

Chapter 19

Roped Travel with Snowmobiles and Sleds in Crevassed Areas

Crevasses are dangerous, especially when you are traveling with machinery. Avoid crevassed areas if possible, even if it entails making a considerable detour.

To date, no one in the USAP has been killed as a result of a snowmobile (skidoo) crevasse fall, but there have been numerous close calls. It's only a matter of time before a death occurs unless greater attention is given to safety. People have been killed in a crevasse fall where snowmobiles were not involved.

Limited field testing has been carried out on the actual effectiveness of the methods described in this chapter. The results have been sobering in regard to the difficulty of stopping a fall, especially at speeds higher than 5 mph and/or with slack rope between the snowmobiles. The driver of a machine that falls in a crevasse is virtually assured of severe injury. This means that detection of crevasses and good route-finding to avoid dangerous areas are essential to safe travel.

Always have the capability to rope snowmobiles and drivers when traveling on a glacier. Be aware that glacial conditions vary enormously in Antarctica, from one year to the next. Glacial conditions can change in a

few weeks in some areas of Antarctica.

In areas where there is any possibility of crevasses, roped travel should be used. It is often very difficult to detect crevasses. Stop and probe ahead if you're at all suspicious. Act conservatively and operate within a wide margin of safety.

Roped travel with snowmobiles should be practiced with an experienced person in a realistic area before beginning a trip.

There are several systems for traveling through crevassed areas with roped snowmobiles and sleds, and safer options are always being sought. Please feel free to question the systems described in this chapter and provide constructive comments. The information provided here does not substitute for training or experience.

19.1 General Points for Roped Travel with Snowmobiles and Sleds in Crevassed Areas

19.1a Aerial Reconnaissance

Aerial and satellite photographs provide an excellent source of information regarding crevasse locations. Direct aerial reconnaissance from the flight deck should include viewing proposed routes of travel from the air and marking the positions of crevasses on a map. Crevasses are more easily detected when the sun is at a low angle.

19.1b Tow Ropes

Tow ropes are used to connect the lead snowmobile to the sled(s) and/or snowmobile(s) behind it. Tow ropes are separate from, and in addition to, the safety ropes. Tow rope diameters of 3/4" to 1" (22-mm) nylon twisted rope are recommended. Twin 1/2" ropes (or larger) are a good alternative. In Field Safety Training field testing, Figure-8 knots tied every meter in the tow ropes dramatically increased the fall-catching ability of the roped-snowmobile train.

In crevassed areas, all Nansen sleds, including those equipped with rigid hitches, need to be towed with the recommended spacing. The distance between snowmobile and sled should be 15- to 20 meters in suspect areas. In safe terrain, a Nansen sled with rigid hitch can be connected directly to the snowmobile.

The ends of the tow ropes should be tied with Figure-8 knots on a bight, or spliced to 5-ton shackles or locking steel carabiners.

A 1.5-meter-long protective sheath (PVC or rubber tubing) should be placed over the tow rope immediately ahead of where it secures to the sled or snowmobile it's pulling. Secure the sheath with a piece of cord so that it can't move forward. This end of the tow rope will then be protected by the sheath should a sled or snowmobile run over it.

Attach the tow ropes to the snowmobiles and sledges with either 5-ton shackles or steel screwgate carabiners. (Don't use non-locking carabiners.)

Note: Engine vibration can unscrew the locking carabiners. Steel carabiners have failed under very light tow loads when the gate is unscrewed. Two steel carabiners with reversed gates will ensure a safer system. Secure carabiner screw gates and shackle pins with wire, tape, or rubber washers, etc. so that they won't unscrew.

19.1c Nansen Sled Back-up Rope

With Nansen sleds, it's necessary to loosely tie a back-up tow rope on the underside of the bridges. This rope should be 3/4" or 1" nylon twisted rope and should attach onto each end of the Nansen sled towing rope with the same shackle or carabiner that is used for towing. This back-up tow rope needs to be tensioned in such a way that it does not bear the load unless a large impact occurs.

19.1d Snowmobile Cables

All snowmobiles used for travel in crevassed areas should be fitted with a steel cable encircling the snowmobile. The 5-ton shackle on the tow rope must be fitted over this cable when hitching the snowmobile, to ensure that the snowmobile stays belayed to the tow rope in the event a crevasse fall pulls out the snowmobile's hitch plate.

19.1e Tether Switches

The tether switch is a thin line that runs from the snowmobile's kill switch to the driver's harness. This tether ensures that the snowmobile will stop (the engine

is killed) if a driver falls from the machine. If the tether switch isn't used, the driver may end up hanging beside a spinning snowmobile track, which could cut the driver's rope or result in serious injury.

19.1f Driver Safety

- When traveling linked, snowmobile drivers should kneel to one side, rather than straddling the seat, so in the event of a crevasse fall there is a better chance to jump or fall clear of the machine.
- Only one person should be on each snowmobile.
- Helmets should be worn in crevassed areas.
- No loose gear should be hanging from the driver's harness. Dangling items can hang up and drag the driver into a crevasse.
- All drivers and sled riders should have either prussiks or mechanical ascenders attached to their safety ropes.

19.1g Communication

A series of prearranged hand signals should be used for communication between linked snowmobiles and sleds. Your field party should have signals for stopping, slower, faster, ok/ready-to-go, crevasse, and any others found to be necessary (i.e., "place flag here," etc.). The hand signals shown in figure 19-1 have been used effectively by past field parties.



Figure 19-1: Hand signals for crevasse travel.

19.1h Travel Speed

Linked travel requires continuous concentration and is not suited for fast speeds. In Field Safety Training field tests, speeds over 5 mph dramatically increased the distance a snowmobile fell, and stopping the fall proved very difficult.

When traveling in linked formation, it is vital that you don't allow any slack to develop in the tow rope. Invariably this means that the lead snowmobile will at times be slightly pulling the trailing machines. A slack tow rope will continually be run over and will jam. If you drive over the tow ropes and safety ropes, the system will be compromised. The ropes may break under a load if one of the machines falls into a crevasse.

19.1i Crossing Crevasses

Stop and probe all crevasses to determine if they are safe to cross. Probing should be done by the driver of the lead snowmobile. A ski pole, without a basket, will suffice for a probe.

If you must cross a crevasse, always do it perpendicular to the line of the crevasse. If a snowmobile or sled starts to break through a snowbridge, experience and circumstances will dictate whether to brake and attempt to hold the fall, or continue driving forward in hopes of getting across before a catastrophic collapse of the snowbridge. In either case, a change of underwear is recommended.

19.1j Stopping a Fall

When stopping a fall into a crevasse, apply the brakes and, if possible, quickly kill the engine. The engine will be killed automatically if it's your snowmobile that's falling and you fall off the machine, thereby pulling the tether switch line.

In hard snow conditions, rope brakes on the sleds will increase friction and braking ability. If you're a rider on a Nansen sled, and the sled is rigged for it, stand on the footbrake.

19.1k Travel on Foot between Snowmobiles and Sleds

In crevassed terrain, you must remain tied in when walking between your snowmobile and the other machines and sleds. Many a crevasse has been found by a driver stepping off his or her snowmobile (which has a lighter ground pressure than a person on foot), and breaking through a snowbridge that the snowmobile had crossed seconds before without incident. To walk forward or back to another snowmobile or sled, you can self-belay with a prussik or ascender, either on your safety line or a spare rope.

Get into the habit of straddling the tow ropes when walking back and forth between machines and sleds.

19.2 Tying In

The prospect of falling into a crevasse on a snowmobile is extremely frightening. No system presently exists to

allow the driver a guaranteed clearance from the snowmobile. There's a high probability of injury occurring to a falling driver. However, the following roping procedures will keep you as safe as possible in the event of a crevasse fall (see figures 19-2 and 19-3).

19.2a Front Driver

Clip the bitter end of an 11-mm climbing rope to your harness with a Figure-8 knot and locking carabiner. Use a prussik or ascender to fine tune the tension.

Walk the rope back to the sled or second snowmobile, tie a Figure-8 on a bight, and clip it into the front towing thimble with a locking carabiner. Coil the unused rope neatly and stow it on the sled.

If there's a rider on the sled, adjust the remaining portion of the rope, clip it to either the front or rear towing thimble of the sled, and then clip it into the rider's harness with a Figure-8 knot. Stow any extra rope out of the way.

Roping up will be much easier and quicker if you cut your safety ropes to the exact lengths needed before you go into the field.

Lead drivers should carry a 45-meter climbing rope in a stuff sack (throw-bag style) neatly stowed on the snowmobile. This can be used for probing out ahead of the machine or to rescue others in the field party. Equip this rope with prussiks or an ascender next to the carabiner (or Figure-8 knot) used to hook onto the driver's harness.

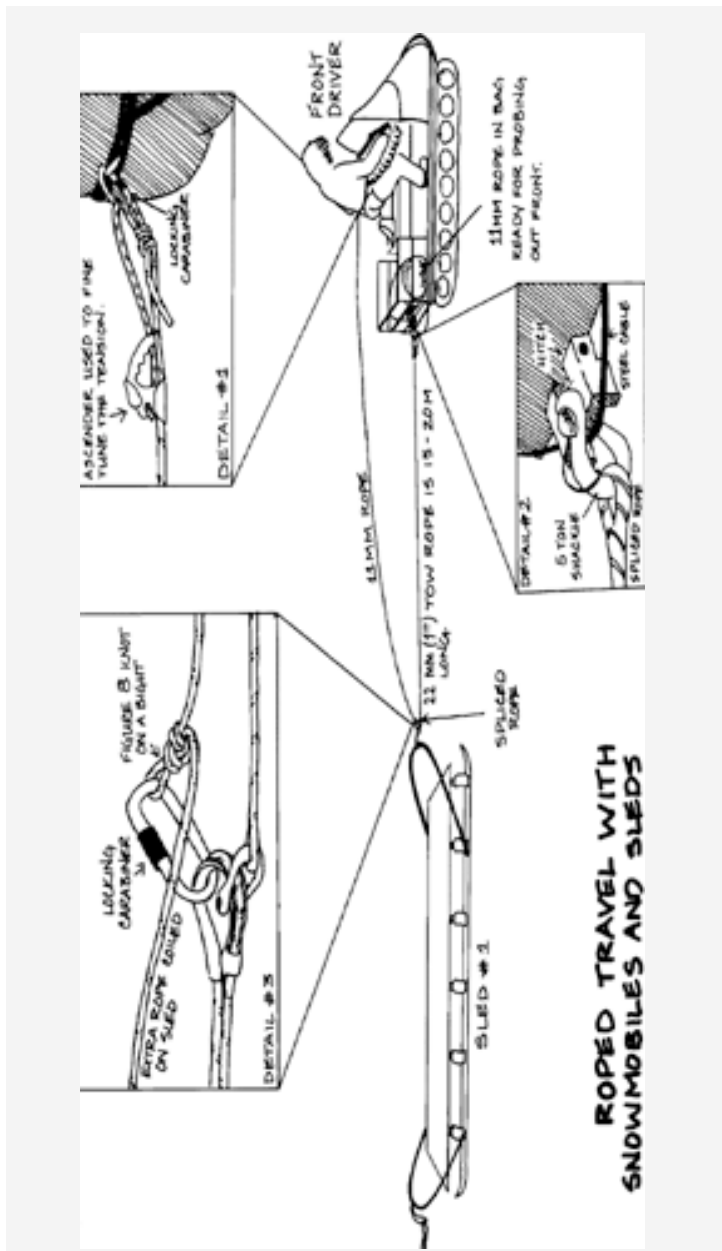


Figure 19-2: Front driver rope configurations.

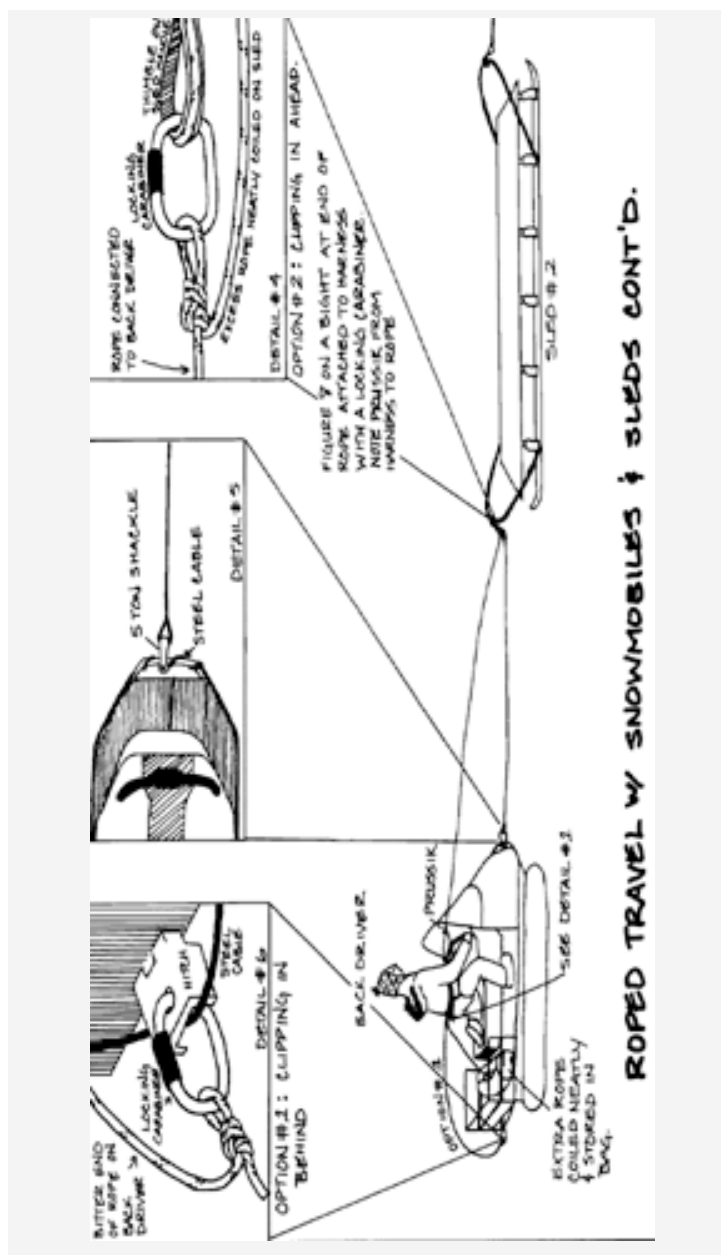


Figure 19-3: Back driver rope configurations.

19.2b Rear Driver

There are two recommended methods for tying in the second snowmobile.

Clipping In Behind: The easiest system to manage is to clip onto the back hitch of the snowmobile you're riding on. Secure the end of a 45-meter rope to your harness with a Figure-8 knot and a locking carabiner. Attach this with a locking carabiner (on a Figure-8 on a bight) to the back hitch of the snowmobile. Make sure the steel cable that encircles the snowmobile runs through the carabiner.

Secure the extra rope in a stuff-sack (throw-bag style) and neatly stow it on the rear of the snowmobile out of the way. The extra rope can be used for self-belaying away from the machine using an ascender and will be handy for rescues. Clipping in behind the snowmobile makes rope management easier, but in a crevasse fall, the driver will be hanging below the machine. Self-rescue will be next to impossible.

Clipping In Ahead: Having the rear driver's safety line run ahead to the Nansen sled is potentially a safer system, but is harder to manage. Attach the end of the safety rope to the driver's harness (Figure-8 and locking carabiner). Take the line forward and attach it to the rear towing thimble on the Nansen sled with a locking carabiner. Use a prussik or ascender on the driver's harness to "fine tune" the distance. Neatly coil excess rope and stow it on the sled.

This system makes it possible for self-rescue by preventing the driver from falling below the snowmobile and by providing an immediate safety line for self-belaying up to the sled in front. However, it's very difficult to keep from running over the rope, especially in rough terrain (sastrugi).

Note: An experienced USAP field mountaineer prefers to run the safety rope from the rear driver to a 9-mm prussik wrapped on the tow rope just ahead of the protective tubing. This helps to not run over the rope and does not allow the driver to fall below the snowmobile.

Remember: It is highly probable that the secondary riders and/or drivers will be the ones that will fall through a weakened snow bridge.

19.3 Travel Configurations

Just as in roped-mountaineering, three snowmobiles roped together are safer than two. In Field Safety Training field testing, a roped-snowmobile train of three dramatically increased the ability to stop a fall quickly (two snowmobiles catching the third). Never travel with less than two snowmobiles and one sledge linked together, when traveling in crevassed areas. Depending on the size of your field party and the amount of cargo you're transporting, there are various travel configurations, which are illustrated in figures 19-4, 19-5 and 19-6.

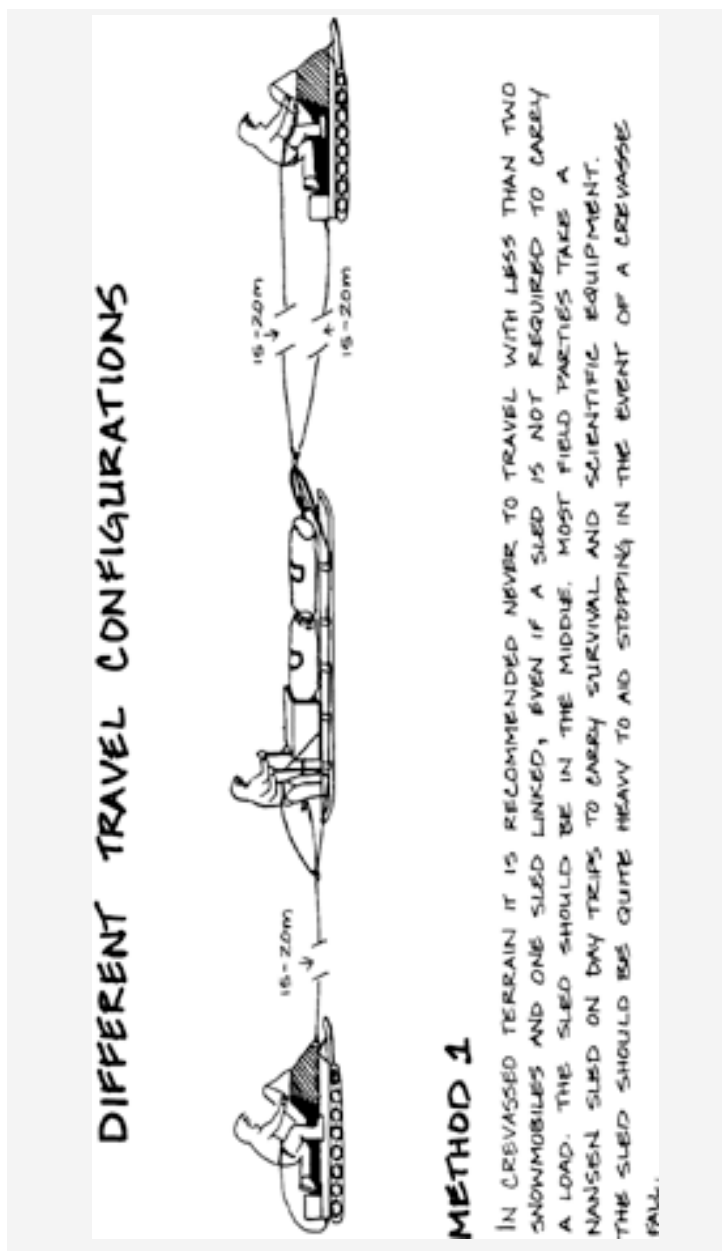


Figure 19-4: Method #1 travel configuration.

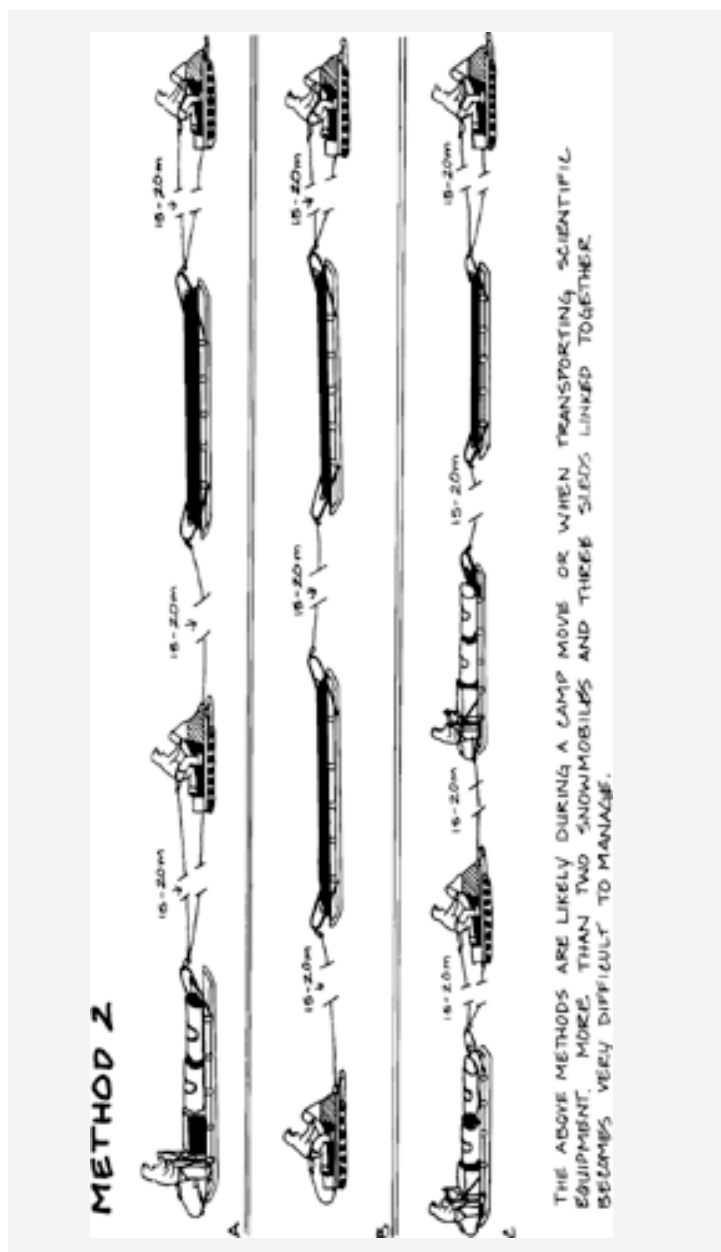


Figure 19-5: Method #2 travel configuration.

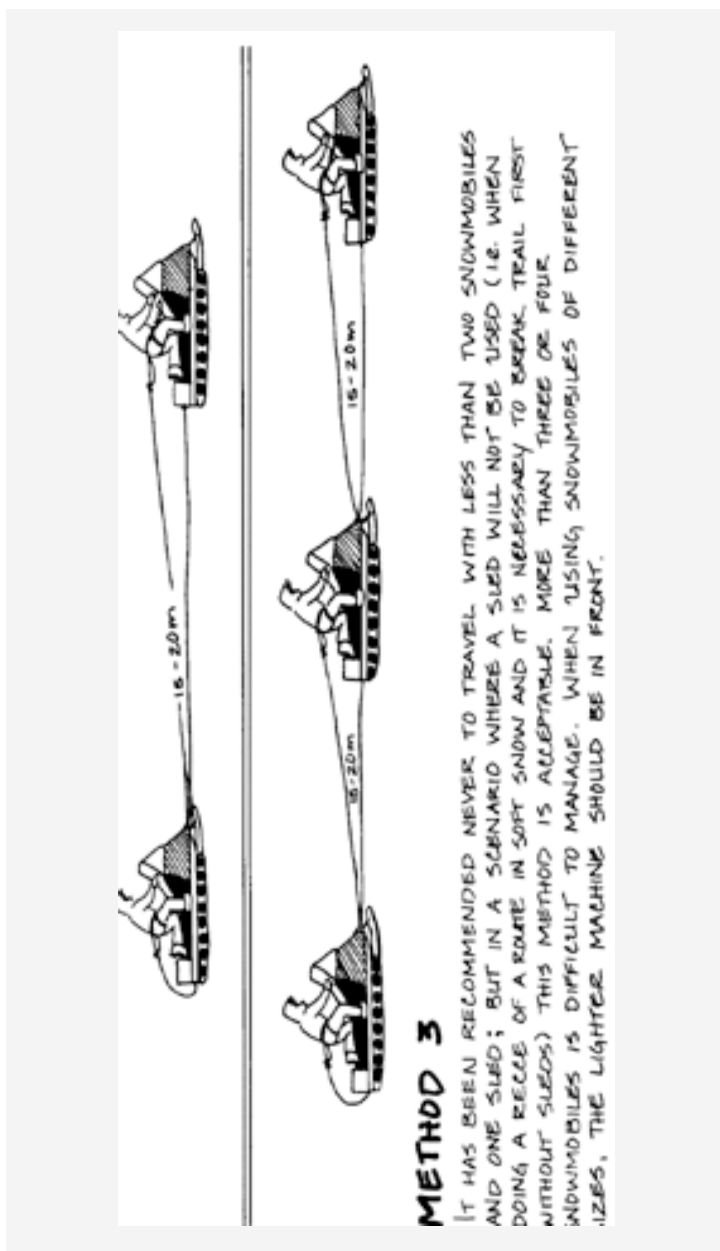


Figure 19-6: Method #3 travel configuration.

19.4 Snowmobile Crevasse Extraction

- Rescue the driver. If necessary, the snowmobile can be tied off and extracted on another day.
- Probe and mark off a safe working perimeter around the crevasse before extracting the snowmobile.
- The crevasse edge must be thoroughly prepared before attempting a snowmobile extraction. Dig a ramp the width of the machine and deep enough to reach very hard snow. Place suitable edge protectors of wood or metal on the lip of the crevasse; tie them off so they don't fall in. These will minimize rope drag during the hauling.
- Your main anchor must be large deadman-style anchors equalized and thoroughly "bombproof."
- A pulley system can be set up on the tow rope, but it is preferable to set the pulley system on an alternate rope (static rope is best) that can be belayed separately as a backup. The snowmobile tow rope can also be secured to a separate anchor for a backup, if necessary. Prussiks should be heavy duty (8-mm is the minimum).
- Before hauling, put the snowmobile in neutral gear, or cut the drive belt so that the tracks can turn. Snow and ice may need to be cleared from the tracks to free them.

- If possible, raise the snowmobile's back end first. Position a person on the crevasse edge for communication and observation. If you have enough people, position another person in the crevasse. This person can ensure that the ski is straight and that the track can spin. Secure this person to a safety rope anchored separately to one side of the main anchor.
- Use three people pulling on a 6:1 pulley system to extract the snowmobile. Or, use snowmobiles to help pull it out. Snowmobile tracks should be pre-packed, and the pull path must be free of anchors and ropes. (See figure 19-7.)

19.5 Rescue Equipment

The following gear should be carried by each member of a field party traveling in crevassed areas. Equipment carried in the crevasse rescue bag is to be used in addition to the personal gear carried by each individual. A listing of the equipment in a crevasse rescue bag appears in Appendix D.

Personal Equipment (Each Person):

4	Prussiks: 2 Long and 2 Short
2	Slings: 1 Long and 1 Short
2	Pulleys
1	Figure-8 Descender
5	Carabiners
2	Locking Carabiners
1	Picket
1	Ice Axe

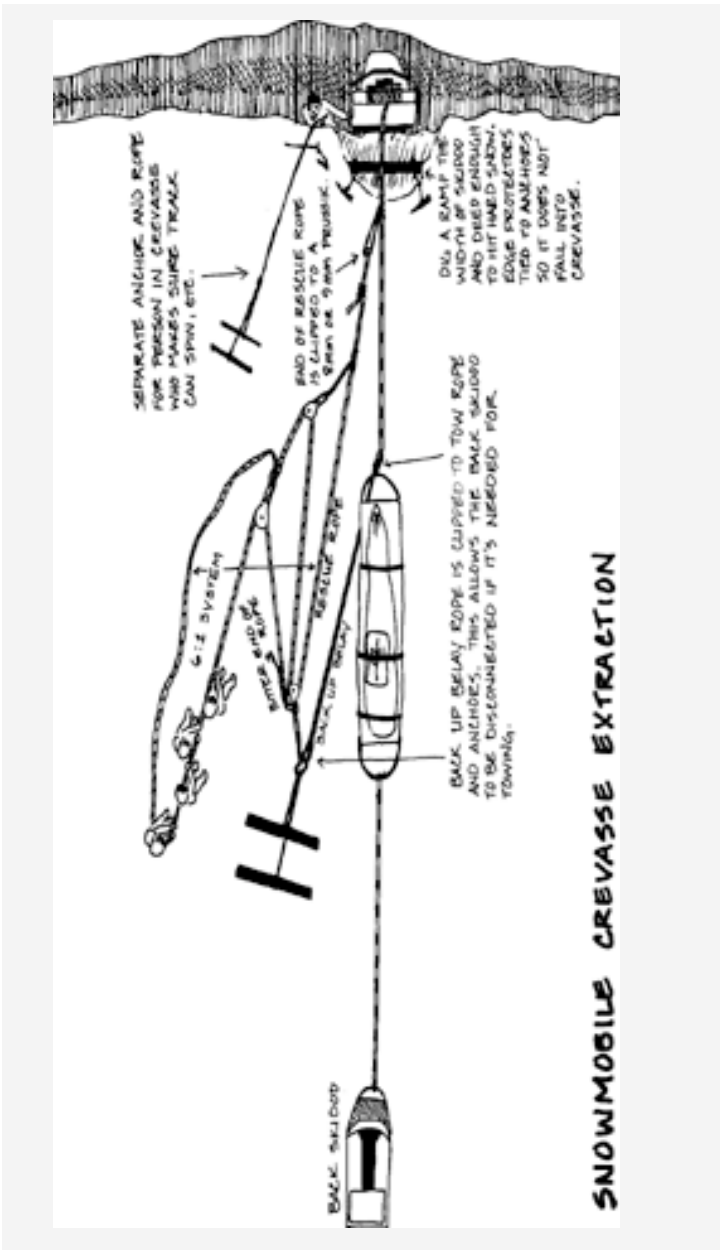


Figure 19-7: Snowmobile extraction from a crevasse.

19.6 How To Travel With A Nansen Sled

19.6a In a Safe, Non-Crevassed Area

If the Nansen sled is equipped with a rigid hitch, attach the sled directly to the snowmobile. (Some of the following comments will still apply.) If the Nansen sled is being pulled with a tow-rope, play close attention to the following:

- When starting with a heavy sled load, have some slack in the tow rope, and have someone rock the sled and push to help break the runners free.
- Stop gradually so that the sled doesn't run into the back of the snowmobile.
- The driver should look back frequently to ensure that the sled is tracking correctly, and those riding the sled are not being dragged by their bootlaces like fools in a cheap spaghetti western.
- When not linked for crevasse travel, keep the tow ropes short to prevent wandering sleds.
- Don't travel too fast. You'll damage equipment if your sled tips over.
- Travel together as a team - don't get spread out too far.

- Use rope brakes on the sled runners when they're needed. A braking snowmobile in the rear is a secure method for steep descents and for traverses. At times, you may need to belay sleds down steep, difficult slopes.
- Sleds with handlebars and footbrakes are recommended on any trip where personnel will be riding on a sled.

19.6b In Crevassed Areas

Even though many Nansen sleds have rigid hitches, do not attach them directly to the snowmobile in crevassed areas. Nansen sleds still need to be positioned 15-20 m from leading or following snowmobiles or other sleds. Attach the tow rope either to the hitch or directly to the front of the sled. Refer back to Figures 19-2, 19-3, 19-4, 19-5 and 19-6.

19.7 How To Load a Nansen Sled

Figures 19-8 and 19-9 show how to distribute the cargo load on a Nansen sled. Following is a list of additional points on loading a Nansen sled:

- Position the heaviest items over a bridge of the sled and slightly toward the rear.
- Use a cargo tank to contain the cargo.
- Support fuel drums with a drum cradle positioned over two bridges. Two 55-gallon drums

can be carried on a Nansen sled, secured by cargo straps.

- Rock-box platforms are available for large numbers of boxes.
- Divide equipment among your sleds so that if a sled is lost in a crevasse accident, you'll still have food, water, a stove, fuel, shelter, and a radio on the remaining sleds.
- Place a Scott tent, pointed forward, on top of the loaded cargo tank, along with bundles of flags and a shovel. The crevasse rescue bag goes on top of all of this.
- Lash loads down tightly using rope and cargo straps. Carry spare rope, cargo straps, and bungees on the snowmobile.
- Each person should have a sleeping kit consisting of a sleeping bag, a Thermarest®, and an Ensolite® pad. Carry the sleeping kit in a cargo bag. If you're using mountaineering tents, the tents should go in the cargo bag, along with the stakes.
- Always take a deep-field survival bag and radios on day trips away from the main camp.
- Carry personal items in a pack or duffel:
 - Spare Clothing
 - Goggles

- Camera
 - Thermos
 - Food
 - Sun Cream
 - Personal Mountaineering Equipment.
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- Use colored webbing or tape to identify each person's gear. The orange "drag" bag issued in Christchurch carries securely on sled handle bars by the bag's shoulder strap. This makes a good personal bag in the field.

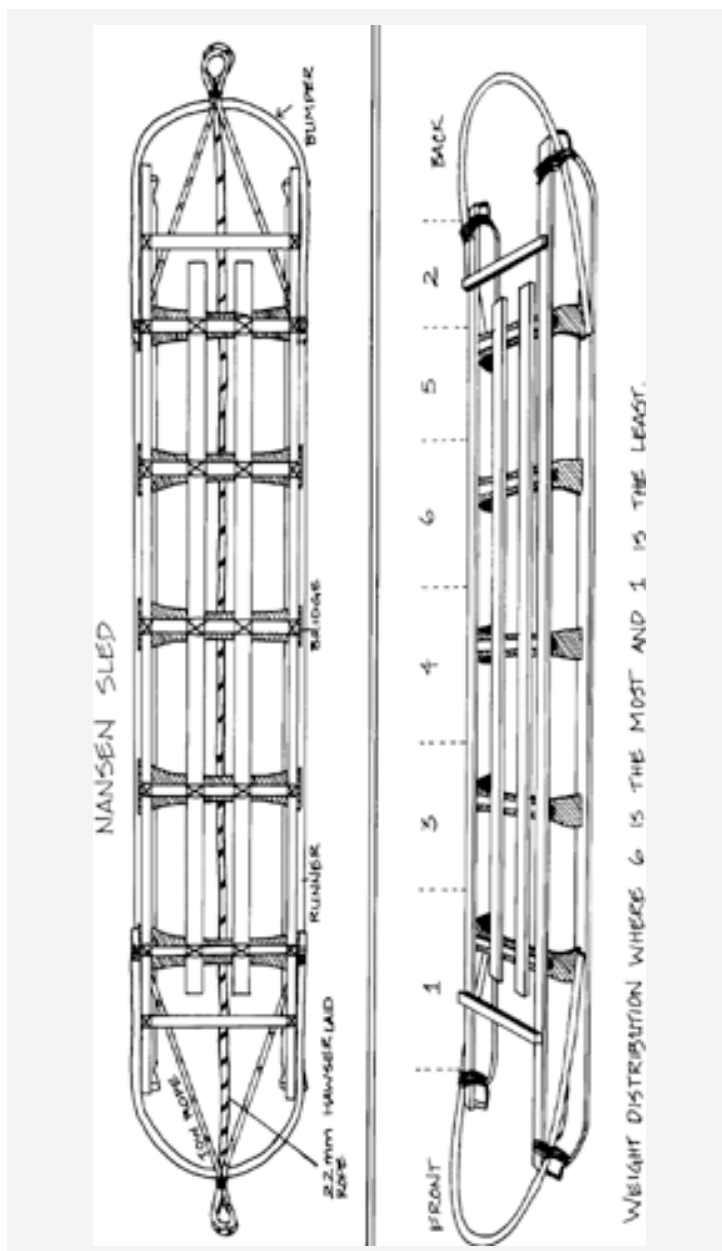


Figure 19-8: Nansen sled weight distribution.

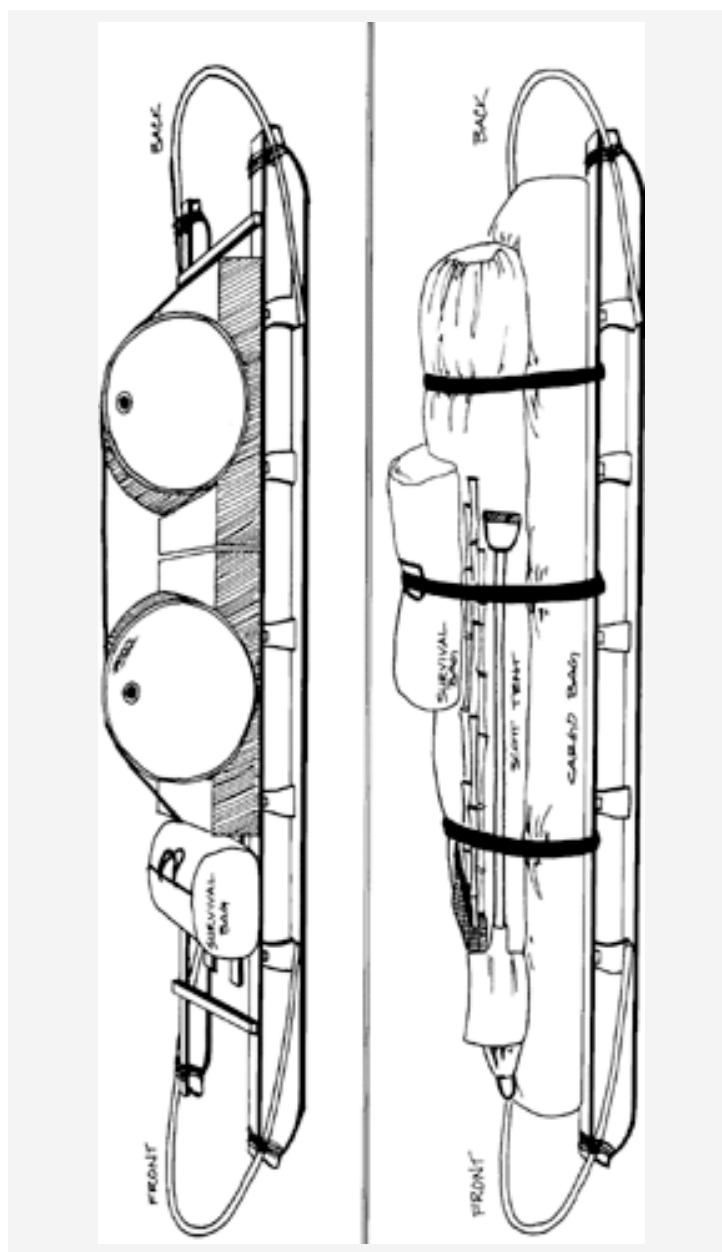


Figure 19-9: Nansen sled load example.