

Shovels That Span the Divide Between Heaven and Hell

By Manuel Genswein and Ragnhild Eide

This project was carried out under the patronage of The Austrian Alpine Club. All equipment has been purchased and paid for by the authors and none of the involved parties are in any way involved in the manufacturing, sales or promotion of any of the tested equipment. The equipment was tested during the field tests for two recent research projects—the V-shaped Excavation Strategy (avalanche.ca vol 84 p 57-60 Spring 2008) and Companion Rescue with Minimal Training (avalanche.ca, vol 86 p 57-60, Fall 2008).

Scope and Description of the Test

The publication of the V-shaped snow conveyor excavation strategy has triggered many questions concerning the quality and efficiency of the working tools—in particular the avalanche shovel. To our big surprise, shovel models that were rated “recommended” by certain European mountain magazines utterly failed during our field tests. It is clear that these shovels had been rated without any serious testing in snow and hard avalanche debris.

Our test focused on avalanche shovels that can be carried in a normal sized backpack. Specialized rescue shovels with large steel blades have not been taken into consideration. The same is true for plastic shovels. They usually break in cold temperatures and hard debris before the first buried subject can be excavated. There are even some shoveling tools available without a shaft. These have not been taken into account due to the inefficiencies of their mechanical and/or ergonomic design.

Only correct shoveling technique was used during the test. All participants were shown how to cut blocks and specifically instructed not to break up the debris by leveraging the handle with a lot of force. All failures and observations were seen during regular use of the shovels and probes in avalanche rescue, the application they are primarily designed and sold for.

Besides testing a selection of the currently available products, the aim of this project is to provide a detailed overview on the many important characteristics and functions of a shovel. The resulting criteria may be used as an evaluation guide for future products. The manufacturers of the tested products have been asked to comment the test result for their product. Their reaction may be found at: www.bergundsteigen.at

1. Shovel selection criteria

From all major manufacturers, only the one or two most promising (mechanically strong, ergonomic, light weight) versions were selected for the test. We purchased three of each of the selected models in a regular mountain sports shop. In addition to a few heavier and larger versions weighing approximately 800 grams, we purposely selected a few lighter shovels in order to see if they can offer comparable properties/qualities as the larger versions. The lighter models were also an attractive choice for those who preferred plastic shovels.

The shovel selection was made with three user groups in mind:

- Professional user—no compromises in mechanical stability, ergonomics and scoop volume
- Randonnee and freeride—lightweight, sturdy and ergonomical
- Light & Fast —ultra light and sturdy

The testers aimed to include at least one product for each user group in the “All Mountain” category. Unfortunately, this goal could only be achieved by adding a third product from one manufacturer to the selection.

2. Shovel Categories

“Hellish”

Shovels in this category not only break, but also damage other equipment during regular use. Shovels with serious safety issues belong in this category, along with shovels likely to break before the first subject has been excavated. Plastic shovels are often preferred for their light weight but are more likely to break in cold temperatures and on hard debris. Furthermore, when plastic shovels do break, typically the entire tool becomes useless. Since there is no weight difference between plastic and the lightest metal shovels in the “mountain” category, plastic shovels should not be considered.

“Life’s a Beach”

Shovels in this category allow you to excavate one or two buried subjects in hard avalanche snow, but are not designed to withstand the stress an avalanche shovel is exposed to without being damaged. After short use, these shovels show irreversible structural failures and need to be replaced. Considering that shovels in the “All Mountain” category are not more expensive, and some models are even cheaper, there is no justifiable reason to purchase a “Life’s a Beach” shovel. These shovels always fail due to inferior properties of the metal.

“All Mountain”

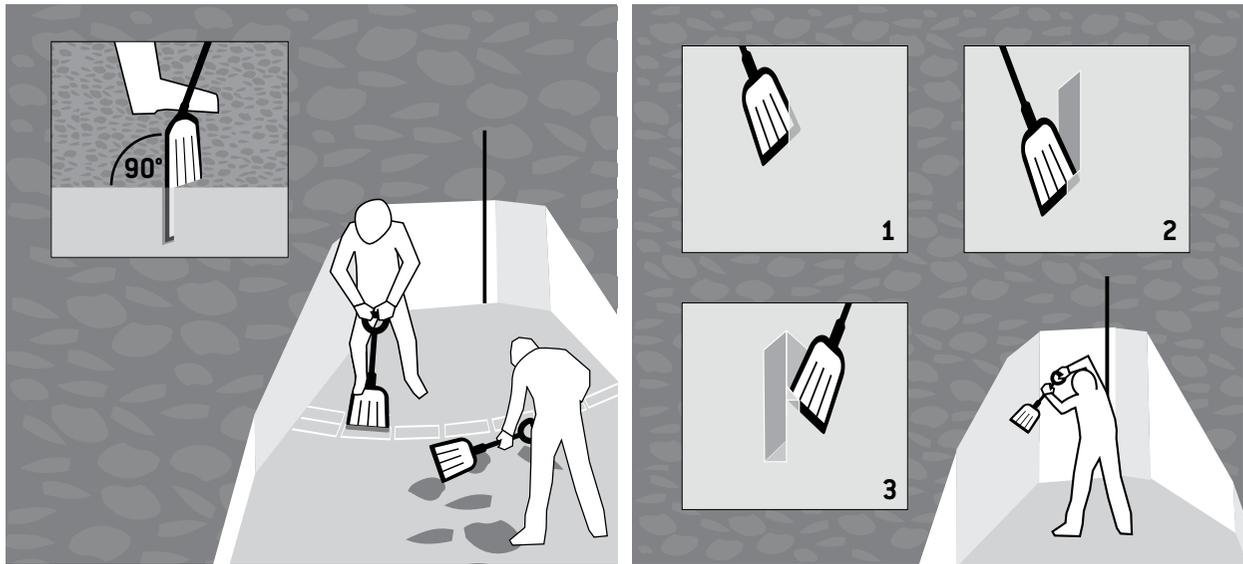
These shovels are made for year-long use in avalanche rescue. These shovels are neither heavier nor more expensive than shovels from the beach or hell categories but all of them are made from durable, heat treated alloys. These shovels do not suffer damage when chopping through hard debris.

“Heavenly”

Unfortunately these do not exist yet. Imagine a prototype of a solar-powered shovel with high energy lithium batteries...to be released in the near future.

3. Predominant Failure Patterns

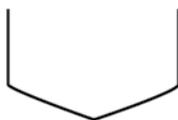
Most mechanical failures occurred while chopping blocks in hard debris. Blade deformations were often caused while jamming the shovel blade into the debris by stepping on the blade with a ski boot. When cutting into hard side walls, it was often not possible to cut into the debris by using the entire front of the blade. By using only the corner of the blade, the same applied force is concentrated in a smaller area and therefore more effective. However, in several models, the blade could not withstand this mechanical stress, which led to irreversible deformations.



4. General Description of Important Characteristics and Features

Blade

Shape:



A triangular shaped blade is offered by a few manufacturers. Theoretically the concentrated point of attack is advantageous when chopping hard debris. Unfortunately practice shows that in hard debris the triangular shape creates an unstable position which forces the blade to twist sideways. If the material could withstand the concentrated stress at the tip, or enhance a sideways attack with the blade, one could theoretically see this shape as an advantage. In practice, however, it has been shown that applying force across the full width of the blade while chopping snow leads to more efficient snow removal.



A serrated leading edge, with several exposed points of attack on a straight line, delivered the best cutting characteristics.



A straight front line of the blade provides a very stable leading edge of the shovel while chopping snow. The mechanical integrity of the main line of attack leads to the greatest blade durability.

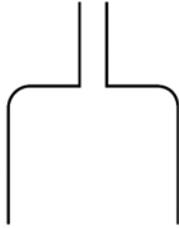


In general rounded tips offer good characteristics for cutting snow, although the rounded shape can lead to some instability.

research and education

- Rescue instructions on the shovel blade make sense from an educational point of view: The equipment is always with the owner and therefore offers a good opportunity to familiarize them with the basic rescue instructions. The print should not however, lead to snow sticking to the blade.
- Shovel blades with mounting holes are useful to connect with the tips of the skis or the bindings for improvised, terrestrial transport of a patient.

Design:



A flat top provides a good platform for stepping on while pushing on the shovel from the back in hard debris.



When the top of the blade slopes to the sides at an angle, the boot simply slides off preventing any energy from being transferred from the foot to the shovel. This wastes energy and causes the shoveler to become discouraged.

Radius: Small radii in the shape of the blade will lead to more mechanical stress being concentrated in those specific zones of the blade. Therefore, small radii are more vulnerable to deformation and eventually cracking.

Size: Small blades take less energy to wield, but make snow chopping and transport less efficient. Contrarily, larger blades can move a lot of snow quickly, but require a very strong person.

Material: Only shovels with blades made of 6061 alloy with T6 heat treatment made it into the “All Mountain” category. Certain other manufacturers claim to work as well with specially treated alloy, but the test did not see the efficiency of alternative materials or heat treatments. It is advised to be very suspicious if 6061 *and* T6 are not clearly specified. The Black Diamond R&D department stated to us in writing that “The mix that we use has taken much work and dedication in order to perfect. For this reason we do not share the specifics.” Too bad. We do share with you that their top of the line product ended up in the “Hellish” category.

Scooping Characteristics: The more the cross section of the blade resembles a U-shape, the more reliably the snow will stay on the shovel while lifting or transporting snow.

Angle of the blade in relation to the shaft

The angle between the shaft and the blade is a compromise between efficiency while chopping and efficiency while transporting snow. Whereas the shaft and the blade should be in a straight line for chopping blocks, a more angled version is preferred while transporting snow in rowing motions.

- Alternative blade-shaft angle: Some models offer the possibility of pivoting the blade to be approximately at a right angle to the shaft, thereby transforming the shovel into a hoe. For certain applications, this can be advantageous. However, the versatility of this feature can compromise long-term durability, and is not always ergonomically superior.

Shaft

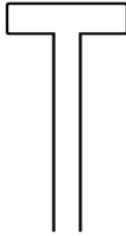
Connection: Round shafts offer less resistance while adjusting length, but are prone to rotating while adjusting. This means more time is required to ensure proper alignment between the extension holes and alignment pins. Shafts with an asymmetric cross section, such as oval or trapezoid shapes, exhibit more resistance while mounting, removing or adjusting the length, but will not waste time aligning the push-pin with the extension hole.

Length: All testers complained continuously about the inefficiency and discomfort of short, non-telescoping shafts. Short shafts mandate an uncomfortable work position and dramatically reduce the effective range of motion. As soon as you use your shovel for what it is meant for—shoveling snow—you will not regret the extra weight a telescoping shaft adds. Telescoping shafts need sufficient overlap between the two segments in the extended state in order to provide enough mechanical stability.

- The opening of the shaft needs to be covered so that no snow may enter the shaft while shoveling. Snow entering the tubular shaft leads to malfunctioning of the locking mechanisms and the compressed snow will melt into the interior of the backpack after use.
- Some manufacturers supply an additional grip on the shaft of the shovel. The concept of this shaft grip is to provide more precision and stability while shoveling.

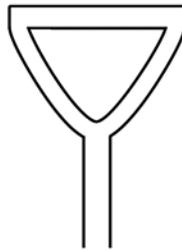
Handle

T-shaped handles



This is the least efficient and least ergonomic version. Newer versions of the T-shaped handles with more rounding show fewer problems, except for rescuers with small hands, where the entire handle is too big and does not allow a proper grip any more.

D-shaped handles



This is the most comfortable grip, although a minimum depth and width must be determined for each person's hand.