

Clothing Materials:

A totally (or near-totally) subjective analysis of newer clothing materials for outdoor clothing

by Keith Conover, M.D., FACEP (not © copyrighted at all, do whatever you want with it.)

Allegheny Mountain Rescue Group, Appalachian Search and Rescue Conference/Mountain Rescue Association

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There are zillions of fabric materials out there. For example, although Malden Mills, the Polartec people, have only about 12-15 brand names, each of these comes in slightly different flavors -- they actually make more than 150 different fabrics! Only some are suitable for the outdoors, and I've tried to limit the table to outdoor or travel clothing materials. A detailed listing of high-tech materials, complete with marketing fluff and links, can be found at <http://www.fabriclink.com/pk/Indexaz.html> - Index. A listing by company is available at <http://www.outfittermag.com/articles/071feat5.html>, and another website with some information on late-breaking fabric news (again from the manufacturers, no independent evaluation) is at http://www.geartrends.com/outdoor_site/fabrics.html. One interesting (and overwhelming) table is available at: <http://bicycleapparel.com/fabrics.html> Please note that the term "technical," as used by many manufacturers to describe their clothing, is meaningless noise: ignore it. (Most marketing-speak is meaningless, but "technical," as far as meaningfulness, actually gets into the negative numbers.)

There are many manufacturers, the ones I know and/or like are listed as links in the footnotes. Because there are so many new good outdoor clothing materials, each manufacturer has to choose just a few fabrics. Thus, if you shop around, you can find many similar garments in different materials. The manufacturers use the same name for many different fabrics, and sometimes a single fabric has more than one name, *and* sometimes they keep the same name but change the fabric. Sigh.

Although you won't find it on the informational pages at www.polartec.com (Malden Mills' site), they have started numbering their fabrics. [Lowe Alpine](#) makes garments using a variety of Malden Mills fabrics, and they were nice enough to include the numbers of the fabrics on their website, which is a great way to make sure the fabric you're buying is (more or less) what you've bought in the past:

- **Polartec Special Edition with Power Dry Technology (7347)**
Technical inner layer insulation. Innovative 'pillar' interior traps warm air, improves breathability, reduces weight and increases packability. PowerDry® wicking performance allows next-to-skin use or as an intermediate layer.
- **Polartec Special Edition with Thermal Pro Technology (4060)**
Versatile mid-layer insulation. The deep pile face is open-stitched to the interior velour, giving a high-loft fabric with low density. Maximum warmth with excellent airflow, low weight and packability. Top warmth-to-weight ratio.
- **Polartec Special Edition with Thermal Pro Technology (40810)**
The fleece that thinks it's down insulation. The deep pile face is open-stitched to the interior velour, giving a high-loft fabric with low density. Maximum warmth with excellent airflow, low weight and packability. Standard and marled versions.

There is also a "Special Edition" version of Powerstretch: **Special Edition Powerstretch (9400)**, see below. If you find this all very confusing, don't worry, the fact that you're confused is clear evidence that you know more than most people, who don't yet know enough to be confused!

Windproofness

One of the trends over the past few years is for new materials that have the warmth of fleece but with improved resistance to wind (traditional fleece has basically no wind resistance). Here are some figures that Katherine at Malden Mills emailed to me in February 2002 as far as wind resistance of newer Malden Mills Polartec fabrics. Wind resistance is cubic feet per square foot per minute (Ft³/ft²/min)

Polartec Windbloc	0
Polartec Power Shield	6.42
Polartec Windbloc ACT	15
Polartec Wind Pro	65
Polartec 200	325

I find this very useful information, because the marketing information really doesn't give you much quantitative information about wind resistance. The way I read the figures, Windbloc (and the Gore equivalent, WindStopper) basically stop all wind but don't ventilate moisture all that well. So Wind Pro is just fleece that's a bit better against wind, without losing too much vapor permeability or softness, but Power Shield makes a pretty good wind shell. BTW, both North Face and [Mountain Equipment Coop](#) offer garments made of Power Shield.

GoreTex et al.

The original Gore-Tex fabric was a true revolution in outdoor fabrics. By allowing water vapor to pass (at least when dry), yet preventing liquid water from penetrating, this fabric was a wonderful replacement for the other fabrics us outdoor people used prior to Gore-Tex. Before Gore-Tex, we had Ventile, which was a special, long-staple Egyptian cotton, the fibers all being very tightly wound. When wet, the fibers swelled, becoming (mostly) waterproof, although when wet and frozen, it was like cast iron (not great for

climbing). 60/40 cloth, which mixed polyester fibers with the long-fiber cotton for better durability and flexibility when frozen, was “the thing” for a while – my wife and I still have our original “sixty-forties” – I use mine as a durable jacket for working on my truck. I think I threw my ventile anorak away years ago (it also had holes in it, ventile wasn’t that durable).

Gore-Tex is a tradename for something known generically as “expanded polytetrafluoroethylene” or PTFE for short – basically Teflon plastic that had been “expanded” in a proprietary manner to make zillions of tiny pores, small enough to prevent liquid water from penetrating, yet small enough for water vapor to get through. How so? Well, when water is liquid, it’s not just individual molecules of H₂O, it’s actually a clump of H₂O molecules bound together with hydrogen bonds, so the clumps are pretty big. But as water vapor, H₂O exists as individual molecules, i.e., much smaller.

Gore-Tex I (“one”) worked, mostly, but broke down quickly. I was lucky enough to have an early North Face pullover made from Gore-Tex I, which was nice, but the waterproofness only lasted about a year. However, Gore had a money-back lifetime guarantee, so I ended up with a free brand new pullover (which still hangs in my closet) made of Gore-Tex II, which was much more sturdy. Gore-Tex I and II, however, really didn’t breathe all that well, and none of these fabrics breathe when they’re wet. And so, especially for those like me who sweat a lot, pit zips (underarm zippers) are essential. I’ve even added pit zips to some of my old Gore-Tex jackets.

Today there are dozens of waterproof and breathable fabrics, including Sympatex, Hydroflex, Ultrex, Omni-Tech, H₂O No Storm HB, Nikwax Analogy, Triple Point Ceramic, Hydro/dry P2 and Hydro/dry P3, Aqua Dry and Aqua Dry Pro, and Aqua Foil. All of these (including current Gore-Tex) are better than Gore-Tex I, and as far as which is best, I doubt that anyone, anywhere, can really give you a good answer. Some are more breathable than the original Gore-Tex, some both more breathable and more waterproof, and all pretty much more durable. Sympatex is pretty much just for shoes, as it’s very durable but not very flexible. Gore-Tex XCR (“extended comfort range”) is about as waterproof as Gore-Tex II but much more breathable – but I still say that Gore-Tex XCR jackets need pit zips.

[Gore-Tex](#) (W.L. Gore) has, in 2002, come out with Gore-Tex Windstopper N2S (“next to skin”) which is a wicking layer directly bonded to Gore-Tex XCR. However, I *hate* the feel of Windstopper (it feels like fingernails on a blackboard sound), and I doubt it’ll stretch enough to be really comfortable – though I hope the fabric proves me wrong.

Wicking vs. Bipolar Construction

There is no argument that, in cold/wet conditions, one wants something against the skin that is warm when wet. And one wants something that doesn’t hold water against the skin. The traditional material was fine [wool](#) -- reasonably warm when wet, doesn’t hold much water against the skin, lasts a long time, and if made from high-quality wool (cashmere, north coast Australian wool like the old Sears wool underwear), not all *that* itchy. (Actually, I caved in the Sears wool underwear and still have some for backup use.)

But wool, unless you got the really good stuff, was itchy. And when wet you smelled like a wet sheep. And though it was much, much better than cotton, it still held a significant amount of water against the skin -- wet wool is still heavy and cold when you put it on. But compared to cotton, the water would drain out the bottom of the wool underwear a lot quicker.

Well, next was [PolyPro](#) underwear. Polypropylene was used because it was very hydrophobic (“water-hating”) -- compared to wool, it wouldn’t hold hardly any water at all, and by staying drier it was warmer (and lighter) when wet. And, since it was made into a loose weave, it was pretty porous, so sweat could pass through fairly easily. But polypro absorbed body odor, “pilled” (developed lots of little fuzzy balls on its surface), and melted in the drier or near a fire, resulting in an ugly, smelly lump of melted plastic. So [polyester](#), with less pilling, and better heat resistance, replaced polypro.

But even polyester didn’t really feel all that comfortable against the skin in warm weather compared to dry cotton. Why? Well, cotton fibers, unlike polyester fibers, are made up of many, many smaller microfibers, which makes it softer against the skin, and allows it to drape a bit better. Cotton’s microfiber construction, along with its hydrophilic (“water-loving”), means that it *wicks* water away from the skin -- that is, until the cotton is soaked through and through. When soaked, cotton holds water near the skin, and allows it to circulate from the skin to the surface of the cotton and back again, making a pretty good heat pump. Good in warm weather, bad in cold weather.

So people thought “Can’t we find something that is as comfortable as cotton in warm weather AND in cold weather? And is comfortable even when soaked?” One way is to make polyester fibers made up of tiny microfibers, just like cotton -- this should make it more comfortable against the skin, drape better, and look better, but with polyester’s hydrophilic nature, it shouldn’t hold as much water or act like a heat pump. Indeed, as I type this, I’m wearing a pair of [polyester microfiber](#) dress pants at work, and they’re extremely comfortable against the skin. Nice stuff. You can also “brush” materials made out of microfibers so that they are all fuzzy on one side, and wear that against your skin. Malden Powerdry is a great example of this kind of construction (and the most comfortable stuff against the skin I’ve ever worn, it’s even better than cotton).

But there was still the problem of sweat. Even though polyester knits could pass sweat, they still weren’t as good as dry cotton at sucking up sweat. So what can we do? If we make material as hydrophilic as cotton, and with as small a microfiber size, it’ll end up acting just like cotton. It turns out that you can coat polyester fibers with a variety of materials, you can make the surface hydrophilic enough to wick water -- but since the fibers aren’t as small or as hydrophilic as cotton, it still won’t hold much water.

But, compared with cotton, this wicking effect isn't great, so what else can we do? Well, some clever people realized that if you combine two different types of fibers, in just the right yarn and with just the right construction, you can put a hydrophilic material on the outside and hydrophobic on the inside. The first such fabric I saw was called DriClima, and I was impressed. The outdoor store had a swatch, and the owner wadded it up, put it in a cup of water, and then wrung it out. He handed it to me, and I could feel that one side was wet and cold, and the other side felt warm and dry. I've had a Marmot Shelled DriClima windshirt since then and been very happy with it.

Some companies insist that artificial fibers don't wick at all, moisture just passes through them via vapor diffusion and bipolar fabrics are the only thing that seem to move moisture away from your skin. Well, we know that cotton wicks -- you can demonstrate this by taking a cotton towel, and hanging it up so that one end is in a bucket of water. Half an hour later a lot of the water will be drawn up into the towel, and it will be soggy. You can do the same thing with artificial "wicking" fibers, too -- there is little moisture in them after the bucket experiment, but enough to show that there is indeed wicking. Certainly polyester microfiber seems to do this more than other artificial fibers with which I've tried this, perhaps due to the enhanced wicking of the microfibers, and the best I've seen so far for wicking is Malden [Powerdry](#), although [Powerstretch](#) comes close, mostly because you can buy it small and wear it so it's tight against your skin (improves wicking a lot). Powerdry seems best as a summer T-shirt or as a base layer in colder weather.

Two days before version 1.7 of this document, I was hiking fast on a warm day, relatively level trail, with a heavy pack (20 lbs. gear + 30 lbs. of 2-year-old) and was wearing a [Powerdry](#) shirt. Admittedly it was a fairly dry day for the Appalachians, but even though my entire shirt would get soaked in sweat going uphill - showing it spread out the sweat quite well -- a 15' rest stop would find it almost entirely dry at the end.

So don't believe that artificial fibers don't wick. As far as the relative contribution of wicking vs. bipolar construction for moving water away from your body, though, the jury is still out. One thing I've found is wicking layers only work if they're right up against your skin. So stretch materials are important, another reason to like Malden [Powerdry](#) or [Powerstretch](#). (No I don't own stock in Malden Mills or work for them!)

The most interesting recent development along this line is the idea espoused by the European company Paramo in the Parameta-S fiber garments that they market. These are reversible bipolar garments, wear one way for hot weather and inside out for cold weather. Interesting idea! However, this material isn't really stretchy, so it loses out to Malden Mills' similar [Powerstretch](#) fabric in my book.

Keith's Picks in Bold		comfort against skin	warmth (not per weight)	warmth when wet?	water resistance	wind resistance	abrasion resistance	stretch	wicking and sweaty comfort	resistance to pilling	thorn-pull resistance	Speed of Drying	Wrinkle-resistance	Resistance to matting
Against the Skin Everyday Clothing														
Shell-Wicking "SoftShell" ⁱ	Schoeller Dynamic ⁱⁱ	++	+	++	+	++	++	++	++	NA	xxx	+++	+	+
	Schoeller Dryskin	++	++	+	+	++	+++	+	+++	NA	xx	++	++	++
	Schoeller Dryskin Extreme ⁱⁱⁱ	++++	+++	+++	+	++	+++	+++	++++	NA	x	+++	++	++
	Schoeller WB-400 ^{iv}	?	?	?	?	?	?	?	?	?	?	?	?	?
	Polartec Power-stretch Cordura ^v	?	?	?	?	?	?	?	?	?	?	?	?	?
	Polartec Power-Shield ^{vi}	?	?	?	?	?	?	?	?	?	?	?	?	?
	Gore Wind-stopper ^{vii}	x	+	+	++	++++	?	+	x	?	?	?	++	++
	Malden Windbloc	+	++	+	++	++++	?	+++	+	?	?	?	++	++

[illegible]

Pile and Fleece	Helly-Hansen Pile ^{ix}	+++	+++	+++	X	X	X	+	++	+	X	++	++	X
	Non-Helly-Hansen Pile ^x	+++	+++	+++	X	X	X	+	++	xxx	X	++	++	X
	Malden ^{xi} Polartec 100/200	+++	+++	+++	X	X	+	++	++++	++	X	+++++	+++++	+
	Polartec High Void Grid	?	?	?	?	?	?	?	?	?	?	?	?	?
	Polartec Regulator	?	?	?	?	?	?	?	?	?	?	?	?	?
	Marmot Outlast ^{xii}													
	Polartec Powerstretch 100/200 ^{xiii}	++++	+++	++++	X	X	+	++++	+++++	++	X	+++++	+++++	+
	Paramo Parameta S ^{xiv}	++	++	++	X	X	X	+	++	?	X	++	++	++
Shellish Clothing	Water-proof Zippers ^{xv}													
	Nylon ^{xvi}	X	X	X	++	++++	+	xxxx	X	++++	+	++++	+	NA
	Coated Nylon	xxx	++	X	+++++	+++++	+							
	Supplex Nylon	+	X	X	++	++++	++	xxxx	X	NA	++	++++	++	NA
	Spandura ^{xvii}	X	+	+	+	++	++++	+++	X	+++++	X	++	++	NA
	Supplex Ripstop Nylon ^{xviii}	++	X	X	++	++++	+++	xxxxx	++	NA	++++	++++	+++	NA
	Goretex ^{xix}	X	+	+	++++	+++++	varies ^{xx}	x ^{xxi}	xxxx	NA	+++	++	varies	NA
	Pertex ^{xxii}	X	+	+	++	+++++	varies	X	xxx	NA	+++	++	varies	NA
Everyday Materials	Wool ^{xxiii}	X	++	++	X	X	++	+	X	X	+++	X	+++	+++++
	Silk	++	+	++	+	++	++	+	xxx	NA	X	+	xx	NA
	Cotton ^{xxiv}	++ ^{xxv}	+++	xxxxx	xxx	++	+	X	x ^{xxvi}	+++++	++++	xxxxx	xx	xx
	Malden Powerdry ^{xxvii}	++++	++	+++	X	X	X	++++	+++++	++	X	+++	++++	++
	Intera ^{xxviii}	+++	+	+	X	+++	++	X	++++	NA	+	+++	+++++	NA
	Tencel ^{xxix}	+++	X	+	X	++	X	X	X	NA	X	+	+++	NA
	Polyester Microfibre ^{xxx}	++	+	++	X	+++	X	+	++	NA	X	+++	+++	NA
	duPont CoolMax (as everyday clothing) ^{xxxi}	++	++	+	X	X	X	+++	+++	xx	xx	+++	+	NA
		comfort against skin	warmth (not per weight)	warmth when wet?	water resistance	wind resistance	abrasion resistance	stretch	wicking and sweaty comfort	resistance to pilling	thorn-pull resistance	Speed of Drying	Wrinkle-resistance	Resistance to matting

<i>Layering and Sleeping Bag Materials</i>													
Down/shell	NA	++++	xxxx	NA	NA	NA	NA	xxxx	NA	NA	xxxxx	NA	xxxxx
Dacron-88	NA	++	++	NA	NA	NA	NA	+	NA	NA	xxxx	NA	xx
Hollofill	NA	+++	++	NA	NA	NA	NA	++	NA	NA	xxx	NA	xx
Qualofill	NA	+++	++	NA	NA	NA	NA	++	NA	NA	xxx	NA	xx
Primaloft/ Liteloft ^{xxxi}	NA	++++	++	NA	NA	NA	NA	+++	NA	NA	xx	NA	xx
3M Thinsulate matting ^{xxxiii}	NA	++++	++	NA	NA	NA	NA	+++	NA	NA	xx	NA	xxxx
	comfort against skin	warmth (not per weight)	warmth when wet?	water resistance	wind resistance	abrasion resistance	stretch	wicking and sweaty comfort	resistance to pilling	thorn-pull resistance	Speed of Drying	Wrinkle- resistance	Resistance to matting
<i>Underwear Materials</i>													
Polypropylene ^{xxxiv}	++	+	++	NA	NA	xxx	+++	xxxv	xxx	xxx	++	x	x
CoolMax polyester ^{xxxvi}	++++	++	+++	NA	NA	xxx	+++	+++++	xxx	xxx	+++	x	x
Thermax polyester ^{xxxvii}	+++	++	+++	NA	NA	xxx	+++	+++	xxx	xxx	+++	x	x
Other polyester ^{xxxviii}	++++	++	+++	NA	NA	xxx	+++	++++	xxx	xxx	+++	x	x
<i>Unique Clothing Materials</i>													
crystalline alkanes ^{xxxix}													
gel-bead bandannas ^{xl}													

NOTES:

ⁱ**Shell-Wicking “Softshell”:** People are talking (cf the Mountain Gear catalog) about the “old” method of outdoor dressing, i.e., wearing a “hardshell” GoreTex parka over middle and inner layers that really don’t resist wind or rain. They contrast this with the new “softshell” where the middle layers not only provide stretchy insulation but also shed wind and rain to a degree (as well as providing significant protection against abrasion, mud and dirt, which the older fleece didn’t). Having worn some of these “softshell” garments, I have to admit I’m impressed with the idea. With “softshell” dressing, you rarely take out your GoreTex parka, and can therefore have a relatively thinner and lighter shell which stays in your pack most of the time.

These relatively new fabrics, pioneered by Schoeller of Switzerland, are woven so that they have a tough nylon on the outside and a warm, fuzzy, wicking CoolMax on the inside. Malden Mills also has a kind of fleece called “BiPolar” that is similar in intent, but the outside is really just shaved pile, not a heavy-duty shell like the Schoeller fabrics – but now they are getting into the field with a vengeance with some of their newer fabrics. Malden Powerstretch, for example, has a bit more of a “shell” on the outside, though still nothing compared to Schoeller Dryskin Extreme. However, the newer Malden fabrics like PowerShield may give Scholler a run for its money. Most of these softshell garments, especially the Schoeller, have moderate wind resistance but are extremely breathable. Even for heavy-sweating people like me, they may do OK without pit zips (unlike any kind of GoreTex equivalent).

ⁱⁱ**Schoeller Dynamic:** My pick for pants and thin jacket for mild conditions. Cloudveil makes nice pants (“Maverick”) and a pullover.

ⁱⁱⁱ**Schoeller Dryskin Extreme** Somewhat thicker than Dynamic, and ideal for cool conditions. The Cloudveil Symmetry pants made out of Scholler Dryskin Extreme are the best pants I’ve ever had, perfect for inside, outside, wherever. The Cloudveil jacket is an ideal allaround jacket. Stretchy enough to be quite comfortable – I’ve found that I wear a size smaller than normal (small instead of medium) and the pants don’t bind at all.

^{iv}**Schoeller WB-400** seems to be like their Dryskin Extreme but with a layer of fleece inside. [Mountain Gear](#) offers a Cloudwalker vest/bib and a top of this material. Sounds interesting but haven’t seen it in the flesh so to speak.

^v**Polartec Powerstretch Cordura:** [Crestone Alpine Designs](#) is now offering tops and bottoms of this material, which I haven’t tried yet but will soon. Sounds promising.

^{vi}**Polartec Powershield** This is reportedly a combination of 100-weight Polartec fleece combined with a breathable barrier (? GoreTex equivalent) and stretch nylon/Lycra outside. Sounds interesting, possibly competition for Schoeller’s Dryskin Extreme. Available in some of the 2000-2001 Arc’Teryx line.

^{vii}**Gore Windstopper and Malden WindBloc:** Both the Gore and Malden wind-blocking fleece seem a bit silly – the nice thing about fleece is that it is stretchy and porous, and works nicely under a shell garment. They seem especially silly, since the fleece is on the outside where it does virtually no good. Theories for this include (1) fashion, and (2) protection of the wind-blocking layer from abrasion. The Malden Windbloc, in my opinion, has it all over the Gore Windstopper. Winbloc is stretchier by far. And Windstopper

feels, well, yucky against the skin. Malden now has WindBloc ACT, which only blocks 98% of the wind, to allow better ventilation. The also have WindPro which is a somewhat wind-resistant fleece.

^{viii}**Malden Aqua Shell (AKA Thermal Stretch)** This new material is made for whitewater sports and sailing and perhaps diving – it's being touted as a replacement for 2.5/3 mm neoprene wetsuit materials. Gotten some good reviews for diving in warmer water. [Wyoming River Raiders](#) makes a "Farmer John" of the material. [Bomber Gear](#) makes tops and bottoms of it. Yet to find anyone who makes a front-zip top to go over the Wyoming River Raiders Farmer John, though. I'm trying some of it for wet caving, but no experience with it yet.

^{ix}**Helly-Hansen Pile;** Knitted base with fibers sticking up, started by Helly-Hansen; matted down after a while, though lightweight, transports moisture quite well.

^x**Non-Helly-Hansen Pile** copies of Helly-Hansen pile by other companies used different, non-knit base (basically, glued); pilled a lot, matted down after a while, though lightweight, transport moisture quite well. Not as good as the patented original Helly-Hansen stuff.

^{xi}**Malden Polartec 100-micro, 100, 200, 300, Bipolar, DWR, High Void Grid, Regulator, Thermal Pro, Thermal-FR (flame-resistant), Aircore-200** Fleece=pile with two faces, has replaced older styles of pile; Malden Mills makes most of this although marketed under a variety of names; Polartec is Malden Mill's trademark, and almost every fabric they make is preceded with "Polartec" so it's not a very useful name, now is it? There are many, many types of Polartec, in addition to the Powerstretch stuff described below; they do have a variety other tradenames added to the Polartec moniker, but even within each of the sub-tradenames (e.g., Malden Polartec Thermal Pro) there are many different fabrics. The original Polartec 100 and 200 and 300 were three increasing thicknesses of fleece, slightly stretchy, very soft and comfortable, and virtually no wind resistance. Now, they've come out with Polartec 200 and 300 "Bipolar" which has a thicker inner layer and thin outer layer that is a bit more abrasion resistant. It is reputedly slightly more wind resistant (i.e., slightly instead of not at all). They are also offering a DWR (durable water-repellent) finish on Bipolar 200. Some recent additions to the line are Polartec High Void Grid (with little holes in the fleece to decrease weight without decreasing warmth) and Polartec Regulator – Arc'Teryx has some garments made out of these, but I've not had a chance to see them yet. Even more recently, you can get garments made out of Thermal Pro -- I have a Cloudveil vest of Thermal Pro and Powerstretch, size small, which is extremely light and durable -- the newer fabrics have fibers with a hollow core, that cuts weight, yet are even more durable than the fleece they made even just a year or two ago.

^{xii}**Marmot Outlast** is a type of thick pile for gloves, but with tiny beads of wax embedded in the material – the idea is that the beads absorb heat when your hands are warm and then reradiate it to your hands when they are cold. I would have said that this was a bizarre and unworkable idea but it really does seem to work. A friend who's an instructor at the Scottish National Outdoor Center at Glenmore Lodge has tried alternating them with similar gloves during winter climbs – and the hand with the Outlast glove always stayed warmer. I tried one of his Outlast gloves on a winter trip near Cairn Gorm and indeed, it really seemed to work.

^{xiii}**Malden Powerstretch (and Powerstretch RX, and Special Edition Powerstretch 9400)**

Very, very stretchy. I loaned my Powerstretch pullover to a colleague during a wet-cold Wilderness EMT exercise where he was a victim. He liked it so much I had a very hard time getting it back! This stuff is as stretchy as Spandex – or maybe more so. As with Scholler Dryskin Extreme, I've found I wear a small instead of a medium as I usually do. It is so stretchy that getting pullovers on and off is very easy. Used for layering usually right over a polypro fishnet (from [Brigade Quartermasters](#)), and with a shell over it when needed, this stuff is great. Indeed, Malden Mills markets it as an against-the-skin fabric.

[Cloudveil](#) makes a very nice pullover (unfortunately they gave up on the vest), [LL Bean](#) makes a great pullover, , and [Crestone Alpine Designs](#) makes a variety of garments out of Powerstretch 100 – I particularly like Crestone's designs as they all include lots of long zippers for ventilation, which I think is very important. For women, Crestone even makes bra tops of Powerstretch 100.

[Toesteessocks](#) makes custom whole-body suits that are great under a caving suit; BTW, for a shell over this, the best custom caving suits are from [B&C Wunderwear](#).

Although Malden's website shows Polartec 100/200/300 having mild-moderate wind resistance and Powerstretch having moderate wind resistance, really this stuff isn't very wind resistant, even the Powerstretch. Nonetheless it make a great layering material – *very* stretchy, very comfortable.

Malden notes there are two major versions of Powerstretch: the original and then a version with a durable water-repellent treatment. There is also a version that is treated with silver to prevent bacterial growth that causes bad odors. Silver is well-known as a nontoxic antibacterial, and should work pretty well, at least in theory. Mountain Hardwear makes some garments containing these silver-treated "X-Static" fibers that they call eXtend. In the summer of 2002, I got some garments from [Lowe Alpine Systems](#) (their MultiPro line) made of **Special Edition Powerstretch 9400** which is different from "standard" Powerstretch in that the fuzzy inner layer is only about 1/4 there: it's a series of "dots" that hold the garment away from the skin. This makes a bit smaller-packing and lighter garment with a bit less insulation but a better warmth/weight ratio than standard Powerstretch. I'm going to have to try this stuff under a variety of conditions to see if this smaller amount of material in contact with the skin still does an adequate job of soaking up the sweat.

Recommended highly.

^{xiv}**Parameta-S** from [Paramo](#) is an interesting material, or at least interesting marketing. This is a bipolar material, hydrophilic on one side and hydrophobic on the other. The interesting twist is that it's reversible clothing -- wear the fleecy side, which is like a fine plush velour, against your skin for warmth. The plush velour fleece is hydrophobic, but the hydrophilic outer layer attracts moisture away from the skin (sort of like DriClima - if you dip the material in water then feel it, the plush side feels dry). If you find it too warm, you take it off and put it back on inside out. Nice idea, but you can tell that, because they ship them with the plush on the inside and the pockets on the outside only, that you're expected to wear it mostly with the plush side inside. But I must admit, wearing it inside out when you're sweating a bit makes it a bit cooler and more comfortable. They make a Mountain Shirt that's a pullover with a snap mock turtleneck and sleeves designed for reaching above your neck, and a Trail Shirt that's cut on a standard shirt design with a collar and a full set of front snaps. Interesting and different, but not on a par with Powerdry or Scholler Dryskin Extreme.

^{xv}**Waterproof Zippers** I first saw these on Arc'Teryx packs, but now they're appearing everywhere. Arc'Teryx calls them WaterTight zips, and Mountain Hardware calls the Simplex zips. Regardless of the name, they allow manufacturers to eliminate flaps over zippers. Though the waterproof zippers are stiff compared with non-waterproof zippers, they're flexible enough, at least on rainpants, that they do cut down on bulk and weight without impeding movement. I wondered why there aren't more parkas using these as the main front zipper. Someone at the local outdoor store said that the manufacturer hasn't been able to develop a two-way separating version yet. Arc'teryx *does* have a parka with a waterproof front zipper, but it's very short in front so the parka will expose one's seat harness. As of Fall 2002, the major zipper manufacturer YKK is making these things, and I'm trying to find a retail source, but no luck yet.

^{xvi}**Nylon** Retains feeling of warmth next to skin, while still allowing lots of heat through; bad against skin, good in boots.

Tactel is DuPont's tradename for its nylons, and Tactel Aquator is their tradename for a special construction of nylon with a bipolar construction -- the only thing I could find that was made out of this stuff was a dress riding shirt, no outdoor garments, and the Dupont site has little information other than that it's a bipolar sweat-moving fabric.

^{xvii}**Spandura** A combination of Lycra and Cordura. [Outdoor Research](#) makes a variety of garments, especially pants, out of Spandura. Not very comfortable against the skin, but stretchy and tough.

^{xviii}**Supplex Ripstop Nylon** As with the Intera shirts, the combination of a ripstop-style weave with a wicking coating on the fibers makes this stuff a lot more comfortable against the skin than non-ripstop nylon and Supplex nylon materials. [LL Bean](#) makes a nice pair of ripstop nylon pants (All-Terrain Shorts) with pants legs that zip off. I've had good experiences in wet, rainy weather with wearing Supplex nylon clothing from [Ex-Officio](#) over some thin wicking layer of underwear -- many of Ex-Officio's shirts are ventilated with mesh inserts. [RailRiders](#) offers supplex nylon shirts and pants that have even more ventilation in the form of CoolMax mesh inserts. Their EcoMesh pants have zippers that close over the CoolMax inserts, allowing a degree of control over warmth/ventilation -- however, even though I am not all that fat around the middle, I found that the EcoMesh pants that fit my waist were way too long, and with the zippers the way they are they're a pain to tailor. Supplex is DuPont's tradename for microfiber nylon.

^{xix}**GoreTex et al** I include here Goretex and all the various similar fabrics, now that the original patent has expired. Please email with similar fabrics you've seen and I'll add them here. At http://www.gorefabrics.com/product-adviser/result_allproducts.html there is a whole list of Goretex fabric variants (Pertex, Cloudveil Dermizax, Bibler ToddTex, Marmot MemBrain and PreCip, Patagonia H2No, Mountain Hardware Conduit, not to mention the list at the beginning of this whole article). Of particular interest is the new Goretex XCR fabric which is just as waterproof as classic Goretex but 25% more breathable, or at least so they say; also their new Paclite which is a very thin but durable lighter-weight GoreTex. Cloudveil (Dermizax) and Marmot (MemBrain) have stretchy-versions of GoreTex, but they're really not that stretchy compared to some of the other fabrics available now. Also note Goretex Windstopper which competes directly with the Malden Mills WindBloc fabric. I personally find the idea of a windproof layer **INSIDE** of a wool or pile or fleece layer one of the stupidest things I've ever seen (every heard of Bloody Stupid Johnson in Terry Pratchett's Discworld novels? He must have designed these fabrics.)

^{xx}**GoreTex et al Abrasion Resistance** The abrasion resistance of Goretex and Pertex and similar waterproof/breathable materials (generally some form of expanded polytetrafluoroethylene = PTFE = Teflon) is nil. The abrasion resistance is entirely dependent on whatever it's laminated to. Some of the materials are simply thin nylon (I have an LL Bean nylon-Goretex parka like this that folds up into almost nothing) but are not suitable for abrasion on rocks -- others, such as parkas made by Patagonia, Marmot, Cloudveil, Arc'teryx and other top-end suppliers, are much more abrasion resistant. One of the most interesting variants is something called ToddTex -- developed by Todd Bibler for Bibler tents. It has a fuzzy internal laminate that works like a built-in frost liner. Nice stuff, but fragile -- I've had to repair some abraded holes in my Bibler Torre tent where something rubbed against the ToddTex. Pertex and similar materials sacrifice some waterproofness for breathability. I have a British-style bivouac shelter (a Bothy 4, from Cotswold Outdoor Equipment, who will sell these by email) of Pertex, which is very light but provides a sort of floorless tent to throw over four people (four very friendly people, or two if you want room to eat lunch in the rain). The Pertex is waterproof enough that you won't notice any rain coming through compared to the condensation, even with two vents.

^{xxi}**GoreTex et al Stretch** There are a few stretchy Goretex-like materials on the market. None of them stretch much compared to, say, Malden Mills' Polartec Powerstretch, or Spandura. Cloudveil, for instance, makes a pair of pants that look like regular pants but are stretchy, waterproof yet breathable. The material is called Dermizax® Stretch Light (where DO they get these names?) and it's called the Snaz line, they also make a parka. I've tried the pants in the rain a couple of times, they're OK, but you still sweat in them, a lot. Remember that Goretex covered with water doesn't breathe. But with intermittent wind and rain, these pants are pretty nice. And they stretch enough to be better than most rainpants (although my Arc'teryx rainpants that have waterproof zips up the side are very, very nice, and roll up quite small for good sturdy rainpants).

^{xxii}**Pertex et al** This includes a variety of similar fabrics -- a fairly open PTFE layer bonded to some other fabric, which is water-resistant (not waterproof like the original Goretex and clones) but very windproof and somewhat breathable (not as breathable as they'd like you to believe, though!) Examples other than Pertex include Activent for shell clothing and Dryloft for sleeping bags from W.L. Gore; interestingly, at least one of the companies that makes expedition-style down parkas went from Dryloft back to regular Goretex as the Dryloft wasn't durable enough, same with some sleeping bag manufacturers)

^{xxiii}**Wool** Scales on outside break up surface tension; when gets very wet, hydrophilic core soaks up water, is heavy, and requires lot of body warmth to dry out; kinky, no parallel surfaces to hold water (such as in cotton). Wool is still king for socks. Some comments on socks may be found in the emails below the chart but above these footnotes. In particular, Jacob Rohner of Switzerland makes what are probably the best everyday socks in the world -- almost all of the socks I wear every day are Rohner trekking socks. Expensive but worth it. Sometimes you can get closeouts on Rohner socks from Sierra Trading Post.

^{xxiv}**Cotton** Has a reputation for killing people in cold, wet conditions, and deservedly so. I had originally planned to leave it off the table entirely. However, in hot, dry conditions, wet cotton's ability to absorb and hold lots of water, and to act like a heat pump, and to

wick and rapidly spread water from one place to another, is a positive benefit. In hot, dry environments, it's common to wear a cotton T-shirt with a loose, long-sleeve cotton shirt over it. And I've heard that at Outward Bound in Texas, not only the women but some of the men hike in ankle-length loose cotton skirts to protect against the sun while allowing ventilation. (Thanks to Suzanne Atkinson of [Allegheny Mountain Rescue Group](#) for this tip.)

Subject: RE: Clothing Materials Table/no cotton?
To: NCRC Discussion List <NCRC@ontosystems.com>
Copies to: sar-l@listserv.islandnet.com, mra@altadena.net
Send reply to: kconover@pitt.edu
Priority: normal

On 16 Aug 2000, at 15:54, Steve Knutson wrote:

> Regarding cotton, I think it is absolutely necessary if you want to have "perfect" clothing. On the feet,
> it should be either cotton or wool (some people are allergic to wool) next to the skin--the coefficient of
> friction of synthetics is much higher than natural fabrics and you will be more prone to blisters and skin
> irritation in tropical conditions with synthetic socks.

Interesting point. I don't like cotton for liner socks because they tend to hold water against your skin, causing maceration ("prunification") and thus predispose to blisters.

Nevertheless, this at least is something on which we have some scientific evidence. Murray Hamlet of the U.S. Army looked at various types and combinations of socks in various materials, because the Army has a BIG interest in preventing blisters. He finally decided that there were no socks out there that were ideal, and so ended up contracting for what are now known as "Hamlet Socks" -- a combination of an outer very thick sock, made mostly of Merino (=expensive) wool, with the plush layer on the outside and the flat, smooth surface on the inside. The fibers are very highly twisted during material construction, both to resist matting and for durability, and despite the military's desire for multiple suppliers, they've only got one supplier at present. I got a pair of the original Hamlet socks and they are the best socks I've ever had. However, then I ordered some more and they, to put it bluntly, sucked. I found out from Murray that the original company basically went bankrupt and their quality was terrible -- later they got bought out and the socks are now back up to Murray's exacting standards.

Interestingly, he specifies a Coolmax liner sock. And with this combination, compared to normal wool Army socks, he found a lot less blisters. Specifically, he went to the US Marine Corps base at Paris Island, South Carolina and outfitted recruits and their drill sergeants with Hamlet socks, Coolmax liners, and then let them get on with their 14 hours/day of basic training. Blisters dropped by a factor of 3! This is the best scientific evidence for any particular sock actually making blisters less likely.

A poor second best, he says, is to get SmartWool socks with CoolMax liners, but wear the SmartWool socks inside-out.

To buy Hamlet socks, call 800-392-8500 and speak with Joe Gallagher.

I have no affiliation nor do I receive any kind of remuneration for endorsing these socks.

> Remember that synthetics DO NOT wick moisture--the myth that they do is an advertising ploy and has no reality.
> Synthetics are almost always hydrophobic and thus CANNOT wick moisture. What happens is that your body heat
> drives the moisture in vapor form through the fabric, but this doesn't happen when you are very cold. Drylete
> and other dual fiber fabrics (with a hydrophillic yarn on one side and hydrophobic on the other) are the only
> synthetics that wick moisture. Cotton underwear shorts are also much kinder to your skin. This is
> especially important in the tropics.

You know, I've heard this before, but certainly there are a lot of people, Murray Hamlet included, who disagree, and indeed have done some studies to show that these wicking treatments do work. For instance, remember the British ship hit by an Exocet missile during the Falklands war? They were wearing polypro, and during the explosion, there were a lot of burns, and there was melted polypro all over them. But the British docs found the polypro actually helped the debridement of the burns slightly, rather than causing much additional burning as rumored. So, the British still wear polypro -- but have a silverized outer layer that helps protect against flash burns. (Information from the British via Murray Hamlet of the U.S. Army, again.) Maybe this should make us reconsider the polypro vs. cotton/fireproof fabrics for domestic mountain rescue helicopter use?

[Recently, Massif (http://www.massif.com/outerwear/fr_nomex.html) has introduced a line of Nomex fleece -- certainly fire-resistant, but insulating/wicking qualities not well known. -- KC.]

Indeed, there is an easy way to test this yourself. Take a bowl of water and hang some of the material in it. Wait an hour and see how high the moisture has climbed up the material. Cotton is clearly the champ, but the fact that it also acts like a heat pump when wet, along with the large amount of water that it retains.

However, this is a poor test of wicking related to what we really want it to do, as in wicking sweat off the skin. I suspect that the Army has done some more detailed tests, and I'll ask Murray what he's found in his lab at Natick, MA and let everyone know.

And John Gookin wrote:

> Thanks for posting this great information. Good stuff. I completely agree with the confusion created by
> manufacturers' claims.

Not sure it's "great," in fact I'm sure, especially after looking at all the typos and stupidity in version 0.1 (0.2 is up now) that it's pretty cr**py information. But I just couldn't find anything quite like it, and whenever I do something for my own use, I like to share it. A few others might find it interesting, and many others like you with more knowledge than me may give me some pointers.

> I wrote the clothing chapter for Paul Auerbach's upcoming edition of his big Wilderness Med book. My point
> isn't that I'm smart; it is that I recently researched these topics pret I included cotton in the fabrics (in
> PA's book) for a few reasons. 1) "Cotton kills", so people who do serious stuff need to see how far off
> scale it is in temperate or cold environs. People often want to do micro-analyses of various fabrics when 2)
> In hot weather, "cotton's cool" because it wicks moisture so well. 3) Firefighters, welders, helo crews and
> others exposed to flames like the slow burn/melt rate of cotton. 4) When we are going in and out of heated
> spaces the absorbancy of cotton socks CAN BE healthier for athlete's foot or even immersion foot. I think
> cotton socks cause more immersi Don't get me wrong. I don't WANT all those firefighters & EMT's to
> keep wearing jeans when they come "lend a hand" in the deep snow. But I think cotton has its little niche as a

> t
> John Gookin
> Curriculum Manager The National Outdoor Leadership School (NOLS)
> 288 W Main St. Lander, WY 82520-3140 307.335.2264 / fax
> 307.332.8811

OK, OK, I'll add cotton. And the things that make cotton bad in cold- wet conditions makes it good in the heat -- retaining lots of water and acting like a heat-pump. Speaking of which, I've tried those "cool bandannas" with beads of some sort of polymer in them that hold water -- and though they do indeed hold a lot of water for a long time, they give it up pretty sparingly. In the humidity of the East they're useless. So last week I tried one of them at 10,000 feet in Utah. The outer cotton dried out pretty quickly, cutting down on the coolness and evaporative cooling, even though the polymer beads had lots of water still left in them. So I think a nice cotton headband, wetted every hour or so, is probably a lot better brow-cooler.

And Rebecca Jones wrote:

> Just a note, this is the way these fibers perform under "ideal" conditions. Add dirt, and all bets are off.
> Mud encrusted clothing can't wick, no matter what it's made of. "Resistance to Compression Matting" is
> probably the best indication that, after thorough washing, a garment will regain its
> characteristics.

True. When your clothing is covered with cave mud, you're basically wearing cave-mud laminate, and it doesn't really matter what the inner layer is. Which is one of the reasons why my caving suits have pitziips for ventilation. Surprisingly, I've had no failures or problems with them over the past 10 years.

And Anmar Mirza wrote:

> Further, I really like jeans for caving in the conditions in which I normally cave for a number of reasons.
> (some of my trips extend 15-20 hours. Mostly non immersed but many slimy and wet)
> 1. Jeans are very cheap. \$10 a pair from wally world, I can wear them for a few months then retire them for
> caving.
Point. Most of these new materials are expensive.
> 2. Jeans are fairly durable. I cave a *lot* (1-2 trips a week) and some of the places I go are very hard on
> clothing. I can't afford to buy a new cave suit every couple of months which is what I would have to
> do given the type and quantity of caving I do. (this is based on experience)
> 3. Jeans are flexible (unless you buy them too tight).
> I also like surplus light jackets which are also made of cotton. I can get these for \$5-10 and they last a
> long time (except for having to sew the buttons back on).
> I cave *hot* so normally being cold is not a problem for me. For others this is not the case. Cotton is
> pretty good when it comes to hot weather stuff, combine this with it being cheap and you have a resource
> that should not be ignored.

I suspect that you are in excellent aerobic condition, too -- so you don't tire out where others might. And the problem with cotton comes when one's energy runs down -- and there's still all that cold water held against your skin. I'd suggest that your wearing cotton is a lot like rock-climbing without a helmet or belaying without gloves -- some people can get away with it but it's certainly not something to suggest to a newbie, or to even allow them to know about.

> When I am going into a wet cave, or a cold cave, or cold weather conditions, of course my clothing fabric
> choices will change (34f caving, expedition weight polypros, a 3mm shorty wetsuit, and a full
> nylon caving suit. 72f caving, shorts, tshirt and knee and elbow pads...) But for 90% of the caving I do and
> a third of the outdoor stuff, the cotton shell I use suits my needs pretty well.
> While it is fine to say "cotton kills," what really kills is ignorance and lack of experience/training.
> Just like I said in another thread on this list, I think that using equipment and resources when and where
> appropriate is much better than trying to make a rule of thumb fit every occasion.
> Other than that think the table is a neat idea. Even though it is subjective, it gives folks a good
starting
> point. I've got it bookmarked, thanks Keith!

> Anmar Mirza - Central Region National Cave Rescue Commission
> Coordinator EMT-A: Amateur Radio N9ISY: Cave Rescue Coordinator for
> LCSAR IKC Rescue Coordinator

Well, please let me know about all of the errors and omissions. I've added Goretex and Pertex and will need to add Activent, Bipolar, and some others. As well as some links to some good sites with more information about clothing materials. There are so many different materials that I'm going to have to, I think, keep it a selective list, with the best/most popular only (with the ones I like best featured, of course).

Thanks for all the comments!

--Keith Conover, M.D., FACEP
<http://www.pitt.edu/~kconover>
sent with Pegasus high-security email
download free from www.pmail.com

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SAR-L Search and Rescue discussion list. For unsubscribe information-email
to sar-l-request@listserv.islandnet.com with the word 'help' in the
subject field.

=====

From: Keith Conover, M.D., FACEP <kconover@pitt.edu>
To: sar-l@listserv.islandnet.com, Allegheny Mtn. Rescue Maillist <amrg@list.pitt.edu>
Subject: more on Hamlet socks
Copies to: mra@altadena.net, NCRC@ontosystems.com (NCRC Discussion List)
Send reply to: kconover+@pitt.edu
Date sent: Fri, 25 Aug 2000 08:13:13 -0400

Some more information on the military-designed Hamlet socks I have been raving about recently. The company is Double Lay-R doing business as TechSpun, and is reachable via the email <tecspun@aol.com> (Joe said that AOL wouldn't let him put in the "h". Go figure.). Or 1-800-392-8500. They offer several different socks.

1. Double Lay-R Blister Free.

These double-layer socks have outer and inner faces that are designed to be high-friction, and the matching faces are designed to slip against one another. I used to use some of these socks as liner socks, and they worked pretty well to prevent blisters. However, you have to be careful in putting them on so as not to get wrinkles, and your foot does slide a bit, which can be a bit of a problem going downhill.

2. Seamfree seamless socks.

These are designed for people with diabetes and ischemic feet.

3. All-Weather Lightweight Sock System.

These are a somewhat lighter version of the "true" Hamlet socks, below. Includes a lightweight Coolmax liner sock and a thicker outer sock, about the same weight as a usual boot or Ragg sock. If your boots fit snugly, you won't be able to wear the "real" Hamlet sock without your boot fitting too tightly, so order these. Retail price is \$13.75/set as of August 2000 (? if that includes the liners). High-density reverse nap, same as the "real" Hamlet socks. Liners are 80% Coolmax, 20% nylon. Socks proper are 40% long-staple wool, 40% polypro, 10% nylon in the toe and leg, and 50% long-staple wool, 50% polypro in the foot.

4. All Weather "Extreme Weather" Heavyweight

This is the "real" Hamlet sock, the one with the 3-fold decrease in blisters in Marine boot camp recruits and DIs at Paris Island. Work well in very hot or very cold, but may require a boot one size larger than usual. As of August 2000, retail price was \$14.75/set. (Actually, I think it's \$5 extra for the liners -- although maybe that's for extra liners.)

Bulk pricing is available if you order in lots of 12, especially for SAR teams -- available in whole sizes 7-15. Cost varies with sock size and number of socks and shipping, but less than \$10/pr for the outer socks, and \$3/pair plus shipping for the liners.

Again, I have no affiliation with this company at all, I just really, really like the socks and respect the guy from the Army who designed them (who also makes no money at all from their sales).

^{xxv} **Cotton Comfort** For cotton, comfort against skin is really +++++ when dry and XXXXX when wet. Take your pick.

^{xxvi} **Cotton Wicking** For cotton, when sweaty, it starts off great, but after it gets soaked it's miserable.

^{xxvii} **Malden Powerdry** Against your skin, this stuff is as comfortable as a well-worn cotton sweatshirt -- and soaks up your sweat as well (must be the way that they make the inner portion). However, it's warm when wet and dries quickly. Great stuff. Cloudveil's TeeWinot line uses this material. I think the fuzziness of the inner face of this fabric is what allows it to soak up the sweat so well. Just like the original polypro spread out the sweat better than wool, and wicking treatments for polypro and now polyester allow underwear to wick sweat better than the original polypro, this stuff beats other treated polyester -- the best wicking layer I've experienced. The Cloudveil TeeWinot line also looks good, good enough to replace a polo shirt for when you need to be dressed up just slightly.

^{xxviii} **Intera** Intera is a coating for either nylon or polyester, a permanent wicking coating (at least they say it's permanent, and have some test data on their website that, if accurate, supports this, and nothing on the other companies' websites contradicts it). But as I know it from two shirts I have, is type of almost ripstop-like nylon, and the Intera shirts I own have alternating thicker and thinner threads in the weave. Although a relatively hard fabric, it's nonetheless relatively comfortable against the skin when you're sweating. I got a couple of shirts from LL Bean out of this fabric, and they are indestructible, almost totally impervious to wrinkles, and look good. Ideal for travel clothing. They still have something called a Journey shirt that is made of ripstop with a wicking treatment, but may not be the Intera tradename. They point out on their [website](#), though, that using fabric softeners can ruin the coating.

^{xxix} **Tencel** [Tencel](#) is a fabric made from reprocessed cotton. The main marketing feature is that it feels like silk. It does, and drapes nicely -- I have a couple of [mock-denim shirts](#) out of the stuff and they're *quite* nice. Seem to wick a bit less than cotton, hold a great deal less water than cotton, and wrinkle quite a bit less (though not so wrinkle-resistant as Intera).

^{xxx} **Polyester microfiber** Despite the reputation of polyester from the 1960's, this is a great material. It's really not an "outdoor" fabric, but as I'm a fan of wearing "outdoor" clothing everyday (I don't see why *everyone* doesn't switch from cotton to CoolMax underpants) I have several pair of dress pants in polyester microfiber from [Travelsmith](#), which are virtually indistinguishable from fine worsted wool trousers -- but resist stains better, dries more quickly, doesn't wrinkle as much (though worsted wool is quite good for resisting wrinkles) and can be washed in a hotel sink and hung up, and they will be dry the next morning. Travelsmith has shirts and pants, and LL Bean also makes a nice pair of pants in microfiber. I also have a blazer from Travelsmith in "tropical" microfiber -- relatively light, looks nice, doesn't wrinkle, stains come out easily. Indeed, one of the nursing supervisors at my hospital spilled some coffee on my blazer, and she was horrified and was afraid she'd ruined it. I threw the arm of the jacket in the sink, rinsed a bit of hand soap through it, rinsed it out, and hung it up on the back of a chair for an hour. After that it was dry and looked good as new.

^{xxxi} **CoolMax everyday wear** I got a pair of pants from Travelsmith in sort of a stretchy CoolMax canvas. They pill a lot, get a lot of pulls, and are sort of ugly. Totally unlike their polyester microfiber.

^{xxxii} **Primaloft/Liteloft** Three different diameters together, crimped, larger fibers on the outside layers,

^{xxxiii} **Thinsulate** Once washed, the insulation value goes down; made by blowing fibers onto a surface; good for high-compression areas, too stiff for handwear, OK for boots and similar.

^{xxxiv} **Polypropylene** There are many various coatings for polypro and polyester underwear, with various brand names and various claims. However, polyesters have generally replaced polypro for against-the-skin wear -- does better in hot dryers and near campfires without melting, doesn't hold odors as much, doesn't "pill" as much.

^{xxxv} **Polypro Wicking** Depends on coating.

^{xxxvi} **CoolMax Polyester** CoolMax is an extruded material with dips in it, better than Thermax; very good against-the-skin material. There is also now a CoolMax Alta fabric, which reputedly is better in all sorts of ways -- as far as I can tell from one T-shirt I got (from [Campmor](#), by Duofold: Hydrid Lightweight T-shirt), it's a bit thinner yarn, which can make a thinner layer against your skin (although I'm sure they can make it thicker), and it's a bit more durable (doesn't pill as much). So it's probably just the next generation CoolMax. Look for it to replace CoolMax. However, it seems a bit fragile--my T-shirt developed several holes after only having it for a few months.

^{xxxvii} **Thermax Polyester** Extruded hollow polyester; doesn't pass moisture well compared with CoolMax.

^{xxxviii}**Other Polyester** Capilene, others – no independent confirmation of various wicking claims. Some of the materials/coatings include: Terramar's Body Sensors EC2 Qwik-Dri fabric (I hope they didn't pay much to the agency that came up with these names), which claims it moves perspiration by electrostatics and not by wicking. They say that this makes it work better because it sucks water vapor away even where it's not in contact with the skin. Of interest, Terramar has trademarked the phrase "There is no such thing as bad weather, only bad clothing." The way I'd heard it was "There's no such thing as bad weather, just the wrong clothes." Whatever. I gotta admit all these materials/coatings seem to wick pretty well, and except for Malden Power Dry, none seems to be much better than the other. See also the notes on [Intera](#), above.

^{xxxix}**Crystalline Alkanes** [Talion Corporation](#) makes vests, for both humans and dogs, of this special material that cools as it melts. Objective testing by the U.S. Air Force, [quoted on their website](#), confirms its efficacy. Certainly for hot, humid conditions, like inside a HazMat suit, or in Florida or Louisiana or the tropics, evaporation is of limited use. Amir Findling of [Western New York SearchDogs](#) says the vests are somewhat heavy, pricey, and maybe not durable enough for a dog in a backcountry search task, but did a great job of cooling for about 4 hours.

^{xl}**Gel-Bead Bandannas** These are marketed under a variety of names. The gel inside the "bandanna" soaks up water and lets it evaporate slowly. These are, by my testing, totally useless anywhere in the East or the Appalachians in the summer. I've used them in dry conditions in Utah and they help, a little bit, but the beads evaporate so slowly they don't cool enough. Despite some good testimonials from some people, my recommendation is to get a stretchy cotton terry cloth sweatband and keep soaking it with water instead. The Sharper Image used to market an active cooling device for the back of the neck. It had a metal plate for good heat transfer to the neck, a reservoir for water, and a little fan powered by a single AA cell. It had a number of significant design flaws and some signs of frantic last-minute modifications. I got one to play with and wasn't impressed. A nice water-soaked terry-cloth sweatband and a small bottle of water will work better and weigh less.