

## clothing

A layering system needs to be considered when walking in winter. For most winter conditions, this will consist of 4 layers : base, mid, soft shell and outer shell.

Base layer : close fitting synthetic or merino that transfer moisture away from the body

Mid layer : quick drying and warm, typically fleece. Two or three lighter mid layers perform better than one heavy mid layer

Soft shell : a windproof and water-resistant layer

Outer shell: wind and waterproof/breathable fabrics

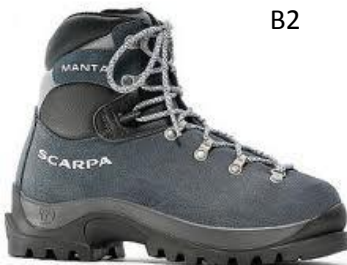
## BOOTS

Boots can be categorised into 4 categories – trail shoes, hiking boots, backpacking boots and mountaineering boots. In winter only consider the use of mountaineering boots. This type of boot can be made of leather, fabric, plastic or a combination of any of the three.

There are 4 categories of mountaineering boots: B0, B1, B2 and B3.



B1



B2

**B0** are 3 season boots, not designed for winter use.

**B1** boots are 4 season with a semi-stiffened mid-sole to take crampons and a more supportive upper.

**B2** boots have a near fully stiffened mid-sole, higher ankle profile, thicker upper and the facility to take crampons with heel-clip bindings. Suitable for general winter walking, glacial

terrain and mid-grade climbing.

**B3** technical boots are totally rigid, usually plastic and have the facility for heel clips and wire toe balls. These are suitable for general walking, hard ice climbing, glacial terrain and high altitude mountaineering.



B3

**Gaiters** provide protection from water and snow, add some insulation and guard against crampon snagging

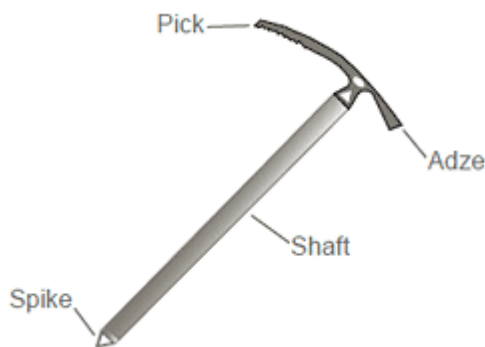
**GLOVES** should be waterproof and long enough to cover wrists. Take more than one pair. Consider mitts – they are warmer than gloves, but at the expense of dexterity !

**Hat** is necessary to prevent heat loss from the head. Balaclava, neck-gaiter, scarf and buff should also be considered to preserve body heat.

In addition to your standard hill walking gear, you should consider other equipment for winter hill walking such as **goggles, sunglasses, head torch** (with spare batteries), **sunscreen, emergency bag, group shelter, hot drink** in flask, **poles, shovel** and an **avalanche transceiver**. All put into a **larger rucksack** than for summer use, with appropriate fastenings for ice-axe etc.

## ICE AXE

**Head** of the axe contains the **Pick, Adze** and possibly a **Karabiner hole**.



**Pick** Used for self arrest and hooking into ice. The curvature affects the holding power of the axe. Mountaineering and walking axes tend to have an angle of 65° to 70°, whereas technical axes have an angle of 55° to 60°. The tip of the pick can have positive, neutral or negative clearance – positive is less likely to bounce out when hitting ice.

**Adze** Used for cutting steps and clearing snow and acts as a grasp for self belay

**Shaft** Typically aluminium, straight shaft best for general mountaineering, curved more suited for climbing. The shaft length of a mountaineering axe is determined primarily by your height – hold it by your side and the bottom of the axe should touch roughly around the top of your boot.

**Spike** Used as a stabilizer when walking on snow or ice

**Karabiner hole** Some ice axes have a carabiner hole and a leash may be threaded through. Leashes have advantages and disadvantages and use is to personal taste !

## crampons



C1 Crampon



C2 Crampon

Crampons are classed as C1, C2 and C3.

**C1** flexible crampons have typically 8-10 points and are fully strapped or have a flexible cradle/strap combination. For general winter walking C1 crampons are fine and can be attached to most boots.

**C2** articulated crampons tend to have 10-12 points and a cradle/heel-clip attachment. C2 Crampons can only be used with B2 or B3 boots. With more front points than C1s, C2 crampons are fine for steep walking, scrambling or mid-grade climbing, but are also acceptable for walking on easy angled terrain.

**C3** rigid crampons are technical crampons for winter climbing and can only be attached to B3 boots. Due to their weight and stiffness, this type is not recommended for general winter walking.

Crampons come with anti-balling plates – flexible plastic sections designed to prevent snow build-up on the underside of crampons.

Get familiar with putting on crampons prior to heading for the hills !

## walking on snow and ice

Without crampons:

**Kick in steps** – on a direct ascent kick in enough to give positive hold

**Slash steps with boot** – using the hard edge of boot to create small ledge to progress on, used in a diagonal ascent and width of step should be at least half a boot wide

**Slash steps with axe** – use the adze of the axe to cut a more stable ledge than possible with boot

**Heel plunge** – when descending, keep toes up and plunge your heel into snow, keeping your weight on your heels

Note that when you use an ice-axe while walking, you should always keep it in your uphill hand, swapping it over when you change direction

With crampons :

When the snow and ice becomes too hard to kick, get your crampons on. Crampons should always be put on before you actually need them, so plan ahead. If on a slope, use your axe to cut a small platform and put your crampons on facing uphill. When walking with crampons, always keep your legs wider apart than normal – adopting a 'John Wayne' walk – this will prevent trips and rips to your expensive Gore-tex !

**Front pointing** – on a direct ascent and steep slopes can be tiring on the calf muscles. Keep your body upright, using your axe for balance and support. If the slope becomes steeper, you can lean into the hillside, using your axe pick

**Flat-footing** (or French technique) – bending your legs so as all the crampon points go into the snow. Can be done on more gentle slopes on direct ascent, or diagonally on more steep ascents.

**Hybrid technique** (or American technique) – upper foot is front-pointing, lower foot is flat-footing and axe is held for support

# emergency techniques

## Self belay

This is the basic technique to stop a slip becoming a slide. Walking on snow or ice your ice-axe should be in the uphill hand with the adze pointing forward and the shaft vertical. As you slip, plunge the shaft into the snow at the same time kick your boots into the slope. In deep snow the axe shaft should plunge all the way in, however in harder snow, the shaft will only part way plunge, in which case, grab the shaft just above the snow with your free hand – this will make for a tough anchor, enabling you to kick your feet in and get back upright.

## Self arrest or ice braking

Once a slip has started, this is the technique used to stop

If **falling feet first and facing the slope**, as you slide, get your axe into the basic ice-axe arrest position - the axe needs to be diagonally across your chest, pick facing forward and away from you, upper hand grasping the adze and tucked into your shoulder, lower hand holding the shaft at the spike. Point your head away from the adze, keep your legs apart and knees bent. If wearing crampons have your feet in the air, otherwise use your toes. Try to put as much force onto the axe head as possible and plunge it into the slope.



If **falling feet first with your back to the slope**, get your axe into the arrest position, then flip over and get the rest of your body into the arrest position.

If **falling head first and facing the slope**, grasp the axe by the head and the spike with the pick angled uphill. Plunge the pick into the snow, which will drag and turn your body to face uphill. Knees apart, lift the axe out of the snow and get into the self arrest position remembering to keep your feet up and head to the side.



If **falling head first and on your back**, you can get into self arrest in one of two ways. One is to flip over onto your front, then use the procedure described above for falling head first and facing the slope. Alternatively and more quickly, as you are sliding, hold the axe out to the side of your body and drag the pick in the snow. Bend your knees and move into a foetal position, pivoting around the axe, then flip over into the arrest position.



# snow structures and features

Snow is complex ! The lightest and driest snow (**powder snow**) forms in calm low temperatures, whereas the heaviest and wettest snow (**wet snow**) is formed in higher temperatures.

Once snow lands, many changes affect its structure and stability.



Powder snow, Etive Beag

**Rime ice** is created when water freezes as it is blown onto something and forms in the direction of the wind.

**Verglas** (or Black Ice) is formed when water comes in contact with a surface less than 0°C.

**Graupel** is the balled snow found at the bottom of gullies or slopes, formed by riming of the snowflakes in clouds

**Windslab** is snow that has landed, then moved around by wind. Can be hard or soft, very unstable and common in Scotland. Characterised as whiter layers in the snow and gives a squeaky noise when walked on.



Rime ice, Creag Meagaidh

**Sastrugi** is eroded snow and along with raised footprints, indicates snow shift.



Sastrugi, Pentlands



Raised footprints on Ben Avon

## Snow formation

Snow moves from windward slopes to lee slopes and into gullies. Snow builds up in layers, each layer forms by one of three basic processes – rounding, kinetic growth and melt-freeze metamorphism.

**Rounding** or **dry snow metamorphism** occurs near 0°C and is where the branches in the snow crystals become rounded as water sublimates. The branches attach themselves to other crystals and the result is firm and stable snow.

**Kinetic Growth** is where there is a temperature different between the ground surface and the snow surface. This difference is called a temperature gradient. Water vapour rises and can create unstable layers, indicated by **depth hoar** or **surface hoar**.

**Melt-freeze metamorphism** occurs where temperature fluctuates above and below 0°C. Water forms on the snow crystals, refreezes and creates a strong bond between the crystals. The result is a strong layer of snow, often referred to as **Névé** – the best snow for climbing and walking !



Surface Hoar, Cairngorms (PJMountains)

**Cornices** are large build-ups of snow layers forming on the lee sides of ridges, plateau edges and other changes in hillside slope angle. The layers are built up by wind shifting the snow. Directly underneath the cornice there is another build up of snow, known as the **scarp slope** and often built up of slab snow. The extent of a cornice can be very difficult to access and the break-off point can occur further away from the edge than expected. Freshly formed or thawing cornices are the most unstable.



Cornice on Ben Nevis in late April



The infamous cornice on Beinn a'Chaoirainn near Roy Bridge

# Avalanches

There are 3 basic types of avalanche : powder, slab and wet snow.

**Powder avalanches** occur when the snow layers build up in fairly windless conditions. The more rapid accumulation, the greater the danger. Powder avalanches are rare in Scotland, however smaller slides associated with wind transported snow (known as **spindrift avalanche**) are common.



Full depth slab avalanche in The Pentlands

**Slab avalanches** occur when an area of snow detaches from the surrounding build up. These avalanches mostly occur on slopes between 30° and 45°, with the key figure at **37°**. Slab avalanches can be **full-depth** where the hillside becomes exposed or **partial-depth** where only an upper layer or layers of snow detaches.

**Wet snow avalanches** occur when the temperature exceeds 0°C. As water is formed, the snow layers become heavier and lubricated.

## **Avalanche Checklist - Top 6 Factors** (source MCoS)

1. **Visible avalanche activity.** If you see avalanche activity on a slope where you intend to go, go somewhere else.
2. **New snow build-up.** More than 2 cm/hr may produce unstable conditions. More than 30 cm continuous build-up is regarded as very hazardous. 90% of all avalanches occur during snow-storms.
3. **Slab lying on ice or névé,** with or without aggravating factors such as thaw.
4. **Discontinuity between layers,** usually caused by loose graupel pellets or airspace.
5. **Sudden temperature rise.** The nearer this brings the snow temperature to 0°C, the higher the hazard, even if thaw does not occur.
6. **Feels unsafe.** The "seat of the pants" feeling of the experienced observer deserves respect.

**If you get caught** in an avalanche, any defensive action is very difficult and movement is often impossible. There are however some actions you may be able to take. Plunging your ice-axe into the undersurface may help to keep you near the top of the slide and upright. Shout and hopefully other hillwalkers will hear and see you. Try to jump to the side or above the fracture. Get rid of your external gear. Swimming motions are known to sometimes help. As the avalanche slows down, you may be able to get some purchase on the debris. Make a desperate effort to get to the surface, or at least get a hand through so you can be seen by people searching.

**If you get buried** then keep one hand in front of your face to clear an air space. Also try to maintain space for chest expansion by taking and holding a deep breath. It is important to conserve energy and avoid panicking – your companions are probably searching for you.

# PLANNING your day on the hills

Weather forecasts – MWIS, Met Office and SAIS provide a comprehensive cover

Wind speeds and direction, temperature, snowfall/rainfall, cloud-level, wind-chill and freezing-levels should be noted

Watch the forecasts for a few days prior to heading out to understand the general pattern and figure out on which side of the hills you'd expect cornices to have formed and which sides will be likely to be scraped of snow.

Wind (mph)	Temperature (Celsius)							
	10	5	0	-5	-10	-15	-20	-25
10	5	-1	-7	-13	-19	-25	-31	-37
20	0	-6	-13	-20	-27	-34	-41	-48
30	-1	-9	-16	-24	-31	-39	-46	-54
40	-2	-10	-18	-26	-34	-41	-49	-57
50	-3	-11	-19	-27	-35	-43	-50	-58
60	-3	-11	-19	-27	-35	-43	-50	-58
70	-3	-10	-18	-26	-34	-42	-50	-57
80	-2	-10	-17	-25	-33	-40	-48	-56
90	-1	-9	-16	-24	-31	-39	-46	-54

Look at the forecast for the day after you're heading out – weather can move in quicker than expected !

To avoid avalanches, consider slope angles and profiles, ground surface and features and lee slopes. Most large slab avalanches run on slopes between 30 and 45 degrees. Smooth ground surface such as rock slabs will give rise to full-depth avalanches, whereas rough ground will have large boulders and tend to anchor base layers in position, making avalanches less likely. Convex slope profiles are generally more hazardous than uniform or concave slopes. Ridges and buttresses are better choices than open slopes or gullies when avalanche conditions prevail. Lee slopes should be avoided after snow storms or heavy drifting

You'll be walking much slower on ice or through snow and, with shorter daylight, you'll need to plan accordingly. Snow-cover cuts down on navigational points and creates poor visibility, even white-outs, which can hide the horizon and other features leading to lack of confidence and sometimes nausea. Strong winds can cause visibility to deteriorate further, slowing progress and influence navigation options. Check your planned route and ensure you have some escape options. Be flexible and have a back-up alternative route (and a back-up back-up alternative) !

In winter air pressure fluctuates more frequently, therefore if you use an altimeter, you will need to reset it more regularly. Low temperatures cause batteries to be much less efficient, therefore GPS batteries won't last as long in winter.

## SNOW INJURIES

**Hypothermia** is where the body's temperature drops below 37°C and is characterised by feeling cold, becoming clumsy and disorientated. If not dealt with, unconsciousness and ultimately death occur ! Anyone showing signs of hypothermia should be put in warmth, given warm drinks and have wet clothing removed and replaced with dry.

**Frostbite** is a localised cold injury usually to hands and feet where circulation of the blood supply is affected. Mild frostbite (or frostnip) is treatable by re-warming the affected areas. With deep frostbite don't rub the area or warm with direct heat, nor burst any blisters.

**Snow blindness and sunburn** should be prevented by wearing goggles and applying sunscreen and block. Particularly a problem in spring when UV levels are highest.