarn containing two different types of filament , which have different shrinkages.
Cellulosic fibres:	fibres made or chemically derived from a naturally occurring cellulose raw material.
Chemiluminescence products:	products which glow when one liquid chemical containing special fluorescers interacts with another (an activator).
Clo value:	the amount of insulation required to keep a resting subject with a metabolism of 50 kcal/metre ² /hour comfortable for an indefinite period of time at a temperature of 21°C (70°F).
Composite (fabric):	a fabric structure, usually nonwoven , comprising several layers.
Composite (fibre reinforced):	see fibre reinforced composite .
Comonomer:	one of the compounds which constitute a copolymer .
Copolymer:	a polymer in which there are two or more repeat units.
Core-spun yarn:	a yarn consisting of an inner core yarn surrounded by staple fibres. A core-spun yarn combines the strength and/or elongation of the core thread and the characteristics of the staple fibres which form the surface.

Core-twisted yarn:	a yarn produced by combining one fibre or filament with another during a twisting process.
Count:	a measure of linear density (see decitex , denier , tex).
Covered yarn:	a yarn made by feeding one yarn through one or more revolving spindles carrying the other (wrapping) yarn. Covered yarn may also be produced using air-jet technology.
Cover factor (knitted fabrics):	a number which indicates the extent to which the area of a knitted fabric is covered by yarn. It is also an indication of the relative looseness or tightness of the knitting.
Cover factor (woven fabrics):	a number which indicates the extent to which the area of a fabric is covered by one set of threads. For any woven fabric, there are two cover factors: a warp cover factor and a weft cover factor. Under the cotton system, the cover factor is the ratio of the number of threads per inch to the square root of the cotton yarn count .
Decitex:	a unit of the tex system. A measure of linear density ; the weight in grams of 10,000 metres of yarn.
Decitex per filament (dpf):	the average decitex of each filament in a multifilament yarn .
Dendrimer:	a synthetic polymer with a tree-like branching structure.
Denier:	a measure of linear density ; the weight in grams of 9,000 metres of yarn.
Distribution layer:	a layer in a nonwoven hygiene product (such as a diaper) which distributes fluid to a superabsorbent and/or fluff pulp material, where it is absorbed.
Dobby:	a mechanism for controlling the vertical position of heald shafts on a loom, so as to selectively raise some warp threads while leaving others depressed. The use of a doobby facilitates the weaving of a fabric which has a more complex structure than that achievable by using cams and tappets to raise and lower heald shafts. However, it can not offer weaves as complex as those obtained by using a jacquard mechanism.
Dobby weave:	a type of weave produced on a loom equipped with a doobby.
Dpf:	see decitex per filament .
Drape:	a cover sheet.
Dry spinning:	in the dry spinning process, polymer is dissolved in a solvent before being spun into warm air where the solvent evaporates. This leaves the fibrous polymer ready for drawing.
Dry spun:	a fibre or filament produced by the dry spinning process.
Dtex:	see decitex .

Elastane, elastomeric:	a fibre , often made of polyurethane, possessing inherent stretch properties (also known as spandex , especially in the USA).
Elastomer:	a polymer which has a high extensibility, together with rapid and substantially complete elastic recovery (most fibres formed from elastomers have breaking elongations in excess of 100%).
End (in weaving):	an individual warp yarn.
False-twist texturing:	a process in which a single filament yarn is twisted, set and untwisted. When yarns made from thermoplastic materials are heat-set in a twisted condition, the deformation of the filaments is “memorised” and the yarn is given greater bulk.
FDY:	fully drawn yarn.
Fibre:	a material used to make textiles which is flexible, fine, and has a high ratio of length to thickness.
Fibre reinforced composite (FRC):	a product formed by intimately combining two or more discrete physical phases—usually a solid matrix, such as a resin , and a fibrous reinforcing component.
Filament:	a fibre of indefinite length.
Filamentation:	breakage of filaments , resulting in the creation of a fibrous or hairy appearance on the surface of a yarn package or fabric.
Fill:	see weft .
Flame resistant:	a term used to describe fibres , yarns or fabrics which resist burning.
Flame retardant:	a substance added or a treatment applied to a material in order to suppress, significantly reduce or delay the propagation of flame.
Fleece (fabric):	pile or napped fabric with a deep, soft, woolly-style surface.
Fleece (garment):	outerwear jacket made from fleece fabric.
Fluorescent material:	a material which absorbs certain wavelengths of light and emits or reflects wavelengths that are longer than those which are absorbed.
FOY:	fully oriented yarn.
FR:	see flame retardant .
Free swell absorbency:	the weight of fluid in grams which can be absorbed by 1 gram of fibre , yarn or fabric.
Gpd (gm/denier):	a unit of force divided by the weight per unit length of a fibre , yarn or rope.
Granulation:	the process of forming new tissues.

Hydroentanglement:	see spunlacing .
Hydrophilic:	a term used to describe a substance which tends to mix with or to be wetted by water.
Hydrophobic:	a term used to describe a substance which tends to repel or not to be wetted by water.
Hygroscopic:	a term used to describe a substance which attracts moisture from the atmosphere.
Imagewear:	a term used to describe apparel which is used to project a corporate identity. Examples include workwear, career wear and uniforms.
Industrial textiles:	a category of technical textiles used as part of an industrial process, or incorporated into final products.
Islands-in-the-sea:	a type of bicomponent yarn in which one component polymer is formed, during extrusion, as longitudinal strands within the matrix of a second polymer .
ISPO:	International Trade Fair for Sports Equipment & Fashion, held in Munich, Germany.
kPa (kilopascal):	the pressure exerted by a 10 g mass resting on an area of 1 cm ² .
Linear density:	the weight per unit length of a yarn or fibre . Units of linear density include decitex , denier and tex .
LOY:	low orientation yarn.
Lycra:	brand name used by DuPont for its spandex or elastane fibre .
Lyocell:	the generic name given to a new family of cellulosic fibres and yarns which have been produced by solvent spinning. The process is widely regarded as being environmentally-friendly, and the product offers a number of advantages over traditional cellulosic fibres .
Man-made fibres:	fibres which are manufactured and which do not occur in nature. The term man-made fibres is also used to refer to man-made filament yarns.
Man-made filaments:	filaments which are manufactured and which do not occur in nature.
Mass coloration:	a method of colouring man-made fibres by incorporating a dye or colorant in the spinning solution or melt before extrusion into filaments . Also known as dope-dyeing .
Microfibre:	a fibre or filament with a linear density approximately below 1 decitex . Some commercial fibres or filaments as coarse as 1.3 decitex are classified as microfibrils by their producers (see also microfilament).
Microfilament:	a continuous filament with a linear density approximately below 1 decitex . Some commercial filaments as coarse as 1.3 decitex are classified as microfilaments by their producers (see also microfibre).

Micron (micrometre):	one millionth of a metre (10^{-6} metres).
Micro-organisms:	living organisms of microscopic size such as bacteria or fungi which produce infection and disease.
Microyarn:	a yarn consisting of several microfilaments .
Modal:	a type of cellulosic fibre having improved strength and modulus when wet.
Modulus:	a measure of the ability of a fibre to resist extension. Normally measured as the ratio of the stress (or load) applied on a yarn or filament to the elongation (strain) resulting from the application of that stress.
Moisture management (in textiles and garments):	the process by which moisture is moved away from the skin and dispersed through a fabric to its outer surface, from where moisture can evaporate, leaving both the skin and garment dry.
Moisture regain:	the percentage of moisture in a textile material brought into equilibrium with a standard atmosphere after partial drying, calculated as a percentage of the moisture-free weight.
Monofilament yarn:	a yarn consisting of a single filament .
Monolithic (membrane):	continuous polymer layer.
mPa (megapascal):	the pressure exerted by a force of 1 Newton applied over an area of 1 mm ² .
Multifilament yarn:	a yarn made up of more than one filament .
Nanometre:	one billionth of a metre (10^{-9} metres).
Nanotechnology:	research and technology development at the atomic, molecular or macromolecular levels (in the 1-100 nanometre range) aimed at creating and using materials which have novel properties and functions.
Nanotubes:	all-carbon cylinders which are up to 100 times stronger than steel.
Nonwoven:	(according to ISO 9092:1988) a manufactured sheet, web or batt of directionally or randomly orientated fibres , bonded by friction and/or cohesion and/or adhesion, excluding paper and products which are woven, knitted, tufted, stitchbonded incorporating binding yarns or filaments , or felted by wet-milling, whether or not additionally needed.
Novoloid:	a manufactured fibre which contains at least 85% by weight of a cross-linked novolac (phenolic resin).
Nylon:	another word for polyamide .
Oleophilic:	a propensity to absorb oil.
Partially oriented yarn:	a continuous synthetic filament made by extruding a polymer so that a substantial degree of molecular orientation is present in the resulting filaments , but so that further substantial molecular orientation is still possible. The resulting yarn will usually have to be drawn in a subsequent

	process in order to orient the molecular structure fully and optimise the yarn's tensile properties.
PET:	polyethylene terephthalate, the most common form of polyester.
Pick:	a single weft thread in a woven fabric.
Pill, pilling:	the entangling of fibres during washing, dry cleaning, testing or in wear to form balls or pills which stand proud of the surface of a fabric and which are of such density that light will not pass through them (so that they cast a shadow).
PLA:	polylactic acid, a synthetic polymer formed from plant-based material and used as the starting material for a new range of melt spun synthetic fibres, including Ingeo from Cargill Dow.
Polyamide:	another word for nylon .
Polylactic acid:	see PLA .
Polymer:	a long molecule made up from many smaller repeat molecules; the following polymers are the main ones used to make synthetic fibres : <ul style="list-style-type: none">● polyacrylic;● polyamide (nylon);● polyester;● polypropylene; and● polyurethane.
Polymerisation:	the process of linking small chemical units together to form larger molecules.
POY:	see partially oriented yarn .
Prepolymer:	a polymer of relatively low molecular weight—usually intermediate between that of the monomer and the final polymer or resin—which may be mixed with compounding additives and which is capable of being hardened by further polymerisation during or after a forming process.
Push-pull fabrics:	bicomponent fabrics composed of a non-absorbent hydrophobic material, usually polyester, on the inside (worn next to the skin) and an absorbent hydrophilic material, usually nylon , on the outside.
Rayon:	a term used to describe fibres made from regenerated cellulose (see also viscose , modal and acetate).
Reaction spinning:	one of three types of production process used to make elastane (the other two being dry spinning and wet spinning) in which fibres are formed through a chemical reaction, and polymerisation and formation of filaments occur simultaneously as the prepolymer is extruded in a reagent bath.
Retention:	the weight of fluid remaining after a freely swollen fibre , yarn or fabric is subjected to a pressure of 0.5 lb/in ² .
Rip stop:	a lightweight woven fabric containing corded yarns spaced at regular

	intervals—in both the warp and the weft —which form squares on the surface of the fabric in order to prevent a tear in the fabric from spreading. Common applications include parachutes, outerwear and activewear.
Sanforizing:	a controlled compressive shrinkage process. The word Sanforized is a registered trade mark and can be used to describe fabrics which meet defined and approved standards of washing shrinkage.
Shape memory polymers (SMPs):	chemical compounds which have one form at a certain temperature, which can be given a different shape when subjected to a stimulus such as heat, and which, under certain conditions, can return to their original “memorised” form. Current textile research is focused on using shape memory polymers to create “smart” fabrics with protective and moisture management capabilities.
Shed (weaving):	an opening formed during weaving by raising some warp threads and lowering others to facilitate the passage of a weft yarn or a weft carrying device across the weaving machine.
Shedding:	a motion in weaving whereby a shed is created to facilitate the passage of a weft yarn or a weft carrying device across the weaving machine.
Spandex:	the generic name used in the USA to denote elastane fibre .
Spinneret:	a nozzle or plate provided with fine holes or slits through which a fibre -forming solution or melt is extruded during fibre manufacture.
Spinning solution:	a solution of fibre -forming polymer ready for extrusion through a spinneret .
Sputtered:	a material which has been subjected to sputtering .
Sputtering:	a process in which atoms, ions and molecules are ejected from the surface of a target material when it is irradiated by an ion beam. One application of sputtering is to exploit the conditions in which the ejected particles re-form on another substrate as a thin film or coating. For instance, thin metallic films are often applied in this way to electrically non-conductive substrates to give them conductive properties.
Staple fibres (man-made):	man-made fibres of predetermined short lengths, usually prepared by cutting or breaking filaments of the material into lengths suitable for their intended processing route.
Sublimation:	a process in which a substance changes directly from a solid to a gas when it is heated, without passing through the liquid state.
Synthetic fibres:	man-made fibres made from a polymer which has been produced artificially, in contrast to fibres made from naturally occurring polymers such as cellulose. The term synthetic fibres is also used to refer to synthetic filaments .
Synthetic filaments:	man-made filaments made from a polymer which has been produced artificially, in contrast to filaments made from naturally occurring polymers such as cellulose.

Technical textiles:	textile materials and products manufactured primarily for their technical performance and functional properties rather than their aesthetic or decorative characteristics. End uses include aerospace, industrial, marine, medical, military, safety and transport textiles, and geotextiles.
Tenacity:	a unit used to measure the strength of a fibre or yarn, usually calculated by dividing the breaking force by the linear density .
Tencel:	a brand name used by Lenzing for a cellulosic fibre first commercialised in the late 1990s by Courtaulds and generically known as lyocell . Tencel is stronger than viscose cellulosic fibre and is characterised by its softness and drape.
Tensile strength:	the longitudinal stress which a substance can bear without tearing apart.
Tex:	a measure of linear density ; the weight in grams of 1,000 metres of yarn.
Textured yarn:	a continuous filament yarn which has been processed to introduce durable crimps, coils, loops or other fine distortions along the lengths of the filaments .
Texturing:	a process during which a textured yarn is produced.
Thermoplastic yarns:	yarns which are deformable by applying heat and pressure without any accompanying change, and in which the deformation is reversible.
Thermoregulation:	regulation of body temperature.
Ton:	(in this publication) 1,000 kilograms.
Tow:	the name given to an untwisted assembly of a large number of filaments ; tows are cut up to produce staple fibres .
UPF:	ultra-violet protection factor.
Viscose:	the generic name for a type of cellulosic fibre obtained from wood cellulose.
Warp:	yarns which are incorporated along the length of a fabric.
Warp knitting:	a method of making a knitted fabric from a warp in which loops made from each warp thread are formed substantially along the length of the fabric. Warp knitting is characterised by the fact that each warp thread is fed more or less in line with the direction in which the fabric is produced. (See also weft knitting .)
Weaving:	the process of producing fabric by interlacing warp and weft yarns.
Web:	a sheet of fibres produced by a carding machine (carded web) or combing machine (combed web).
Weft:	yarns which are incorporated across the width of a fabric.
Weft knitting:	a method of making a knitted fabric in which the loops made by each weft thread are formed substantially across the width of the fabric. Weft knitting

	is characterised by the fact that each weft thread is fed more or less at right angles to the direction in which the fabric is produced.
Wet spinning:	in the wet spinning process, the polymer solution (also known as “dope”) is spun into a spin bath containing a liquid chosen for its ability to extract the solvent from the dope.
Wet spun:	a fibre or filament produced by the wet spinning process.
Wicking:	a process whereby a textile material transports moisture away from a surface such as the skin.
Wrapped yarn:	see wrap-spun yarn .
Wrap-spun yarn:	a yarn consisting of a core wrapped with a binder.

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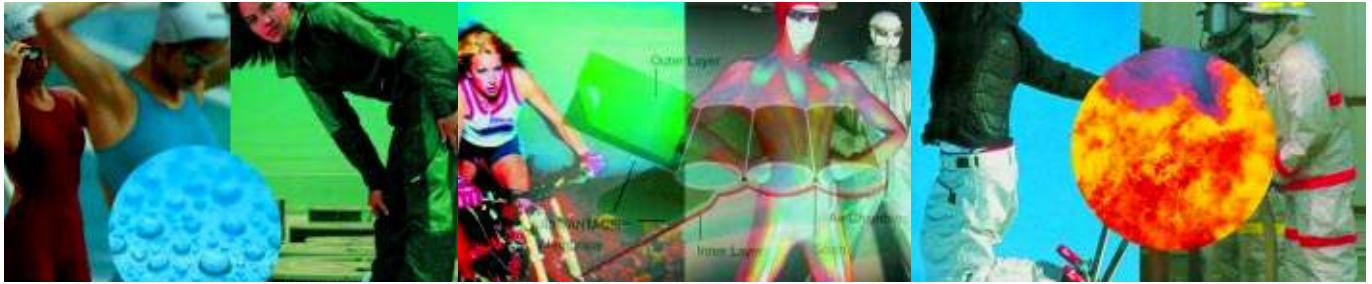
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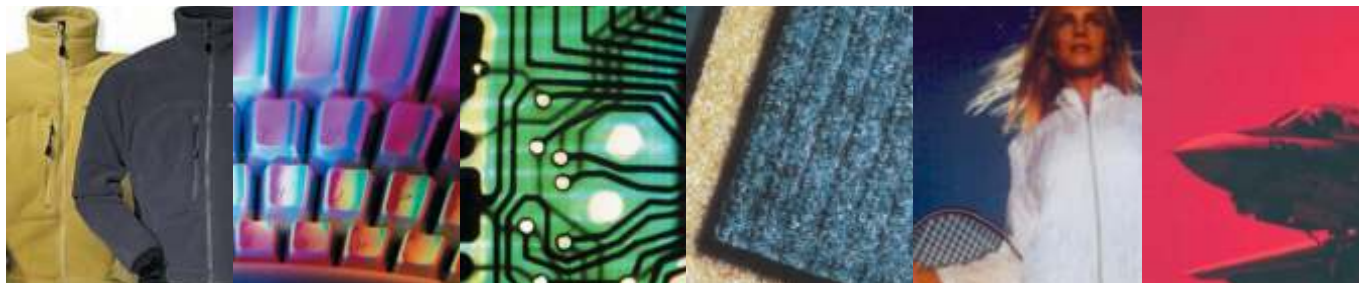
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Traditional applications for high performance fibres and technical textiles include conveyor belts, tarpaulins, tyre cords and ropes. Producers are also manufacturing high-tech products for an increasingly wide range of industrial end uses.

However, as the markets for fashion and sports clothing have started to merge, high performance fibres and technical textiles are also meeting the demand for new materials created by changes in consumer "lifestyle". Furthermore, as leisure time increases, so does the demand for specialist sports goods.

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New technology offers more flexibility, customised products, smaller order sizes

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