



# BREATHE DEEPLY

**Rob Wylie from Mountain Hardwear takes a look at waterproof breathable fabrics - how they work and how they should be used.**

**We all know what it's like to step out into a raging storm, be it from a tent, a climbing hut or a car. There's nothing more satisfying than donning your mountain armour and feeling the elements thrash feebly against your seemingly impenetrable outer layer. That's probably why people are sometimes so disappointed, thinking they had cheated nature's forces, that feeling of high elation leading to a slow realisation that driving rain has penetrated your defences.**

**At times like this you realise that all waterproof breathable jackets are not created equal. Especially when your climbing/walking partner revels in the fact that they continue to remain bone dry. Your loss (of comfort) is their gain (in smugness). How did you get it so wrong?**

#### **What makes a fabric waterproof & breathable?**

All waterproof fabrics have an outer layer, or face fabric. The main function of the face fabric is to provide a flexible & durable outer shell. The inside of the face fabric is either laminated or coated with a protective moisture barrier. This barrier is the part that does all the work of keeping you dry and comfortable in wet conditions. It prevents water ingress from the outside and allows moisture vapour to escape, keeping you comfortable inside.

#### **If it's that simple, don't all fabrics perform pretty much the same?**

In a word, no. Firstly face fabrics differ significantly in abrasion resistance, tear strength, weight and water repellency. It's important that the jacket has the right face fabric for the job. You wouldn't want a nice soft handle, low tear resistance fabric on a full mountain shell, no matter how pretty it might look in the shop. Likewise, on the protective moisture barrier, whether a membrane or coating, the range of breathability and durability on offer is vast.

#### **How can one fabric be more breathable than another in the same conditions?**

To understand why breathability can differ, you have to first understand why/how breathable fabrics work. Regardless of the product: Gore-Tex, Sympatex, Conduit, H2n0 etc. they all work, or 'breathe' by temperature differential (Delta T). When the environment on the inside of the jacket is warmer than the environment on the outside a driving force is created. The higher the Delta T, the higher the driving force and the more the fabric will 'breathe'. The perspiration you create when active outdoors trans-

forms into water vapour. The structure of the inner protective moisture barrier allows the water vapour to pass through it, but prevents rain from coming in. This is due to the fact that water vapour molecules are much smaller than liquid molecules. How much the fabric 'breathes' depends upon the inner barriers 'resistance to evaporative transfer'. This rate of breathability is widely termed RET. The lower the RET rating the higher the breathability, because the resistance to vapour transfer is less. That's why different fabrics can have different levels of breathability (or comfort), even if the Delta T or conditions are identical.

#### **What is a DWR?**

DWR stands for Durable Water Repellency. A DWR is a chemical treatment that is applied to the outside of the face fabric. This DWR treatment makes water hitting the face fabric surface bead up and run off, like rain on a window. After extended use the DWR treatment on all face fabrics wears out. Water hitting the fabric surface starts to give the impression of soaking into the face, rather than beading up and running off. When this happens it isn't immediately necessary to re-proof the garment using TX Direct, Grangers Extreme or similar proofing agent. You can easily restore the DWR water beading qualities of the fabric by applying heat, usually by washing & tumble-drying. The DWR treatment held within the face fabric melts at reasonably low temperatures spreading to the outer face, allowing the water to bead once again. DWR treatments can wear out quickly in certain situations, smoke from campfires for example greatly reduces the effectiveness of DWR treatments. Despite claims to the contrary, no manufacturer has developed a permanent DWR finish. All DWR treatments wear off over time and eventually need re-proofing.

#### **Is durability all about the face fabric?**

Face fabric is certainly important, but the prime factor in determining long term durability is the overall fabric construction. Membranes and coatings are thin and fragile, they need protecting on the outside (the function of the face fabric) and on the inside (the function of the lining). Serious mountaineering shells

## A typical mountain jacket, showing features to look out for:

**Shown: Mountain Hardware  
Ethereal FTX Parka**

### Gore-Tex® Fabric

The most proven and durable waterproof/breathable fabric on the market.

### Fully Taped Seams

All seams are sealed with Gore-Seam® tape, creating a permanent waterproof seal.

### Durable Reinforcements

Areas prone to high abrasion (cuffs, elbows, lower sleeves and shoulders) are reinforced with heavier duty fabric.

### Special Inside Pockets

An inner, elastic-edged pocket is large enough to hold a fire water bottle. An inner, zippered pocket stores essentials securely.



### Articulated Elbows

Elbows are articulated with 6 to 8 pieces of fabric in both the shell and lining for unrestricted freedom of movement.

### Rain Gutters

The front zipper has a guttered inner flap that channels water away.

### Two-Way Zippers

YKK zippers with easy-to-engage sliders. The sliders operate from both the top and the bottom, allowing for venting options and use with a climbing harness. A grosgrain strip keeps the zipper from snagging.

### Powder Skirt

This added protection keeps snow from blowing in under the jacket.

### Napoleon Pockets

Hidden interior zippered pockets under the front zipper flap. Therefore you don't have to unzip your parka to access an inside pocket.

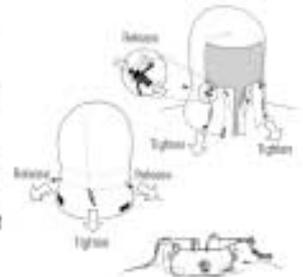
### XCR Extended Comfort Range

Very rarely does an industry leading fabric take such a quantum leap in performance. Gore's new "Extended Comfort Range" membrane is 40% more breathable than the classic Gore-Tex membrane. This huge increase in breathability has been achieved without sacrificing any durability. In the laboratory, 3 Layer Gore-Tex laminates clock over 600 hours in the benchmark fabric stamina test the wet flex. This is far in excess of any other outdoor waterproof breathable fabric. This new laminate technology also gives 3 Layer XCR a much higher degree of flexibility than ever before.



### Mountain Hardware Ergo Hood

The updated Ergo Hood moves with your head so peripheral vision is unimpaired. The volume of the fit can be customized with our updated single pull system, allowing an excellent fit either with or without a helmet (see diagram right). Also the single pull face drawcord incorporates our new webbing keeper system that eliminates the need for excess "looped" elastic. A laminated stiffened bill keeps the hood peak in shape during the most ferocious winds and when not in use the Ergo hood can roll away into a collar, secured by a Velcro flap.



### Fleece-Lined Chin Guard

Soft polyester fleece inside the hood collar eliminates chin-chafing. When the hood is not sealed closed at the neck, a "keeper" keeps Velcro® hooks covered so that they don't scratch your face.

### Cuffs

Large-diameter cuffs fit easily over the bulkiest of mittens and snug down with easy-to-grab Velcro® tabs.

### Simplex Pit Zips

Extra-long, waterproof pit zips feature our new Simplex Zipper construction that eliminates bulky double flaps. They extend from elbow to waist for lots of easy venting.

### Adjustable Hem & Waist Cords

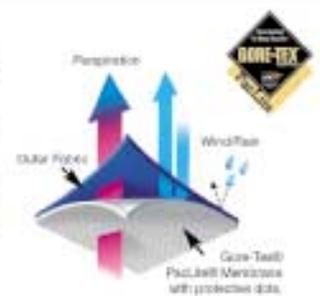
Drawcords allow you to customize the fit over a variety of underlayers and still keep the weather out. The hem drawcord can be adjusted with one hand. The waist drawcord features our new, durable Welded Waistcord construction that minimizes abrasion in this vulnerable area.

### Hand Pockets/ Inside Access

Generous fleece-lined hand pockets are placed high so for access while wearing a pack or harness. Protected from weather by wide flaps, with a ring for lift tickets and a hook for keys or gloves. Hidden zippers next to the hand pockets allow access to transceivers or other items in the interior.

### PacLite

Until PacLite came along, if you wanted the full protective benefits of a waterproof breathable shell, you had to make some compromises when it came to compressibility and weight. With PacLite you can have it all: a waterproof, durable, breathable and packable shell that is ultra light in weight. PacLite is the lightest Gore-Tex waterproof breathable fabric weighing only 90 grams/yard, its unique as it uses tiny polymer dots to protect the membrane, which do away with the need for an inner lining or mesh. The net result is a fabric that is at least 15% lighter and 30% more compressible than either 2-layer or 3-layer fabrics.



all utilise a laminated mesh liner on the inner surface. Under a microscope this laminated lining looks very similar to a fishing net. It protects the membrane or coating, but easily facilitates the passage of water vapour. This construction is described as 3 Layer. This type of construction also yields the lightest weight for strength. 2 Layer construction has a loose mesh liner on the inside, rather than a laminated mesh. Contrary to popular belief the primary function of the loose mesh liner isn't to aid breathability. It is to increase durability. It doesn't matter if the fabric is a coating or a membrane, 3 Layer construction is always far more durable than 2 Layer construction, in every single case. With the exception of Gore-Tex Paclite (discussed later) an unlined jacket is either not very durable or not very breathable (or both) when compared to 3 Layer.

#### **You've blinded me with science can you summarise?**

The more demanding user should only consider a 3 Layer type construction. Colder weather means better breathability and in mild conditions it's more important that you have a highly breathable product (as the Delta T driving forces will be lower). Recent steps forward in membrane technology have evolved a new generation of Gore-Tex fabrics, called XCR (short for Extended Comfort Range). 3 Layer XCR offers a staggering 40% increase in breathability over the Classic 3 Layer Gore-Tex, with no sacrifice in durability. Gore-Tex also simultaneously launched a 2 Layer version of XCR, a good product, but significantly less breathable and less durable than the 3 Layer XCR version.

#### **What about the Gore-Tex Paclite that you mentioned?**

Paclite is sometimes described as a 2½ Layer construction. Rather than a laminated mesh on the inner of the membrane Paclite has a pattern of small polymer dots. These dots do the same job as the 3 Layer laminated mesh (they protect the membrane) but with significant weight and pack size savings (hence the name Paclite). Unlike unlined garments, Paclite is still very durable (due to the dots) and very breathable, although not as breathable or durable as 3 Layer XCR due to a difference in the membrane technology and construction.

### **Fabric, Features and Fit for Function**

Fabric is only a third of the story. After all it's not what you've got, but what you do with it. Mountain users require a very different set of features to the dog walker, this is where design and innovation comes to the fore. The exploded diagram on the opposite page illustrates some common jacket features.

#### **Mountain Hoods**

Hoods should be able to fit a helmet underneath if required. Some hood designs use acres of fabric to compensate for poor fit. It's easier to cut, sew and tape fabric in straight lines and, let's face it, the head is a melon shaped object. Check for ease of hood adjustment using a gloved hand, single pull cords are far superior in this area, especially when you can't see the cord lock behind your head. When the weather turns foul you'll need a good seal around the face to prevent water ingress and a good hood will turn with your head. If it's windy and your hood isn't in use, some type of roll down facility is a nice touch. Winds tend to rush up vertical surfaces so it's an irritation to have your hood constantly flapping around. With the recent advances in lamination and glueing, hood bills (or peaks) have become fairly advanced. Laminated fabrics, as well as being stiffer, also trap less moisture. The 'thick-wire-in-the-peak' approach is fairly old hat. Of course look for a stiff peak, one that will withstand a stiff wind.

#### **Pockets**

Venting pockets backed with mesh are pretty cool (literally!). But then Gore-Tex pocket bags are good for storing wet gloves/

hats (at the expense of better breathability). You really have to decide on your intended end use. Multiple pockets are great for storing gear but lower situated pockets are a pain as they get in the way whilst active. Another common mistake is to think that a jacket is better because it has 4 pockets rather than 2. It's usually a bad idea to 'load' heavy items in your outer shell, you will find this quite fatiguing (especially when not wearing a pack) as the jacket will tend to hang from your shoulders. Access zippers that allow you to store items in the pockets of your inner layers are a nice idea as they also double as a venting option.

#### **Pit Zips**

Anything that allows you to get rid of unwanted heat is a good idea. True, you have a large zip in the front of all jackets, which is pretty effective for cooling off. But what if it's lightly raining or you are climbing? Pit zips do offer fairly efficient venting and when used in conjunction with body or pocket vents, large amounts of cool air can be pumped around the inside of the jacket. In the past Pit Zips have added bulk and weight to jackets, but new zip technologies have partly solved these problems, allowing for much easier instant access.

#### **Water Resistant Zippers**

You've probably all seen them, shiny zips that look pretty cool. Many people describe them as "like a dry suit zip" but this isn't the case. These zips are classed as water-resistant as they can't hold back any water pressure. Water running over a surface i.e. not falling onto it, has surprisingly low water pressure, hence when water-resistant type zips are used correctly (with a small flap covering them) they are particularly effective at keeping water out, minimizing bulk and weight. Water-resistant zips are used exposed to the elements but they must have a waterproof pocket behind the zipper, preventing the inevitable seepage of water entering the inside of the jacket. Do these zips spell the end for the 'standard' zipper? No. Water-resistant zippers work well when they are flat and in a straight line, bend them or crease them, like under the arm for example and they do tend to open. Water-resistant zips are also fairly stiff in operation and particularly expensive. Durability wise these zips are tested to 100,000 cycles which is more than adequate for most needs! Therefore water-resistant zips are certainly a worthwhile innovation, but not practical in every application.

#### **Waterproof stretch fabrics**

Waterproof fabrics with stretch already exist. It's quite a nice concept and certainly conjures up ideas of total freedom of movement. Current stretch fabrics however do require fairly high levels of mechanical force to engage the stretch. They also make some compromises on durability. Stretch panels in strategic places (away from main wear areas) make more sense than jackets made entirely from stretch material.

#### **Other considerations before purchase**

Jackets and fabrics are a little like football teams. Don't ask a mate who's an avid Liverpool supporter to explain the merits of the Manchester United back four and expect to get a 100% impartial answer. Don't get too bogged down in fabrics and features - give some thought to fit. Cheaper jackets tend to use lots of fabric to compensate for poor fit. Go to your nearest specialist outdoor store that is staffed by climbers. It shouldn't be too difficult to find someone who has used many of the jacket/fabric combinations on offer and will be familiar with the merits and disadvantages of each one. Explain the conditions that you usually find yourself in and what activities the jacket will be used for. Next time you could be the one smiling whilst everyone else can't wait to get home and dry out.