

"SAFE SKIING"
BACKCOUNTRY SKIING IN AVALANCHE TERRAIN¹

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Abstract.--Over the three winters from 1987 to 1990, 70% of U.S. avalanche victims were "experienced" backcountry skiers. Current avalanche education does not address the backcountry skier who actively seeks avalanche terrain as a playground. Field methods exist which increase the safety of backcountry skiing in avalanche terrain. These techniques include; placement and use of snowpits, selection and use of test slopes, stability testing with cornices and rocks, ski cutting, run selection, on-slope skiing, group movement, and communication. Proper timing, and the ability to adjust skiing and route selections according to snow stability, are key elements in "safe skiing". A safety protocol based on these skills is presented in this paper for use by educators and advanced backcountry skiers.

INTRODUCTION

The debate comes up every year over whether backcountry skiing is increasing. The answer may be unclear, but without question, backcountry skiers are getting better and bolder every year. The refinement of equipment is certainly a factor; three-pin gear is now more suited to steep chutes than golf courses. Overcrowding and overpricing at ski resorts also contribute by pushing alpine-equipped skiers into the backcountry.

But whatever the reasons for it, the new boldness has had a price. Over the past three winters, from 1987 to 1990, roughly 70% of the avalanche victims in the U.S. would have described themselves as experienced backcountry skiers. Most of these people died while skiing steep terrain that obviously had the potential to avalanche. Technically, these people were competent, some earning the label of "extreme skier", but their avalanche skills had not kept up with their skiing skills.

Granted, some of these skiers couldn't even recognize an avalanche path. But there is a growing population of backcountry

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skiers who do recognize avalanche terrain, and in fact choose avalanche terrain as a place to ski. If you doubt the popularity of this kind of skiing, you haven't seen a Chouinard/Black Diamond ski catalog lately. Or videos like "The Blizzard of Aahs" or the new "Revenge of the Telemarkers."

Unfortunately, these videos and catalogs say almost nothing about avalanches. What's more, most sources of avalanche education have little guidance for people who are skiing the steep backcountry. Standard avalanche advice recommends complete avoidance of avalanche-prone slopes, or at best, how to get past, through, or around avalanche areas. Learning beyond the basics is left to experience, which, with avalanches, can be a harsh teacher.

Over many years, ski patrollers, helicopter ski guides, and other avalanche professionals have developed guidelines that increase their safety when skiing in avalanche terrain. These methods range from strict rules to subtle tricks to unspoken understandings, and vary by person and region. These guidelines get passed on from hand to hand, and make dangerous work a little safer.

There is not a similar set of guidelines for backcountry skiers. In areas like the Wasatch Mountains of Utah, backcountry skiers are coming up with their own methods; some are valid and effective, while others are useless, or even dangerous. For the most part, the steep backcountry is getting skied in a rather random way, with unpleasant results.

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But there are better ways, smarter ways, to ski in avalanche terrain. It is possible to balance the pleasure of skiing with avalanche safety and have plenty of both. The result is "Safe Skiing."

Safe Skiing is an approach to avalanche safety designed for skiers. Safe Skiing picks up where most avalanche education leaves off by helping skiers put their avalanche knowledge to practical use. Because few backcountry skiers have any interest in snow science, or even snowpits, the emphasis is on techniques that are simple and effective. Rather than a strict protocol, or a cookbook, Safe Skiing is a loose collection of ideas, rules, and techniques that can make backcountry skiing safer. Skiing smarter, not steeper, is the aim of Safe Skiing.

Timing and Technique

We know that snow stability is variable, changing with location and over time. Also, snow stability exists over a continuum, and is relative to the stresses that act on the snow. These concepts are obvious; one day a huge cornice dropped on a

slope does nothing, while the next day a single skier causes an avalanche.

Because the stability of snow is variable, when and how we ski affect our exposure to avalanches. We can safely ski any slope that holds snow, **if we choose the right time**. Likewise, we can often avoid triggering an avalanche, **if we choose the right technique**. With bad timing and bad technique, only good luck will keep a skier alive.

Timing is an important concept that many backcountry skiers do not understand. It can mean having to wait an entire season until a particular slope is stable enough to be skied. Sometimes waiting a few hours, or not waiting at all, can make the difference. If you want to go skiing right now, you have to pick slopes that are stable enough to be skied right now. Flexibility is the key to good timing.

Since we can never know for certain just how good our timing is, we need technique for a margin of safety. Everything from where we start skiing a slope to where we stop, from how many people are on the slope to how they make their turns, can influence our avalanche safety. As each situation will call for a different approach, we have to be as adaptable in how we ski as when or where we ski.

Timing and technique are partly a function of factors like group size, skier ability, equipment, and attitudes towards risk. How we balance these factors against snow stability will affect our avalanche exposure, as well as our skiing experience.

Risk Attitudes

Of the factors which influence when and how we ski, the individual or group attitudes towards risk are the hardest to control. Every individual has a different tolerance for risk; some require it as an element of life, while others do better without it. Each person finds their own solution to the Risk/Reward equation.

Backcountry skiing does not happen without some risk, but the risks are manageable. Generally, the steeper the terrain or the more unstable the snow, the greater the risk. A person with a low tolerance for risk may stick to lower angled slopes through much of the winter, only venturing onto steeper slopes when the snowpack is extremely stable. A risk-tolerant person might ski steep slopes throughout the winter, varying his skiing choices based on the existing snow stability. A risk-seeker will ski steep slopes at any time, with no apparent regard for the conditions, and finds his reward in the game of odds.

Before venturing into avalanche terrain with a group, it is

important to know the risk attitudes of the individuals. The worst situations are those in which people with widely differing tolerances of risk are skiing together. If there is any conflict, the group should adapt to the lowest common denominator rather than force someone into an uncomfortable and dangerous situation.

Group Size

The larger the group, the more conservative its skiing aims should be. Big groups travel slower, take longer to reach decisions, and are more likely to become disorganized and dangerous. Larger groups also need larger slopes so each person can have their first tracks. On some slopes, there may only be room for one or two skiers to ski safely.

Group sizes of four or less seem to be the most manageable, while even smaller groups are better for more extreme situations or conditions. Two evenly matched partners can be ideal for moving efficiently through avalanche terrain, but may be insufficient for any avalanche rescue work. Larger groups should confine themselves to lower angled terrain and to days when the snow is relatively stable.

While one of the cardinal rules of avalanche safety is to never ski alone, some people do. An individual alone is free of group pressure and better able to make decisions based on observations, but has no source of help should they make a mistake. Conservative route-finding and skiing selections are a good idea for people skiing alone.

Skier Ability

The steeper the terrain or the more unstable the snow, the better the skiers in the group should be. Good skiers can move more quickly and easily, putting a minimum of stress on the snowpack. Good skiers can also stick closely to lines that skirt marginally stable slopes. Repeatedly, I have watched skiers make beautiful, smooth tracks down slopes that I swore would slide. I am convinced that the reason they get away with it is because they are such good skiers.

Also, a falling skier puts much more stress on a slope than a skier making smooth turns. Anyone who has taken a fall in the middle of a steep slope understands the term "human hand charge". Of course, few people ever plan to fall, but some are more inclined to it than others.

Equipment

Anyone skiing in avalanche terrain should be prepared to deal with an avalanche accident. Self-rescue by the party is the only chance of a live rescue. The basics of a rescue beacon and shovel

should be carried by every member, and everyone should be familiar with their use. Probe poles are a good idea, as are First Aid gear and a repair kit.

Don't go into avalanche terrain without a rescue beacon, but don't go because you have one. Rescue beacons do not ward off avalanches, and do not insure that you will survive one. If you wouldn't ski that slope between your ski tips without a beacon, you had better think again.

Standard three-pin bindings keep a tight grip on your boots, and often will not release in an avalanche. Your skis then act as anchors in a slide, pulling you under the moving snow. Even cable bindings do not come off as easily as you might think. Releasable bindings are certainly an advantage, and there are releasable three-pin bindings on the market.

Alpine equipment does provide better control for poor snow conditions and for making ski cuts, but lack of mobility and slower speed can be disadvantages for climbing or traversing.

Under certain snowpack conditions, such as when buried layers of surface hoar or depth hoar exist, wide skis may be safer than narrow ones. Wide skis usually float higher in the snow, and are less likely to disturb a buried weak layer. For the same reasons, snowboards are often safer than skis.

The factors of group size, skier ability, equipment, and risk attitude should influence which slopes are skied when and how they are skied. Small groups of good skiers who are well-equipped and who have a tolerance for risk are better prepared to ski steep avalanche terrain than opposite groups. These "human factors" need to be balanced against the existing avalanche conditions.

STABILITY EVALUATION

There are a number of ways you can get information about the avalanche conditions, and you should take the first steps before you go into the backcountry. You can start by calling the local avalanche forecast office, talking to a local ski patrol, or by closely following the weather throughout the winter. This information will help you decide where and when you should go, and help you control the group factors discussed above.

Once out in the mountains, you have lots of clues about snow stability, recent avalanches being the most obvious. Other clues include recent snowfall, windloading, and cracking and collapsing of the snowpack.

There are also physical tests that backcountry skiers can do to check the stability of the snow. All of these tests involve stressing the snowpack in some way to get an idea of how it might

respond to a skier. Here are some of the best tests for the backcountry:

Test Slopes

An easy way to check snow stability is to find short, steep, test slopes. Ideally, a test slope would be a smaller version of the slope that you plan to ski. It should at least have the same aspect, if not the same elevation and steepness. A test slope should be fairly steep, at least 35 degrees, and less than 20 feet high; cutbanks are ideal. The idea is to stomp around with your skis on near the top of the slope to see if you can cause an avalanche. Test slopes should be small enough that, if they do slide, they cannot bury you. Any sign of instability on test slopes should be a clear signal to avoid larger slopes.

Cornices

One of my rules of the backcountry is "Always kick cornices." Cornices are the bomb of the backcountry, and are great tools for testing the stability of the snow. Often, a refrigerator-sized chunk of cornice will bring out an avalanche, or will start a small slide which will trigger a larger one. A boxcar-sized block that rolls down the slope you want to ski with no results should boost your confidence.

It's best to work with small, fresh cornices, rather than older, larger ones which have a bad habit of breaking further back than you might imagine. Smaller cornices can easily be stomped off with one ski, or knocked off with a ski pole, but as they get larger you may want an anchor. You can start by digging the tail of one ski into the snow and stomping with the other ski. A solid belay can help you work more safely on larger cornices. Cornices can be pried off with a shovel or a ski, and can be sawn off using a cord with knots in it.

Snowpits and Snowpit Tests

I sometimes feel like I am wasting my breath when I talk about snowpits with avid backcountry skiers. I know they know how to run a shovel, but you hardly ever see a hole dug in the snow. Even if there is one, chances are good that the slope was skied anyway.

In some ways I can understand. Snowpits are cold, time consuming, confusing, and sometimes dangerous. If you don't know what you are looking for, snowpits can be a waste of time. But not digging a snowpit can be like crossing a highway without looking both ways. It doesn't hurt to look, and it just might help.

Perhaps as important as how you dig a snowpit or what you do to it is where you dig one. Stay away from drift zones and scoured areas, and avoid tree wells and rock bands. You should dig a

snowpit as close as possible to the slope you plan to ski. If your pit on an adjacent slope looked good, dig another one on the margin of the slope you plan to ski. If it looks good, move further out, probing with your ski pole or doing quick "armpits" with your hand to see if the stratigraphy has changed.

The key to snowpits is to keep them simple. Don't waste a lot of time looking at individual crystals, or taking temperatures or densities. What you really want to know is whether the snow is unstable, and the best way to find out is by testing it. The best test for skiers is one which simulates the stress a skier will put on the snow.

The Rutschblock test is the only test that is simple, reliable, and easy to learn. The results are hard to misinterpret, especially when the snow is unstable. It is the only snowpit test that shows clearly how the snow might react to a skier.

You can easily dig out a Rutschblock in less than 5 minutes, and you don't have to get fancy about it. All the tools you need are a shovel, a strong back, and a pair of eyeballs. My own rule is that a Rutschblock failure of less than 2 jumps says the slope could fail with a skier.

Bear in mind that snowpits themselves stress the snowpack quite a bit, and more than one person has caused a slope to release by digging a snowpit. Pick as safe a location as possible, or use a roped belay.

If all this sounds like a lot of caveats, it is, and is part of the reason some people don't bother with snowpits. Snowpits and snowpit tests can give you a lot of good information, but they are just one way of finding out the stability of the snow.

Ski Cuts

Ski patrollers have used ski cuts for years to release deposits of wind slab, especially small pockets just below ridgelines. The idea is to make a fast, diagonalling run across the top of the slope, pushing down or bouncing on your skis as you cross. Hopefully, if you initiate an avalanche, you will be at or just above the fracture, and the slide will move away from you. You should aim for a safe stopping spot, such as a clump of tress or a rock band. Stay as high as you can on the first pass, and have your partner make a second, lower cut.

Ski cuts are quite effective on small pockets of recently-formed windslab. A small slide you start with a ski cut can often start a larger avalanche below. However, ski cuts are notoriously ineffective for hard slab conditions or where a deep-slab instability exists. Ski cuts are also not a good idea on large, open slopes.

Ski cuts can be made with a rope on, but due to the unknown dynamic forces that might result, this should only be done on small slopes with a solid belay anchor. Making ski cuts with three-pin gear can be tricky because you need to carry some speed; alpine equipment makes it easier.

Other Tricks

If a deep slab instability is known to exist, such as a buried surface hoar layer or a layer of depth hoar, it is sometimes possible to intentionally collapse the snowpack. This collapse can result in an avalanche if the nearby slopes are steep enough. The collapse can be started from a safer, lower angled slope by digging a snowpit down into the buried weak layer, by pushing your pole through the layer, or by jumping up and down on the snow.

You can also use rocks to test snow stability the same way you use cornices. Rocks bigger than a microwave oven are the best, especially if you can get them rolling down the slope. In soft snow, rocks tend to stick in one place and therefore stress only one spot.

By whatever means, a backcountry skier should take every opportunity to test the stability of the snow. However, a lack of signs of instability does not always mean that the snow is stable, especially where deeper snowpack weaknesses exist. There is no handy formula that tells us what slopes can be skied on which days; the variety of avalanche conditions makes it dangerous to generalize. But our tests and observations should give us some idea of what kind of situation we are dealing with.

For instance, if there are avalanches all around us, all our tests show instability, and it is starting to snow, we might call that a "Red Light Day." That means only the most protected, low angle slopes are a good skiing choice for that day. If, on another day, only windloaded slopes over 35 degrees show any instability, we might call that a "Yellow Light Day." Our skiing options are quite a bit broader, and we may be able to ski some fairly steep slopes if we are selective. On a "Green Light Day," even the biggest boxcar cornices have no effect on a rock-solid snowpack, and we finally feel comfortable on our favorite powder bowl.

Our skiing options may be further limited when we consider all the group factors. A simplified system might put the various factors together as follows:

RED LIGHT DAYS

- Observations Natural avalanches on many aspects. Recent heavy snowfall and windloading. Cracking and collapsing.
- Tests All tests positive; ski cuts, cornices, and test slopes result in avalanches; Rutschblock fails before one jump.
- Skiable Slopes All slopes over 30 degrees, especially large open bowls, should be avoided. Heavily wooded slopes may be skiable. Skiing on or adjacent to avalanche paths that have run may be possible.
- Group Factors Only small groups of the most experienced skiers who are well equipped and tolerate risk should travel in avalanche terrain. All others should stay on ridgelines or on gentle terrain.

YELLOW LIGHT DAYS

- Observations Isolated or no natural avalanches. Recent heavy snowfall or windloading. Isolated cracking; no collapsing.
- Tests Mixed results; ski cuts and test slopes produce nothing or cracking; large cornice releases avalanche; Rutschblock fails with two jumps.
- Skiable Slopes Some slopes up to 35 degrees may be skiable, especially where windloading is insignificant. Slopes over 35 degrees, especially on aspects that show instability, should be avoided. Slopes with anchors are preferred over large, open bowls.
- Group Factors Larger groups or low end skiers should stick to slopes less than 30 degrees, especially on suspect aspects. Small groups of high end skiers may be able to safely ski up to 35 degrees on selected exposures.

GREEN LIGHT DAYS

<u>Observations</u>	No avalanche activity. No recent snow or windloading. No signs of instability.
<u>Tests</u>	All tests negative. Large cornices produce nothing. Rutschblock does not fail with repeated jumps. Ski cuts and test slopes produce minor sluffing.
<u>Skiable Slopes</u>	Most slopes up to 35 degree should be skiable. Slopes of 40 degrees or more may be suspect.
<u>Group Factors</u>	Groups of any makeup can safely ski up to 35 degrees. Stronger groups are preferred for steeper slopes.

Because our knowledge of avalanche conditions is always incomplete, we have to leave a wide margin for error. If you find yourself worried about falling or wishing you had a rope on, maybe you are cutting it too close. Always take at least two big steps back from where you think the edge is. This may mean skiing slopes that are at least 5 degrees less steep than those you think will slide. Or it may mean skiing one at a time even if the snow is stable enough for two. Our choices of how we ski can be just as important as when and where we ski.

SKIING RULES AND SKIING CHOICES

Skiing in avalanche terrain is a matter of odds. The more often you expose yourself to the hazard, the better your chances of getting caught. If you choose to play the game, there are a few strict Safe Skiing rules that you need to know. These are the rules that keep problems from becoming disasters.

Rule #1

Always ski one at a time. Never have more than one person in the same avalanche path, whether you are climbing, crossing, or descending. Not only will this ensure that no more than one person will be caught in an avalanche, it reduces the stress to the snow.

Rule #2

Never ski above your partner, which also means don't stand below a descending skier. If you are at the top, wait until the other skiers are down and out of the way before starting down. If you are at the bottom, move well out of the way. Don't stop in the middle, don't get out your lunch or camera, MOVE!

Rule #3

Have a plan. Know who is going to ski first, as well as last. Know where you are going ski, where you will stop, and what your escape route will be if there is a slide.

Rule #4

Stay in voice or visual contact. If you can keep track of where people are, it will help you follow the first three rules, and make a rescue easier should it be needed.

Other than these few rules, how a slope is skied is largely a matter of choice. However, some choices are better than others. The following are some of the better choices:

- * Start with shorter, lower angled slopes. Increase your exposure only gradually through the day. Start on treed slopes before skiing large open bowls.
- * Choose slopes where you can see the entire run. Avoid steep breakovers.
- * Choose slopes with gradual, open runouts rather than slopes with cliffs, gullies, or trees below.
- * Use natural protection, such as rock bands, trees, or ridges as much as possible.
- * Put a ski cut in across the top of the slope before you ski it.
- * Enter the slope at the top, rather than the sides. If you trigger a slide, you may be above it rather than in the middle.
- * Ski where the snowpack is deepest, avoiding areas of shallow snow which may be more sensitive to skier-triggering.
- * Ski in the smoothest style that you can without falling. Parallel-style skiing often puts less stress on the snowpack than telemark style. Many telemark skiers concentrate their weight on one ski at some point in the turn. This concentration of stress pushes the ski lower into the snow, making it more likely for the skier to trigger an unstable layer.
- * Ski on the sides of avalanche paths, working out towards the middle over successive runs. Don't centerpunch a slope unless you are very confident that the slope will not slide.
- * Ski in control. If you lose control, sit down rather than crash spectacularly.
- * Don't stop in the middle of the slope. Either ski all the way down or ski off to the side.

- * Move out of the way when you reach the bottom.
- * Use simple, clear commands or signals to start each person skiing.
- * Watch each person as they ski the entire run.
- * Don't start skiing until the previous skier is out of the way.
- * If you have the option, ski next to or on avalanches that have already run. If avalanche conditions are bad, you can sometimes start an avalanche and ski down after it runs.
- * In snow climates where depth hoar is common, steer away from rocks which might serve as trigger points. In general, you should ski where the snowpack is deepest, and therefore strongest.
- * Keep your group's tracks close together. Not only will you get more skiing out of a slope, you will decrease your chances of hitting a trigger point.
- * Avoid skiing near other groups.
- * Ski the same slopes as often as you can throughout the season. The skier compaction helps stabilize the snow. You can even do some early-season ski or boot packing if you want a safe place to ski during the winter.
- * If conditions are very unstable, ski exactly in the tracks of the previous skier who descended safely.

You should give the same amount of consideration to the climbing track as to the line of descent. A climbing track usually puts more stress on a slope than a descending skier, especially if the track is used a number of times. You also spend more time going uphill than down.

- * The climbing track should be on lower angled slopes or on snow that is more stable than where you are skiing.
- * Stay spread apart when climbing, crossing exposed areas one at a time.
- * Take as direct a climbing line as you can. Don't zig-zag all over the mountain.
- * Climbing straight up on foot is sometimes the safest route. However, this does concentrate the stress we put on the snow and should only be done on stable slopes.

Of course, not all of these choices will apply to every situation. Being flexible will help us through the variety of conditions we will encounter.

Flexibility is what keeps Safe Skiing from being a strict protocol. A rigid system would be as useless as the old route-finding diagrams. Rather, Safe Skiing is a collection of rules, ideas, and techniques perhaps better called "Safer Skiing," because they can only make a dangerous game a little safer. How, when, and where we play the game can be a matter of choice, rather than chance.

SPREADING THE WORD

Should backcountry skiers be taught how to make ski cuts or how to drop cornices? Isn't that promoting a dangerous game? The fact is, the game is being played without us now. Many of the places that we said should be totally avoided are getting skied regularly. Sitting back with our arms crossed, shaking our heads is not a professional response. We should share our collective knowledge with those who are most at risk.

Spreading this information around will take a variety of approaches. Unfortunately, the people who need it the most are also the least likely to take avalanche courses. Avalanche courses designed specifically for advanced skiers may be one approach. But to teach avalanche safety to backcountry skiers we have to be backcountry skiers ourselves. This means looking at avalanche education curricula with "skiers eyeballs." We could probably use a similar approach to educating snowboarders and snowmobilers.

At the Utah Avalanche Forecast Center, we are working on a video that will focus on Safe Skiing techniques. Regional avalanche forecast centers can also provide useful suggestions of how and where to ski under existing conditions. Ski patrols can do the same thing. If nothing else, maybe we can drill in the importance of timing.

With or without the help of the avalanche community, a growing number of people will be skiing in steep backcountry terrain. Will we get through to the "ski to die" crowd? Somehow I doubt it, but I feel we have a professional obligation to try. Trying to stay one step ahead of those who are pushing the edge may even teach us something new.

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