

Appendix

Avalanche Avoidance, Search, and Rescue

1. Occurrence

Natural avalanches occur during or shortly after storms. Avalanches triggered by man or his equipment may occur at any time when travelling on or near avalanche prone slope.

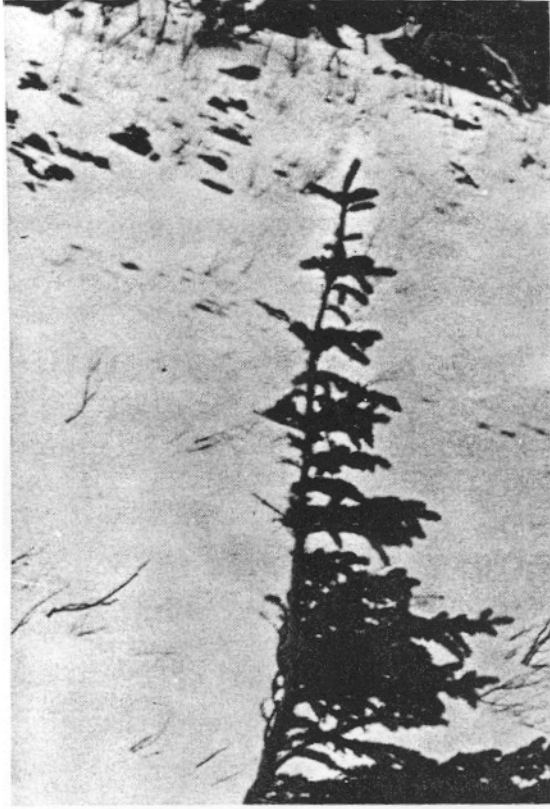
2. Protection

- Seek advice of local experts.
- Learn recent weather history.
- Determine start zones of probable avalanche prone slopes and cross as high as possible, preferably above natural anchors.
- Travel on high points and ridges, especially the windward sides.
- Stay to the sides of the start zone and track when ascending/descending an avalanche prone slope.
- Avoid wind-loaded, lee slopes.
- Favor terrain with anchors, i.e. tree-covered area, over open slopes.
- Pick areas with flat, open runouts so that debris burial depth is decreased. Avoid areas that feed into crevasses and/or cliffs.
- Travel in U-shaped valleys, avoid V-shaped valleys where an avalanche can continue up the opposite side.

3. Signs

a. Instability

- Recent avalanche activity on similar slopes and small avalanches under foot.
- Booming, the audible collapse of snow layers.
- Visible cracks shooting out from under foot.
- Sloughing debris, which is evidence of avalanche activity occurring.
- Sunballing or snow-rollers, which is caused by rapid rewarming.
- Excessive snowfall, over 1" per hour for 24 hours or more.
- Heavy rains that warms and destroys the snowpack.
- Significant wind-loading causing leeward slopes to become overloaded.
- Long, clear, cold, calm period followed by precipitation or wind-loading.
- Rapid temperature rises to near or above freezing after a long, cold period.
- Prolonged periods (more than 24 hours) of above freezing temperatures.
- Snow temperatures remaining at or below 25 degrees F, which slows down the settlement process.
- Flag trees (branches only on the downhill side, trunks bent downhill) or new growth in a mature forest.



**Figure 7-9. Evidence of Past Avalanche Activity.
Branch Damage on Uphill Side of a Tree.**

b. Stability

- Settlement cones around trees and other objects.
- Creep and glide, which can be seen by a ripple effect at the base of a slope.
- Absence of wind during storms, which can be seen by snow accumulation in trees.
- Snowpack temperatures remaining between 25 and 32 degrees F, which promotes settlement.

4. Requirements for Crossing an Avalanche Prone Slope

- Post an observer.
- Loosen ski bindings, remove hands from ski pole straps.
- Loosen pack straps, undo waistbelt, leave downhill strap on shoulder.
- Secure ECWCS hood tightly covering face, trail an avalanche cord, if available.
- Go straight downhill on foot rather than ski and look for possible escape routes.
- Go straight down, do not traverse.
- Cross as high as possible on concave slopes.
- Cross one at a time. Belay each Marine across, if possible.

5. Actions if caught in an Avalanche

- Jettison all gear (pack, ski poles, and skis).
- Assess best line of escape.
- Keep mouth shut, many victims die from a snow plug in the mouth/throat.

- Delay your departure, let as much of the avalanche go by as possible.
- Try and work to the side. There is less force at the edge of the flow.
- Try to swim out using a double backstroke movement or try to roll away at a 45-degree angle.
- A supreme effort should be made to get to the surface as the avalanche settles.
- Make an airspace to breathe.
- Move to position near the surface, if possible.
- Establish orientation (try spitting).
- Don't panic, it wastes oxygen.

6. Search and Rescue

Marines must know how to conduct avalanche searches. They must be conducted quickly and efficiently. Help is needed immediately. The buried victim must be recovered as soon as possible. There is a 20% chance of survival after 30 minutes, and only a 50% chance after 60 minutes. Some victims have survived for days. Only 19% of avalanche victims survive. Actions taken by survivors are paramount to the success of search and rescue. If victims survive, certain first-aid procedures must be given immediately. Survivors should conduct one or more types of searches; hasty, course probe and fine probe.

- Immediate Action of Survivors.** Action in the first few minutes is critical. Someone must take charge and decide immediately if outside help is needed. An overlook should be stationed off to the side and above the slide in a safe area to observe search and rescue procedures. He can provide early warning to the search party of any danger.

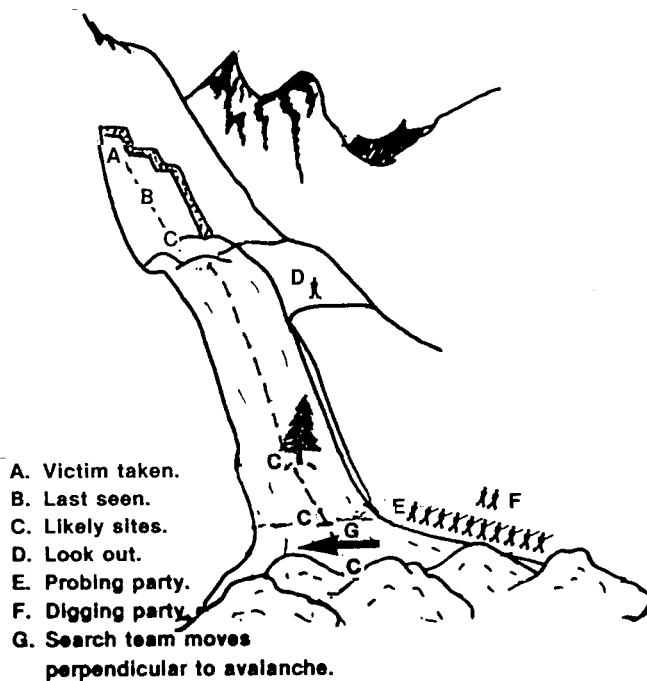


Figure B-1. Avalanche Search.

- Hasty Search.** A hasty search is conducted to determine the most likely place where victims may be located. When conducting the hasty search, speed is vital. Chances of survival decrease rapidly as time passes. Conduct the hasty search as follows:

- Mark the place where the victim was last seen.
- Make a quick search using avalanche probe poles, ski poles, skis, etc.

- Check down the fall line from the last known location to the runout zone.
- Look for some of the victim's equipment. Redirect search accordingly, if found (gear found on the surface means the victim is probably uphill since surface snow slides faster).
- Check above obstacles or anchor points.
- Check the outside of bends.
- Probe only at the most likely spots.
- Have other survivors not involved in the hasty search prepare for a course probe.
- Send for help, if necessary.

c. **Course Probe.** If the hasty search does not work, conduct the course probe. On the average, 20 searchers can cover a 100m x 100m area in 4 hours. There is a 70% chance of finding victims (dead or alive). Conduct the course probe as follows:

- Establish a probe line at the base of the line checked by the hasty search.
- Line up all probe line searchers at close interval (with 1 Marine in charge of the line).
- Make a single insertion with the probe between the feet of each searcher at the command of the senior man. No other will be talking.
- On command, the probe is removed and the line takes a 30" step forward. Repeat this procedure.
- Mark the line probed on the ends with ski poles, sticks, etc. An avalanche cord can be trailed behind the line so that the same area is not searched twice and the search line is kept straight.
- The probe itself should be no deeper than 3m.

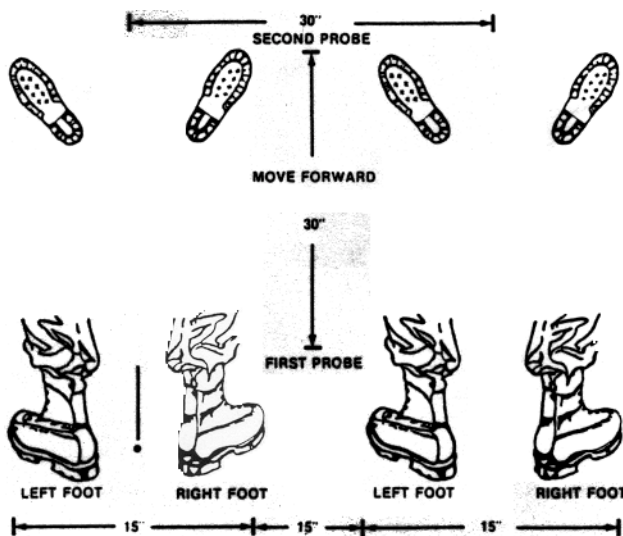


Figure B-2. Course Probe.

d. **Fine Probe.** At this stage, there is little hope for survival. The attempt is now made simply to recover the body. Discipline must be rigid. The chances of finding the bodies are nearly 100% (dead or alive). It usually takes 4 times as long to conduct the a probe than a course probe. Conduct the fine probe as follows:

- Use the same line procedures as in the course probe.
- Each Marine probes in front of his right foot, then between the feet, then in front of his left foot.
- The search line advances at a 15" step and repeats the procedure.

e. **First Aid.** Once the victim is found, if there is to be any chance of survival, digging must be conducted quickly and carefully. First Aid must be started immediately using the following procedures:

- Clear the victim's mouth and nose of any ingested snow and attempt to restart breathing, if necessary.
- Treat the victim for hypothermia, fractures, or bleeding.
- Medevac immediately, if possible.