HANDBOOK

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Soldiers' Guide to Mountain Warfare

Observations, Insights, and Lessons

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SUPPORTING THE WARFIGHTER

Soldiers' Guide to Mountain Warfare

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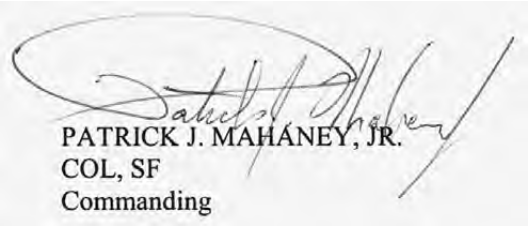
Foreword

This handbook is for individual Soldiers training for or operating in a mountainous environment. This is the second edition of this handbook, and numerous changes have been made to reflect the ever-changing environment based on first-hand observation by operational advisers from or attached to the Asymmetric Warfare Group.

Recently, many additional Army references dealing with this subject have been created following more than ten years of combat experience and identification of best practices in the mountains of Afghanistan. Many charts, references, and examples from other Army publications are incorporated into this handbook where appropriate.

The information contained in this handbook is a result of observations made by Soldiers and operational specialists conducting combat operations primarily in Afghanistan. The Army Mountain Warfare School, Ranger Training Brigade, and Northern Warfare Training Center provided additional insights for this publication. Although many of the observations in this handbook address Afghan-specific information, the concepts included in this work may be adapted to almost any mountainous environment anywhere in the world. Mountains present the Soldier with unique challenges that compound existing difficult combat realities. The adverse environmental conditions in the mountains can make basic tasks seem almost impossible.

The intent of this handbook is to enhance published Army doctrine at the basic Soldier level. Leaders may find this handbook valuable in determining which tasks should receive high priority for training in the predeployment phase for any operation that is likely to involve combat operations in mountainous terrain. No previous mountain training or expertise is required to understand and practice most techniques or tactics, techniques, and procedures contained in this publication. Users who have experience operating in a mountainous environment can use this handbook to assist in learning what veterans of mountain operations already know: vertical environments are among the most challenging in which to conduct and sustain combat operations.



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Soldiers' Guide to Mountain Warfare

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Introduction

Mountains exist on every continent; it is likely that we will continue to conduct operations in Afghanistan and in other mountainous areas around the world. Mountains present unique challenges to Soldiers and commanders alike and provide initial tactical advantage to native forces, the obvious advantage being enemy familiarization with physical terrain. Soldiers who are *physically fit, mentally agile, and able to adapt* to technological advantages that exist for U.S. forces, as compared to most potential adversaries, mitigate this enemy advantage. Although achievement of some level of familiarity occurs over time, it would take years to develop a level of understanding and tactical mastery of the terrain equal to that of the local populace. A Soldier's ability to shoot, move, communicate, and provide medical care while sustaining himself and his element on the battlefield provides a format for this handbook. The intent of this handbook is not to create new doctrine, introduce new tactics, or inform on operational or tactical operations. The sole purpose of this handbook is to prioritize information taken from previous editions and other Army references, so that an individual Soldier can become familiar with information and tactics that can help him survive in a mountain combat environment.

Mountains produce the effect of canalization because of the steep terrain and watercourses commonly found there. When properly evaluated, these canalized areas can be exploited by our enemies and by U.S. forces. Mountainous terrain stretches the limits of armies and individuals not adequately prepared to fight in and meet its demands. U.S. forces must anticipate, understand, and adapt to these physical demands in order to combat the challenges of fighting in areas where our technological supremacy can be negated by even the most crude and nontechnical enemy actions. Severe weather that restricts mountain operations is just one example of an uncontrollable element that can eliminate the use of assets such as helicopters; intelligence, surveillance, and reconnaissance platforms; medical evacuation; wheeled and tracked vehicles; and some fire-support assets. Mountainous terrain usually favors defense and the force most familiar with the operating area, which is a factor to be considered in any comprehensive estimate of the enemy situation. The human terrain factor is another important aspect that merits close evaluation. Mountains restrict movement, delay timely responses, and often give the seasoned enemy a place to seek refuge while he prepares for his next operation. Evaluation of human terrain is as important as evaluation of physical terrain in understanding the complex environment associated with mountainous terrain.

The world over, people who reside in mountainous areas are recognized as being more capable, independent, and, when the time comes, better fighters than those residing in less vertical environments. This aspect of any fight

in mountainous terrain should be considered and weighted based on the best intelligence and information available. Basic principles for success in the mountains are similar to the principles of patrolling, with additional emphasis on the mountainous environment and adaptability.

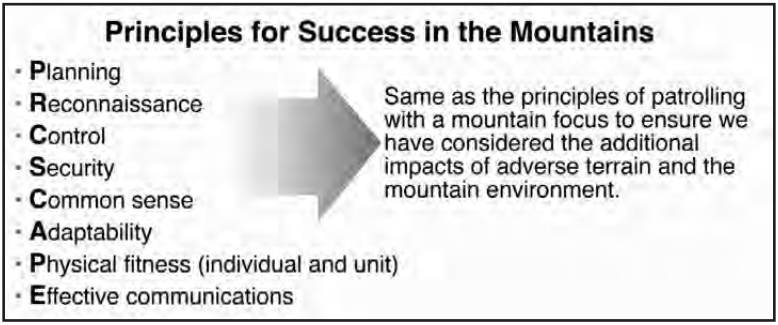


Figure 1

Chapter 1

Mountain Warfare Tips

These tips for mountain warfare operations provide a quick reference that prioritizes key pieces of information that has been found to be most valuable to Soldiers fighting in a mountain environment. When you just cannot remember everything, focus on what is most important. Fellow Soldiers identified these tips as keys for successful operations within mountainous combat environments.

Pre-Mission Training: For all Soldiers

A basic mountaineer, a graduate of the basic mountaineering course, should be trained in the fundamental travel and climbing skills necessary to move safely and efficiently in mountainous terrain. Just because you have not attended a basic mountaineering course does not mean you cannot train on those tasks and perform them in combat. The list below describes those skills that every Soldier operating in a mountain environment should strive to learn. Soldiers should be comfortable functioning in this environment and, under the supervision of qualified mountain leaders or assault climbers, can assist in the rigging and use of all basic rope installations. On technically difficult terrain, the basic mountaineer should be capable of performing duties as the "follower" on a roped climbing team and should be well trained in using all basic rope systems. At a minimum, basic mountaineers should possess the mountain-specific knowledge and skills listed below and train on those skills in anticipation of assigned missions.

- Characteristics of the mountain environment (summer and winter).
- Mountaineering safety.
- Use, care, and packing of individual cold weather clothing and equipment.
- Care and use of basic mountaineering equipment.
- Mountain bivouac techniques.
- Mountain communications.
- Mountain travel and walking techniques.
- Hazard recognition and route selection.
- Mountain navigation.
- Basic medical evacuation.

- Rope management and knots.
- Natural anchors.
- Familiarization with artificial anchors.
- Belay and rappel techniques.
- Use of fixed ropes (lines).
- Rock climbing fundamentals.
- Rope bridges and lowering systems.
- Individual movement on snow and ice.
- Mountain stream crossings (to include water survival techniques).
- First-aid for mountain illnesses and injuries.

Leadership and Planning Tips

- Do not use or allow Soldiers to "test" new or unproven equipment during mountain operations. Equipment should be well prepared, broken-in, and in good repair before each operation. Precombat inspections will ensure compliance and quickly identify deficiencies.
- Consider attachments, indigenous troops, enablers, or anyone accompanying your element as a potential risk. You must ensure they are properly trained, armed, and equipped and will not become a liability when conditions worsen.
- Build standing operating procedures (SOPs) early based on experience and lessons learned. SOPs can be modified for terrain and location once deployed. Develop a system to disseminate lessons learned and especially for relief in place.
- Leaders MUST show a positive attitude and confidence in their ability to survive and maintain in mountainous terrain.
- Think 360-degree security and up/down during movement. Always remember muzzle awareness. The enemy is 360 degrees around you; that 360 degrees encompasses a bubble around you when you are in the mountains.
- Patrols that may negotiate terrain that requires the use of ice axes and other movement tools must have specialized training and conduct rehearsals before attempting these technical operations. Analyze terrain carefully during your planning.

- Operations in the mountains can take much longer times to accomplish because of the terrain; ensure you plan using a realistic timeline when template against vertical or near vertical terrain.
- Use tactical patience with the situation and with Soldiers.
- Continually check Soldier fitness (adequacy of clothing, condition of gear, etc.).
- In high-elevation terrain, be aware of Soldiers who lack focus and pair them with more alert and focused buddies who can monitor their mental and physical status.
- Always use a buddy system for rapid identification of medical or environmental injuries and basic accountability.
- Rotate the point man regularly when dismounted to maintain focus.
- Regulate the marching rate and address it during the planning phase of operations. (It is not a matter of how fast one can get there; it is a matter of what one can do when he gets there.)
- Allow time for Soldiers to acclimatize to the high altitude if the situation permits.
- Stay mission-focused. Tiredness and boredom will set in, so you must have a plan to deal with it.

Preparation for Operations in Mountainous Terrain

- Use a layered approach to preparing your kit. Think about using a rack or load carrying system, instead of attaching all items to your body armor. This method allows a Soldier to drop body armor at patrol bases or forward operating bases while maintaining necessary items in the event that they are needed. This layering method frees you up from carrying all your weight around all the time.
- Pack high-priority gear near the outside and on top of the rucksack for quick access.
- Cross-load mission-essential items across the patrol to ensure mission success. Do not separate ammunition from weapons systems if possible. It is difficult to maneuver with ammunition while under fire, so keeping ammo with the weapons systems will reduce unnecessary exposure.
- Cross-load gear and ammunition, ensuring that those individuals carrying the items are skilled at their use.

- Always have a compass on your person (wrist, neck lanyard, etc.).
- Analyze items by ounces, not pounds.
- Attempt to use night-vision goggles (NVGs), radios, global positioning devices, and other equipment with common batteries to increase flexibility.
- Fit and practice using NVGs during daylight hours, ensuring you halt when tactically feasible just before darkness and daylight to allow eyes to transition and to ensure functioning of equipment.

Dismounted Movement in Mountainous Terrain

- Do not wear "tennis shoe style" boots. While comfortable and light, they will not provide adequate protection from the elements if changes in environmental conditions occur. They are usually not very durable and tend to come apart after prolonged use.
- Use a layered approach to clothing.
- Start movement "cold." You will heat up.
- Use the "rest-step" or "lock-step" method during movement, which will reduce muscle fatigue, and use your skeletal structure to support your weight and combat load.
- When you pause (long or short), think cover and concealment. The enemy will target halted elements. You should use available natural cover and be prepared to fill reusable sandbags where limited cover is available in an Alpine environment.
- Dragging equipment in litters or other improvised devices is usually a bad idea. Breaking up heavy loads into smaller parcels may present the best option. Friction and gravity work against those elements who try to drag heavy equipment in steep terrain.
- Sustained pace beats fast pace. You can only move as fast as the slowest Soldier in your patrol.
- Consider wearing knee and elbow pads.
- Fixed lines may be needed to ascend and descend; rehearse installation and operation while maintaining adequate security. Every Soldier should have basic equipment to construct a safety line for ascending.
- On steep switchback hazards, hand-carry your equipment on the downhill side so that if it is dropped or jettisoned it will not knock your feet from under you.

- Have two light sources per Soldier. Consider dual headlamps and batteries for alpine operations where a sudden loss of light could be catastrophic. Ensure measures are taken to prevent an unintended flash of light by using covers, shields, and reversing batteries if appropriate.
- Everyone should have one or more infrared sources as a recognition system.
- Remember, the enemy will likely have night-vision devices.

Mounted Movement in Mountainous Terrain

- Remove non-mission-essential fuel cans, which will prevent ignition during contact that might create more hazards in a firefight.
- Keep a Leatherman-like tool in the turret to use with heavy weapons' malfunctions and to work on mounts.
- Have a secondary weapon in the turret, and be prepared to use it in cases of limitations caused by elevation and depression with the main gun system and associated mounts.
- Separate communication systems by vehicle when possible to ensure you do not have a catastrophic loss of communications when a single vehicle is lost or destroyed.
- Ensure straps, tow bars, high lift, land anchors, snatch blocks, and other specialized off-road equipment are distributed across the patrol in appropriate vehicles. Rehearse with this equipment before operations.
- Use a ground guide when appropriate. There will be times during movement when a guide must be used to direct the driver on the best route to climb or descend based on the terrain. You may even have to create a route by moving rocks, timber, and debris.
- Decreased power and efficiency at high altitudes are normal. A diesel engine may have problems functioning as you climb higher.
- Reduce the amount of air in tires to gain better traction.
- Brake/throttle modulation should be rehearsed in the high mobility multipurpose wheeled vehicle (HMMWV) before missions.
- Ensure every person (including attachments) can operate doors, weapons, fire suppression systems, and can drive the vehicle if required before beginning operations.
- When a mix of vehicles (HMMWVs, mine resistant ambush protected (MRAP), MAXXPRO MRAP, civilian, etc.) occurs, you should

cross train to ensure every patrol member can open doors and locate emergency gear if required.

- Rehearse down-gunner drills and rollover drills particular to the mountains. These drills include escaping from a vehicle that has entered a river or stream during vehicle rollover.
- Strap down everything to prevent becoming projectiles when vehicles roll over.

Shooting Tips

- Perform range estimation using size reference (know the size of different objects and what they look like at distances); alternatively, use the Reticle/Mil-dot included in many magnified optics (if you know the values).
- Laser range finders are a must and when combined with a binoculars or individual weapons optics are a huge multiplier.
- Sandbags filled with loose dirt placed as the top layer in a fighting position absorb fragmentation better than stacked rock and can be impervious. Consider carrying 10–12 sandbags that are filled, emptied, and reused numerous times throughout your operations.
- Exercise fire discipline: shoot what you can see and what is within range of your weapon system.
- Know your effective range with your assigned weapon and continually practice range estimation.
- Know where dead space is and have a plan to cover it while on the move and while stationary.
- Range cards are value added in the defense. Ensure they are waterproof, reusable, and accurate when completed.
- Use your laser sparingly: assume that the enemy has night-vision capabilities.
- Know how to operate every weapon system within your patrol.
- Test-fire your weapon before a patrol and leave it locked and loaded after it has been test-fired as the situation permits.
- Familiarize yourself with close air support acquisition/control. Keep a cheat card in a location that is common to all. The card should contain the minimum information needed (my location, direction, and distance to target).

Communications Tips

- Have a battery life chart (What do the mission requirements call for? What is the worst case?).
- Have a battery conservation plan when located in a static position that allows for selective monitoring.
- Have an 8-foot section of insulated wire available to construct a field-expedient antenna. (Claymore wire works great.)
- Do not rig individual radios into personal kit so they cannot be cross-loaded or recovered in an operational mode quickly if required.
- Do not choose terrain for patrol bases or defensive positions that will likely have poor communications. Get an effective communications check internally and with higher before establishing any permanent improvements to your position.
- Use the acronym PACE when planning communications: P-Primary, A-Alternate, C-Contingency, E-Emergency.
- Use premade communications cheat cards (operational how-to) for integral systems.
- Consider antenna compatibility (what you are using and who you are talking to).
- Investigate battery commonality (having compatible systems means fewer batteries are needed and flexibility is increased).
- Have a power-consumption chart rate (for most commonly used systems).
- Know the common air-to-ground (CAG) frequency (usually monitored by most friendly aerial assets).
- Know the special instructions (also called SPINS) and ensure information is widely disseminated and preprogrammed as applicable.
- Understand and accept that weather and terrain will have an effect on communications.

Hydration in Mountainous Terrain

- Drink from your rucksack first (this assumes that Soldiers are carrying canteens or hydration systems). When at halts, get water out of your rucksack before using your hydration system, canteens, or containers carried as part of your fighting load.
- Water procurement is addressed in a later chapter of this handbook.

- Hydrate; drink fluids often (water, sports drinks, etc.), even when you are not thirsty.
- You must have a plan for water procurement and practice it before operations. Movements may require additional planning and longer distances to allow for water resupply.

Medical Tips

- Know the medical evacuation (MEDEVAC) procedures/call (have a 9-Line MEDEVAC cheat card in a location that is common to all).
- Soldiers are at elevated risk of heat injury in mountainous terrain; always look for signs and symptoms.
- Hypothermia can occur at high elevations even during the summer months. Be prepared and know how to recognize early signs of hypothermia.
- All Soldiers should carry a space blanket.
- Be thoroughly familiar with what is in your first-aid kit (self-medicate) and how to use it. Keep your first-aid kit in a location within reach of either hand.
- Have your tourniquet readily available and accessible within reach of either hand (consider having two or more tourniquets).
- Consider carrying water-purification tablets.
- Use the buddy system to identify potential warnings of ailments or injuries, especially environmental injuries.
- When operating at high altitudes, seek aid when high-altitude symptoms of acute mountain sickness (also known as AMS) appear.
- Consider carrying a blister aid kit.
- Consider carrying eye protection that addresses snow blindness.

Sustainability/Survival Tips

- Use a layered approach to ensure that critical survival items are not jettisoned early during enemy contact or during evasion.
- Keep signal items on your body in the “last layer” you are likely to jettison or discard.
- Ensure that every item can serve multiple purposes (e.g., a large orange trash bag can be a shelter, a rain jacket, a signal panel, a

water procurement/holding container, a "fish trap," a ground tarp, an improvised rucksack, and many additional purposes in a survival situation).

- Ensure that you know how to activate the beacon function on all issued communications items.
- The ability to build a basic shelter (poncho hooch, lean-to, snow cave) is a mandatory skill that should be occasionally practiced. Protection from the elements is often as important as protection from enemy fire and cannot be overemphasized.
- Consider carrying the following combat essentials at all times:
    - Survival kit (sharp knife, fire-making material [matches, lighter, candles, etc.], lip balm).
    - Signal kit (whistle, flashlight, mirror, piece of orange panel).
    - At least 15 meters of parachute cord.
    - Emergency rations (field-stripped meals, ready to eat or equivalents).
    - Remember the "three Ws" of layering: wicking, warmth, and wind. The layer next to your skin should be polypropylene, which wicks away moisture. Next, pull on a fleece layer to trap body-warmed air. Finally, zip on a tightly woven, breathable, windproof layer that lets moisture out but keeps warmth in. In extremely cold conditions, add another warmth layer. Your fatigue shirt may not be part of this layering system.
    - The same three Ws apply to your hands (thin polypropylene gloves first, warm mittens, and breathable outer shell) and your head (thin wicking hat first, warm hat, and hood for wind protection).
    - Add fat zipper pulls made of parachute cord to your gear so that you can undo zippers while wearing mittens.
    - Choose a patrol base or perimeter sheltered from the wind. Because cold air sinks, a hillside position will be warmer than one on a valley floor. An eastern exposure will give you direct morning sun.
    - Sleep on top of your parka, pants, and other damp clothing when removed as mission, enemy, terrain and weather, troops and support available, time available, and civil considerations allow.

Put your gloves, socks, boot liners, and the next day's clothes inside your sleeping bag so they will dry out and not freeze.

- Wear warm, loose-fitting layers inside your sleeping bag, as the tactical situation allows. Wearing a hat helps prevent heat loss outside of the sleeping bag.
- When nature calls, do not hold it. Keeping urine at body temperature uses up energy that is better spent warming your body.
- Be careful not to breathe inside your bag. Humid breath can lead to frost buildup.

Chapter 2

Shoot

Throughout operations in the mountains, physical fitness and discipline take on greater importance because the terrain exaggerates the demands on these attributes. Specifically when applied to shooting, these demands have the potential to influence the Soldier's ability to effectively engage an elusive mountain enemy. This chapter covers some of the critical aspects of direct-fire engagements in mountainous terrain.

Marksmanship Fundamentals in a Mountainous Engagement

In the mountains, the fundamentals of marksmanship must be enforced:

- **Steady position:** With restrictive terrain in the mountains, Soldiers will find the need to utilize various firing positions other than prone. Additionally, shooting inclined or declined often requires Soldiers to shoot from the least preferred/unpredictable position—***Asymmetric shooting positions.*** Crew served weapons mounts may not allow proper traverse or elevation adjustments. You should carry sandbags that can be filled and placed under crew served weapons so they can effectively engage at high angles.

- **Aiming:** Good site pictures with consideration to angles and range are required. Angular deviation and slope can cause Soldiers to misjudge distance and hold-offs and require Soldiers to incorporate high-angle shooting techniques—***Sight alignment.***

- **Breathing:** Physical fitness and the Soldier's ability to recover his breathing to manageable levels is imperative to enhancing good shooting techniques—***Control your breathing.***

- **Trigger control:** Physical exertion and mental anguish during the mountain fight can cause Soldiers to disregard this fundamental. Soldiers must overcome the expenditure of energy and control their mindset to accurately engage and to expend the minimum number of rounds to achieve the desired effects on target—***Trigger squeeze.***

- **Follow-through:** Determine the effects on the target and make adjustments as needed—***Reset the trigger.***

Tracers may be effective for leaders when marking targets and can assist in range estimation based on "burn-out" location. Tracers are also effective for terminal guidance of some rotary and fixed-wing fire support assets when conditions are favorable**.**

Range Estimation

Range estimation is a skill that pays great dividends in various aspects of mountainous environments. It pertains to both direct and indirect fire engagements. A Soldier's ability to identify, engage, and reduce targets at the maximum effective range of his weapon gives him a great advantage over the enemy.

The Army has many techniques for range estimation; these vary from true estimation to mathematical calculation. A Soldier should have proficiency in multiple range estimation techniques. If available, range finders should be readily available with key leaders and crew served weapons teams for maximum advantage.

100-Meter Unit-of-Measure Method

- The Soldier must be able to visualize a distance of 100 meters on the ground. For distances of up to 500 meters, the Soldier determines the number of 100-meter increments between the two points. Beyond 500 meters, the Soldier must select a point halfway to the target, determine the number of 100-meter increments to the halfway point, and then double it to find the range to the target.
- During training exercises, Soldiers must become familiar with the effect that sloping ground has on the appearance of a 100-meter increment. Ground that slopes upward gives the illusion of greater distance, and observers have a tendency to underestimate a 100-meter increment. Ground that slopes downward gives the illusion of shorter distance, and the observer tends to overestimate.
- Proficiency in the 100-meter unit-of-measure method requires constant practice. When training to master this technique, comparisons should be made continually between the range the Soldier thinks exists and the actual calculation of the range, determined by pacing or other accurate means of measurement. The best training technique to accomplish this comparison is for the Soldier to pace the range after he has visually determined the distance. The Soldier learns more about terrain distance judgments by making individual calculations rather than by simply being told the correct range without experiencing it.
- The greatest limitation of the 100-meter unit-of-measure method is that accuracy is correlated to visible terrain, which is particularly true at longer ranges. If a target appears at 500 meters or more and the observer can see only a portion of the ground between himself and the target, utilization of this method will not offer any degree of accuracy.

Appearance of Objects Method

This method determines range by size and other characteristic details of the object. Judgments based on "appearance of objects" are made by most people in their everyday lives. For example, this method is used when a motorist must judge the distance of oncoming vehicles before passing a car in front of his. This decision hinges on the sizes that vehicles appear at a distance and an assessment of speed.

In this example, the motorist is not interested in precise distances, only that he has sufficient road space to pass the car in front of him. If the same motorist knew for a fact that at a distance of one mile an oncoming vehicle appears to be one-inch wide and two-inches high, then any time he sees other oncoming vehicles that fit these dimensions, he would know for sure that they are about one mile away.

Likewise, if a rifleman knows the characteristics, sizes, and details of personnel and equipment at known ranges, then he can compare these characteristics to similar objects at unknown ranges. When the characteristics match, so then do the ranges.

To use the appearance of objects method with any degree of accuracy, the Soldier must be thoroughly familiar with the characteristic details of objects as they appear at various ranges. For example, the Soldier should study the appearance of a man standing at a range of 100 meters. He should fix the man's appearance firmly in his mind, carefully noting the details of size and the characteristics of uniform and equipment. Next, he should study the same man in a kneeling position and then in a prone position. By comparing the appearances of a figure in these positions at known ranges from 100 to 500 meters, the Soldier can establish a series of mental images that will help him to determine ranges on unfamiliar terrain.

The Soldier also should be thoroughly trained in the appearances of other familiar objects such as weapons or vehicles. Because the successful use of this method depends upon visibility, anything that limits the visibility (such as weather, smoke, or darkness) also limits the effectiveness of this method.

Angles and Range

Most snipers practice shooting/firing using military range facilities, which are relatively flat with an unobstructed line of site; therefore, range is easily estimated.

This range accuracy does not always translate to areas of operation, especially in mountainous or urban environments, which may require engagement at higher and lower elevations. Unless the Soldier knows how to compensate and take corrective action, bullet impact will be *above the point of aim.*

To estimate how high shots will be above the point of aim, the Soldier should assess the horizontal distance and the actual distance to the target. As a rule of thumb, when you do not know distance or angle when shooting up or downhill, simply use a six o'clock hold for engagements with the M4/M16 weapons systems.

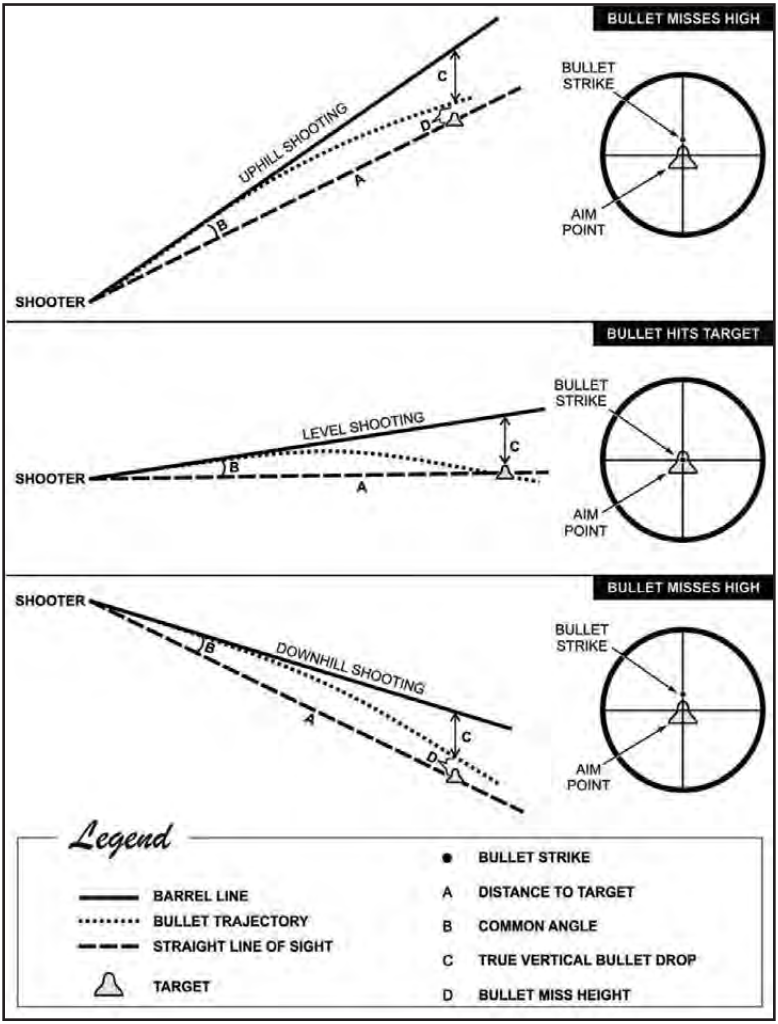


Figure 2-1. Bullet rise at given angles

The Engagement Cycle

The engagement cycle contains the following steps.

Step 1: Target identification. The Soldier identifies/determines that engagement is needed or the leader has directed it.

Step 2: Target acquisition. The Soldier makes the following assessments:

- **Positive identification (PID).** Taking into account range and angle, can the Soldier identify the specific target or area to suppress?
- **Weapons capability.** Is the target within range of the Soldier's assigned weapon?
- **Individual proficiency.** Based on the Soldier's level of training, is he truly able to engage the target? At greater ranges of engagement, the inability to observe feedback can result in no effect on the target.
    - If the answer to any of these is "no" then the Soldier continues to observe the target/target area until a "yes" is achieved. During this time, continue to observe to:
- **Assist friendly fire.** The Soldier may have a better angle to observe the effects of higher-caliber weapon systems on the target.
- **Enemy activity.** Observe and report. If the enemy is out of range, the Soldier can use his optics to observe activity.

Step 3: Target engagement. Soldiers should remember to obtain all the preferred marksmanship fundamentals based on physical, mental, and environmental conditions.

- **Steady position:** Altitude firing, on incline and decline.
- **Aiming:** Angles, range environments (aim low).
- **Breathing:** Obtain control and pause, increased with altitude.
- **Trigger squeeze:** Easily overlooked, and poor application can be brought on by fatigue.
- **Follow-through:** Determine the effects on the target, trigger reset, or adjustment needed for next shot (call your shot).

Step 4: Fire discipline. This can apply to rate-of-fire and/or target engagement.

- Depending on the tactical situation, adjust the rate of fire to expend the minimum number of rounds. Accurate fire conserves ammunition while preventing the enemy from placing effective fire on friendly positions.
- Under the stresses of combat, many Soldiers will not change their point of aim, or they might fail to aim entirely.

Step 5: Reassessment. A Soldier must maintain situational awareness and continually determine whether he is being effective and how either he or his unit can maintain the fire superiority. This is very similar to the "continue to observe" branch under Step 2. ("No.")

Unit Organic Weapons Proficiency

In a combat environment, proficiency in organic weapons is something that every member of a patrol should possess. When a new weapons system is added, it is the leader's duty to train his unit until the Soldier is confident and competent in his ability to use the weapon system.

Proficiency is not limited to conducting load, fire, reduce stoppage, and clear. The ability to engage effectively with the enemy, mounted or dismounted, is imperative. Mountainous terrain demands extra proficiency considerations because of greater ranges, angles of fire, and the variances between weapons system accuracy/effective range and engagement techniques used for such regions.

Soldiers should continually assess their kit/equipment (body armor/rack or vest) to ensure functionality. Aspects of mounted or dismounted operations or unit SOPs may require Soldiers to carry certain items in specific locations. However, nothing is more important than a Soldier's ability to be quick and efficient when reloading a weapon. Therefore, Soldiers should constantly evaluate any prohibitive issues that their kit configurations may possess that would impede their ability to conduct an emergency reload quickly and efficiently.

This skill MUST be practiced repeatedly in various conditions and positions. It is through repetition that an efficient and smooth technique is developed, which will allow this skill to become second nature. Leaders should require Soldiers to practice weapons reloading procedures (magazine changes) often and until they demonstrate proficiency.

Slings

Slings are important tools that can add to Soldiers' ability to operate efficiently during mountain operations. In mountainous terrain, many times Soldiers will find a need to use both hands. Thus, they should be ready to rapidly transition to using two hands for various reasons while maintaining positive control of their weapon.

Slings also can provide additional stability to the weapon during engagements in asymmetric shooting positions. Periodic inspection of slings is required to ensure metal buckles, keepers, and webbing are in optimum condition and will not fail under stress. When practiced, shooting with sling may stabilize shooters for improved accuracy in some situations. Slings must be easily adjustable, durable, and configured so as not to hinder use of sights, optics, and lasers.

Environmental Effects on Weapons

Operations in the mountains provide unique problems for the employment and function of small arms and other weapon systems. Temperature extremes (cold and hot), wind, and slope of terrain are just a few conditions that can affect weapons and ballistics. Soldiers who understand these problems and how to compensate for their effects greatly add to the lethality of their fires. Factors affecting weapons functioning are:

Lubricants. In warmer climates, Soldiers have multiple options to lubricate their weapons systems. However, choices become more limited as Soldiers operate in extremely cold climates. Most lubricants thicken at colder temperatures, causing weapons to become sluggish or freeze, causing malfunctions. The use of LAW (Lubricant, Arctic Weather, NSN 9150-00-292-9689) is the established cold weather lubricant for the Army (refer to each weapon's technical manual for appropriate temperatures to apply LAW as it varies). The use of LAW provides the necessary lubrication without the resulting malfunctions caused by CLP lubricant or LSAT lubricant in cold weather.

Condensation. Condensation will form on weapons when they are taken from a cold environment into any warmer environment (buildings, shelters, vehicles, etc.). This process is commonly known as sweating and can cause weapons under certain conditions to malfunction. By moving weapons from a warmer area to a colder area without proper maintenance, the condensation will begin to freeze, causing internal components to seize up and malfunction. For this reason, it is best to leave weapons outside during freezing temperatures (when possible). When left outside, weapons should remain accessible but sheltered where ice and snow will not get

into the working parts, sights or barrel. When weapons have to be taken inside for cleaning, the condensation or sweating process, once started, will continue for approximately one hour. It is recommended to wait until this sweating process has concluded (approximately one hour) before cleaning the weapon. Inside a shelter, a weapon should be kept near the floor to minimize condensation. When operating in vehicles or aircraft, the interior climate of the troop compartments should be maintained as close to freezing (32 F) to prevent condensation from building on weapons.

Breakage and malfunctions. Breakage and malfunctions occur as the extreme cold causes metal and plastic to become more brittle than normal. Breakage generally occurs early in firing when the components are warming, expanding rapidly and unequally. After a weapon has been fired, the heat that it has generated can cause condensation or melt any snow or ice that was on the weapon. As the weapon begins to cool, this moisture will begin to freeze, causing malfunctions or stoppages. Weapons should be kept free of snow and ice whenever possible to minimize this effect. Careful handling of weapons when moving through snow- and ice-covered woods and allowing weapons to warm up by firing initially at a slow rate eliminate many of the problems. Additionally, Soldiers must be aware that the metal can cool to the point where it must not be touched by bare hands.

Visibility. Visibility may be difficult because of firing weapons in temperatures below -20 F. As the round leaves the weapon, the water vapor in the air is crystallized creating minute ice particles. The ice particles produce ice fog. If the air is still, the fog can remain along the gunner's line of sight for several minutes. When faced with this problem, fire at a slower rate and/or relocate to another firing position. In anticipation, always prepare supplementary firing positions that will cover assigned sectors of fire.

Emplacement. Most crew-served infantry weapons need a natural "base" or gun platform to fire accurately. In warmer climates, the ground provides a solid base and yet has enough resilience to act as a shock absorber. In winter, a soft snow "base" gives under the recoil of the weapon. If the weapon is emplaced on solid frozen ground, there is no give. The weapon absorbs all the shock of firing. This shock may result in breakage. The slippery surface of the frozen ground may also allow the weapon to slide. If the snow is not too deep and time is available, tripods and/or base plates should be dug in. To solve this problem in deep soft snow, the improvised use of snowshoes, skis, sleds, and/or field expedient platforms is recommended. Mortar base plates must still be dug in. Sandbags filled with compacted snow will help to stabilize the firing platform.

Snow and ice. To keep snow and ice out of the weapon, some type of cover is required. Improvised covers are easily made from ration packet material. Any type of material can be used, even plastic bags.

Machine guns. Machine guns (MGs) break and malfunction at a higher rate in cold weather. Gun crews must plan for this by carrying extra sears and bolt parts. One common malfunction that occurs early in firing is short recoil (bolt does not recoil fully to the rear). The prescribed immediate action for the particular weapon should be applied. As the metal warms, the problem will diminish. A second type of malfunction is caused by the freezing and hardening of buffers. This in turn causes great shock and rapid recoil, thereby increasing the cyclic rate. When this happens, parts usually break. All internal parts and friction surfaces of MGs should be coated with LAW. These weapons have fewer malfunctions when fired cold and dry if sub-zero lubricants are not available. Firing should consist of short, two- or three-round bursts fired at close intervals. Since ice fog greatly impairs the gunner's vision along his line of sight, crews must prepare two or three alternate gun positions. After changing barrels, if the hot barrel is laid directly on snow or ice, it may warp or disappear in deep snow. A tarp or barrel bag keeps barrels from warping or disappearing.

Back blast. The cold increases the back blast effect of all recoilless-type weapons by a factor of at least three. Since the back blast areas are significantly increased, all personnel must be instructed to plan for this hazard when fighting or training with recoilless-type weapons.

Cold weather hand gear. When Soldiers wear mittens, the speed in handling and firing weapons is reduced. However, this is not an excuse for not wearing hand protection. Under extreme cold, bare flesh freezes instantly to weapons. Soldiers should be trained to operate their weapons while wearing hand gear. For extended operations in extreme cold, armorers should remove the trigger guards.

Effects of Cold on Ammunition

Cold weather can affect the accuracy of weapons and the performance of munitions. Magazines must be cleaned of all oil and preservatives and checked frequently. Munitions should not be lubricated. When brought from a cold area into a warm space, munitions will sweat. Any ice and condensation must be removed. To prevent these problems, leave munitions outside when moving inside for short periods. The performance of munitions is also affected by the cold. The burning rates of various types of propellant charges are slowed due to cold temperatures. Weapons

zeroed under temperate conditions or with ammunition that has been warmed will fire low in extreme cold. Generally, ammunition provides poor fragmentation in snow.

- **Small arms ammunition.** The effect of the cold on small arms munitions is minimal. Velocity is lowered slightly, which causes the round to drop slightly. To overcome this:
  - Battle-sight zero all weapons when they arrive in the cold weather operating area.
  - Range estimation will come with experience. Use tracers if the tactical situation allows.
  - Increase munitions allocation. Because of the effects of cold weather clothing, differences in range estimation, and the effect of the cold on the human body, marksmanship will be reduced. Consequently, munition allocations must be increased.
- **Mortar rounds.** The effect of snow will decrease the munitions' effectiveness. To combat this use variable time fuses set to trigger above ground. Ammunition allocation will also have to be increased. Dud rates are much greater and must be planned for. The snow will also absorb much of the effect of functioning mortar rounds.
- **Artillery rounds.** Artillery munitions will be affected by the cold, with a result of about 100 meters short for every 1,000 meters of range. Fire direction control (FDC) can compensate if a precision registration is done prior. Illumination rounds may malfunction and fail to open. However, functioning rounds will be more effective because of reflection off the snow pack. Deep snow will absorb the bursting radius. When firing on frozen ground with little or no snow cover, the effects of artillery rounds will be enhanced.

Chapter 3

Move

Movement in mountainous terrain can be accomplished either dismounted or mounted by using helicopters, pack animals, or other specialty motorized vehicles (M-gators, 4-wheeler, etc.). Some movements will be a combination of these types, but ultimately Soldiers must dismount and move by foot to most locations. The mountains limit mobility of wheeled and tracked vehicles and canalize formations of troops into limited maneuver areas. A major point to consider before every movement is that the effects of canalizing and restrictive terrain can force a unit into enemy engagement zones. Soldiers eventually will need to dismount to reach most terrain in mountainous environments. Therefore, most of this chapter will be devoted to dismounted operations.

Maintaining the High Ground in Mountainous Terrain

By maintaining the "high ground" in the mountains, forces derive their strength, balance, and freedom of action through the effective use of terrain. The mobility restrictions inherent in mountainous areas and the necessity to hold dominating ground dictate the use of an area defense. Mountain defenses use security forces, continuous reconnaissance, and combat patrols, as well as numerous observation posts.

Although the individual Soldier is not likely to develop the overall plan to seize the high ground, he should understand the terrain and principles that may mean the difference between success and failure during these complex mountain operations. Skills honed and practiced by the individual Soldier in realistic rehearsals provide the foundation for conducting any operation at altitude where the environmental elements are as much the enemy as the opposing Soldiers are.

In mountainous terrain, the decision to climb to the high ground should be made by using all available intelligence. Consideration must be given to all aspects of mission, enemy, terrain and weather, troops and support available, time available, and civil considerations (METT-TC), with particular emphasis on the cumulative effects of altitude, extreme terrain and weather, and, as always, the enemy. The decision to occupy the high ground must take into account the cost in men and materials and what can be gained by the effort involved.

Seizing and maintaining the high ground may be feasible, whereas maintaining the same terrain may not be possible because of a number of factors. The weather is a major concern, and in choosing positions, the cumulative effects of these harsh conditions must be considered. Soldiers

and units must develop flexible plans for control of fire, maneuver, communications, and logistics. While occupying the high ground, Soldiers must be agile enough to maintain control of the terrain, strike effectively, and shift efforts quickly without losing momentum and flexibility.

Tactical flexibility depends on planning in detail, task organization for increased effectiveness, and a number of environmental variables likely outside of the Soldiers' control. Although the mountains generally allow observation at greater distances, intervening terrain features and weather often prevent Soldiers from seeing the area of operations beyond their immediate front and flanks. Consequently, leaders normally allocate more assets for reconnaissance and security, echeloned in depth and in height, to ensure the ability to sense all aspects of the area of operations and to gain the time needed to apply combat power decisively.

When a decision is made to seize and hold the high ground, Soldiers must ensure that they begin with a thorough reconnaissance. Preparations for a mountain defensive position will require more time than for other terrain, and as units arrive, they must begin immediate preparation of their mountain positions. In some instances, technical mountaineering skills may be needed to establish effective security and to emplace crew-served weapons properly. However, commanders must weigh the advantages gained from these inaccessible positions against the difficulties of repositioning and resupply. Leaders must seek every opportunity to recapture the initiative from the attacker and transition to offensive operations. Preparations for a counterattack in the mountains must include caching ammunition, preparing counterattack positions and routes to attack downhill, identifying crew-served weapons' positions, and establishing rally points, which are usually on the reverse slope.

No matter the type of security used, defending forces must prevent enemy infiltration by carefully positioning observation posts and conducting continuous patrols and ambushes. Combat-reconnaissance patrols and other intelligence-gathering assets should observe the enemy as far ahead of friendly positions as possible and report back the enemy's strength, composition, and route of movement. To accomplish this, reconnaissance patrols may need to rely heavily on technical climbing skills. Ground surveillance radar and unattended ground sensors can be used effectively, but the defender must be sure to cover all gaps and dead spaces. The defender must maximize time efficiency by studying the ground and determining all possible infiltration routes. Effective and timely use of fires provides a devastating effect and demoralizes the enemy. Vantage points allowing long-range observation of the area of operations that can be gained

by seizing the high ground are potentially the most compelling reason to occupy these precarious positions.

For additional information on mountain warfare as it relates to maneuver elements and the operational fight, see Field Manual 3-97.6, *Mountain Operations* (2000).

Dismounted Movement in Mountainous Terrain

Soldiers face many challenges in steep terrain. Terrain can be a worthy adversary if the Soldier does not properly analyze and plan. U.S. forces still suffer casualties resulting from hazardous mountainous terrain even in the absence of enemy forces. Operations during limited visibility are common, and hazards are magnified when using night-vision goggles, which can distort depth perception. A 1-meter ledge rapidly traversed in daylight presents a significant challenge or obstacle during limited visibility or at night.

Individual physical fitness is one key to successful operation in mountainous terrain. Fatigue can result in carelessness and cause Soldiers to undergo injury in steep terrain. Strong knees and ankles are required along with properly fitted boots and equipment to be most effective.

This chapter will focus on individual movement techniques. Movements of large units, specialized movement techniques, and movements in arctic environments are beyond the scope of this handbook.

Cross-Country Movement in Mountainous Terrain

Soldiers must know the terrain to determine the feasible routes for cross-country movement when no roads or trails are available. Advantages may be gained by maneuvering or attacking from a direction or location that the enemy feels is not possible due to the severity of the terrain. The decision to traverse this type of terrain must be evaluated to determine risk versus gain in the planning process.

A pre-operations intelligence effort should include topographic and photographic map coverage and full-motion video surveillance, when available, as well as detailed weather data for the area of operations. When planning operations in mountainous areas, gather additional information concerning size, location, and characteristics of landforms; drainage; types of rock and soil; and density and distribution of vegetation. Always decentralize control to lower levels because of varied terrain, erratic weather, and communication problems inherent to mountainous regions.

Movement often is restricted because of terrain and weather. Because of the erratic weather, Soldiers must be prepared for wide variations in temperature, types, and amounts of precipitation.

- Movement above the timberline reduces the amount of protective cover available at lower elevations. The logistical situation is important; therefore, each man must be self-sufficient to cope with normal weather changes using materials from his rucksack.
- Movement during a storm is difficult because of poor visibility and bad footing on steep terrain. Although the temperature often is higher during a storm than during clear weather, the dampness of rain and snow and the penetration of wind cause Soldiers to chill quickly. Although climbers should get off the high ground and seek shelter and warmth if possible during severe mountain storms, capable commanders may use reduced visibility to achieve tactical surprise.

When the tactical situation requires continued movement during a storm, the following precautions should be observed:

- Maintain visual contact.
- Keep warm. Maintain energy and body heat by eating and drinking often; carry quick and easy-to-eat food while on the move.
- Keep dry. Wear wet-weather clothing when appropriate, but do not overdress, which can cause excessive perspiration and dampen clothing. Upon reaching the objective and securing shelter, put on dry clothing.
- Do not rush. Hasty movement during storms leads to breaks in contact and accidents.
- If lost, stay warm, dry, and calm.
- Do not use ravines as routes of approach during a storm because they often fill with water and are prone to flash floods.
- Avoid high pinnacles and ridge lines during electrical storms.
- Avoid areas of potential avalanche or rock-fall danger.

Basic Principles for Individuals Walking in Mountainous Terrain

The basic principles of mountain walking remain the same, whether moving over scree or talus, through boulder fields or steep wooded mountainsides, over snow or grass-covered slopes.

The Soldier must keep his weight centered directly over his feet at all times. He should place his foot flat on the ground to obtain as much (boot) sole–ground contact as possible. Then, the Soldier should place his foot on the uphill side of grass tussocks, small talus, and other level spots to avoid twisting his ankle and straining his Achilles tendon. He should straighten the knee after each step to allow for rest between steps and take moderate steps at a steady pace. He should avoid any angle of ascent or descent that is too steep and use indentations in the slope to his advantage.

In addition to proper technique, pace should be adapted to conditions. The leader should set a tempo, or number of steps per minute, according to the pace of the unit in which he is moving. (Physical differences mean that the tempos of two people moving at the same speed will not always be the same.) The Soldier should maintain his tempo and compensate for changes in slope or terrain by adjusting the length of his stride. Tempo, pace, and rhythm are enhanced when an interval of three to five paces is kept between individuals. This interval helps lessen the "accordion" effect of people at the end of the file who must constantly stop and start.

The terrain, weather, and light conditions will affect the rate of climb. The pace should be relative to the conditions: the more adverse the conditions, the slower the pace. Moving too fast, even under ideal conditions, will produce early fatigue, require more rest halts, and result in loss of climbing time. A Soldier can only move as fast as his lungs and legs will allow. A trained, conditioned, and acclimatized Soldier will have greater endurance and move more efficiently. Rest, good nutrition and hydration, conditioning, acclimatization, proper training, and the will to climb are keys to successful mountain operations.

Breaks and pauses:

- Minimize breaks. When traveling at a moderate pace, the need for rest halts will decrease and the chance of personnel overheating will be less, enabling a unit to cover a given distance in minimal time. Take rests on level ground, if possible, and avoid steeper inclines.
- Halts should be short to avoid muscles stiffening. Time warnings should be provided for all halts, long or short, so that Soldiers can make decisions regarding clothing and priorities of work and not be surprised by premature move-out while conducting required tasks.
- After the first halt, a well-conditioned party may take a short rest every 1 to 1.5 hours or as conditions dictate. If possible, Soldiers should lean against a tree, rock, or hillside to relieve their shoulders of pack weight, breathe deeply, hydrate, and snack on trail food.

- Later in the march, longer halts may be necessary because of fatigue or mission requirements. At these halts, Soldiers should immediately put on additional clothing to avoid becoming chilled—it is much easier to keep a warm body warm than to warm up a cold one. Keep a hat and gloves immediately available if not worn during movement, and put them on as soon as you stop to retain heat.

Movement techniques:

- After a climb, Soldiers will need a good rest to revive tired muscles. Use a rest step for steep slopes, snowfields, and higher elevations. It controls the pace and limits fatigue by giving the lungs and legs a moment to recuperate between steps. Maintain a slow and rhythmic pace.
- After each step forward, the Soldier should pause briefly, relaxing the muscles of the forward leg while resting his entire body weight on the rear leg. Keep the rear leg straight with the knee locked so that bone, not muscle, supports the weight. (Rest-step technique)
- Synchronize breathing with the rest step. The number of breaths per step will change depending on the difficulty of the climb. Steeper slopes or higher elevations may require several breaths per step. It is especially important to breathe deeply when the air thins at higher altitude, using the "pressure breathing" technique. The Soldier should exhale strongly, enabling an easier, deeper inhale. This slow, steady, halting rest step will be more efficient than spurts of speed, which will be rapidly exhausting and require longer recovery.
- Downhill walking uses less energy than uphill walking but is much harder on the body. Stepping down can hammer the full body weight onto the feet and legs. Blisters, blackened toenails, knee damage, and back pain may follow. To avoid these problems the Soldier should start by tightening bootlaces to ensure a snug fit and keep his toenails trimmed. A ski pole, ice ax, or walking stick will help take some of the load and provide additional stability. Keep a moderate pace and walk with knees flexed to absorb shock. Choosing a route that uses a switchback technique of ascent or descent may take longer than a direct route but is likely to conserve energy and prevent injuries from falls and fatigue in some situations.
- Avoid side-hill travel on any surface whenever possible. Weighted down with a rucksack, the Soldier is vulnerable to twisted ankles, back injury, and loss of balance. If side-hill travel is necessary, try to switch back periodically, and use any lower-angle flat areas, such as rocks, animal trails, and the ground above grass or brush clumps, to level off the route.

Equipment:

- Take an adjustment halt during the first half-hour of movement; Soldiers can loosen or tighten bootlaces as needed, adjust packs, and add or remove layers of clothing as appropriate.
- Movement of nonstandard loads and crew-served weapons and ammunition is a daunting task for most dismounted operations.
    - Packaging loads/weapons in a SKEDCO litter may be feasible for short movements, but seldom works for long distances in steep terrain. Equipment is damaged, haul teams have great difficulty keeping the litters moving in the direction of travel, and loads continually shift and flip, causing delays and damage to equipment.
    - Consider other options for carrying these items and division of equipment in order to effectively share the load among the entire element.
    - While body bags may be effective for dragging supplies and equipment from the cargo hold of a helicopter or vehicle, they are not durable enough to drag for extended distances in rugged mountain terrain.

Mounted Movement in Mountainous Terrain

Mountainous terrain restricts mounted movements and allows the enemy to predict movement corridors and effectively choose areas of engagement. Leaders must accept these risks if mounted movement is planned in mountainous terrain along limited-mobility corridors. When planning for mounted movement, Soldiers and leaders should consider the following points:

- It may be necessary to have dismounted troops interspaced with the vehicles to provide security and route clearance in mountainous terrain.
- Vehicles may carry only drivers, gunners, and supplies, while all others walk to provide security and, when needed, to overwatch. Avoid carrying excess fuel after a careful METT-TC analysis.
- Plan for extended movement times because dismounted troops may have to bound forward to establish overwatch positions or clear dead space before the vehicles can proceed.
- Ground guides are effective when driving in steep or difficult mountainous terrain.

- Gunners should be equipped with the best available optics, range finders, and weapons systems available to support the dismounted maneuver from their vehicle position. A gunner must communicate to drivers when he is in a position to properly scan and engage his sector of fire.
- It may be necessary to "air down" tire pressure to increase traction and performance.
- Drivers must know and rehearse the proper technique for using brake/throttle modulation (BTM) before attempting to drive in steep and broken terrain, and they should be prepared to use the transmission to assist in braking.

Brake/Throttle Modulation Technique

BTM is used to negotiate adverse terrain to regulate speed and movement. This technique is used to mitigate damage to the vehicle drive train. BTM can be used on some vehicles with an automatic transmission and, when possible, should be used in the lowest drive range. This technique is especially effective in up-armored high-mobility multipurpose wheeled vehicles.

- **Stop wheel-spin:** First, gently apply the brake—do not stomp on it. A tire weighs approximately 150 pounds with the run-flat in it, and the brakes are up by the differentials. Stepping on the brake causes the half-shaft to twist as momentum tries to keep the tire spinning; half-shafts are tough, but stomping on the brakes while the tire is spinning freely can break them.
- **Switch feet:** Put your left foot on the brake—it takes a while to get used to this if you have not done it before, but you need to switch feet. Continue to hold the brake to the floor, for now, with your left foot.
- **Apply pressure to the throttle:** Without releasing the brake with your left foot, gently step on the throttle with your right foot—continue to push gently on the throttle until the vehicle begins to move slowly. Once the vehicle starts to move, begin to release pressure on the brake.
- **Slowly take pressure off the brake:** When you reach your target moving speed, slowly start releasing the brake with your left foot—the vehicle will most likely start to crawl forward at this point.
- **Drive through:** If the vehicle stops moving, apply a little more pressure to the brake and enough throttle to keep you moving slowly. If the vehicle begins to move too fast, let off the throttle enough to drop the revolutions per minute (RPM) back down. With practice, you will be able to maintain your RPM and drive through smoothly.

Helicopter Movement in Mountainous Terrain

Helicopter operations in mountainous terrain can provide great mobility and enable Soldiers to access otherwise inaccessible locations. Thus, helicopter operations require thorough planning and a detailed METT-TC assessment focusing on the effects of terrain and weather in mountainous environments. Operations that require aircraft to continuously cycle in and out of the same landing zone (LZ)/pick-up zone (PZ) allow the enemy to template our operations and could result in an aerial ambush. At the individual Soldier level, planning a complex air-assault operation may be transparent until the time of execution. Every individual Soldier's action can have an impact on these operations, so a few key things to remember at the individual Soldier level are as follows:

- Ensure that all individual equipment is secured (tied down when necessary or per standing operating procedures [SOPs]).
- Secure all straps and lanyards so that they do not get caught while exiting the aircraft.
- Make maps available for "thumb nailing" as an additional navigation aid (during aerial movement to and from the LZ/PZ).
- Collapse or break down antennas to reduce hazard to rotors.
- Make sure that weapons are oriented safely (generally at the floor, away from hydraulics, or per SOP). Crew-served and specialty weapons should be cross-loaded and positioned tactically.
- Dedicate someone to monitor internal communications for changes to routes, LZs, or other advisories that affect the ground tactical plan.
- Be aware of rotor blades and sloping terrain that may place individuals in close proximity to turning rotors, especially during limited visibility.
- Make visual contact with the crew chief or gunner to receive clearance to approach, load, or exit the aircraft. Generally approach the aircraft from a 90-degree angle.
- Rehearse everything associated with aerial operations, and ensure you have also rehearsed a bump plan for infiltrate and exfiltrate in case aircraft availability changes.
- Have signal devices readily available during day and night operations to assist pilots in locating your position and touchdown point.
- Make every effort to improve LZs (as situation allows) before scheduled extraction so aircraft can cycle in and out of the LZ without

delay. Hand or chain saws may be required or demolitions can be used to clear larger obstacles.

Pack Animal Usage in Mountainous Terrain

Pack animals (donkeys, mules, horses, llamas, alpacas, etc.) are commonly found in mountainous areas with the indigenous populations who control them. Local nationals (LNs) understand these animals' abilities, limitations, and, most of all, how to control them. LNs understand how to load the animals and then properly secure the loads. They also are skilled at providing the proper motivation to make the animals perform the required tasks. Although these animals may be able to carry significant amounts of equipment, they do have limitations. Their carrying capacity also decreases with higher elevations. Table 3-1 lists the capabilities and limitations to consider before using pack animals.

Some planning elements to consider before deciding to use pack animals are:

- Is the terrain conducive to pack animal operations?
- Does extreme altitude prohibit or restrict pack animal operations?
- Does seasonal bad weather prohibit or restrict pack animal operations?
- Does the unit have experience with these animals in day/night conditions?
- Does the unit have experience enough to execute pack animal operations?

Pack Animals	
Advantages	**Disadvantages**
May save energy and wear on troops.	May have terrain limitations, especially on narrow trails where wide loads limit mobility.
May save time.	May have difficulty seeing during night movement with poor illumination.
Can carry larger loads than troops.	Must have proper feed (grain and roughage) to sustain performance.
Payment for animals may stimulate the local economy in a counterinsurgency situation.	May be difficult to secure from or specifically targeted by the enemy.
Are readily available and replaceable if lost due to injury or combat action.	May be difficult to control and may require LN keepers.
Can carry crew-served and heavy weapons when properly secured and controlled.	Must have frequent water for sustained operations.
May offer leaders additional options in planning and execution.	May create operational security concerns during coordination for use and planning.

Table 3-1. Pack animal considerations

Chapter 4

Communication

Introduction

The enemy often benefits from the mountain environment's degradation of many of our technological advantages, particularly communications. Far too often we fail to take into account the effects of weather and terrain on our communications equipment. Soldiers who understand these effects and the techniques to mitigate them such as field expedient antennas will greatly increase a leader's ability to command and control his unit.

Types of Communication in the Mountains

Line-of-Site Radio Communication

Line-of-site radio communication is generally the preferred method of communication but is not always an option in the mountains. Communicating in the mountains is a challenge since there are few ideal spots for communication. Frequency modulation (FM) radios, which are line-of-sight systems, frequently cannot communicate because their signals are absorbed by terrain folds and features.

Because of the effects of irregular terrain patterns, cold, ice, and dampness on communications equipment, line-of-sight communication is not reliable at any great distance without precise planning and extensive coordination. Communication sites must be carefully selected and often become key terrain. When line-of-sight communications in mountains are possible, communications are excellent, but there are few sites where line of sight is possible to all other elements in the net. There are often only three solutions:

- Move the radio either to a location where it can communicate.
- Set up a radio retransmission site.
- Relay messages across the net.

Location

FM communications are usually possible if all the force is on the same side of the mountain and the mountain forms a bowl. However, radios located on the same side of the mountain at different altitudes have difficulty communicating because of intervening terrain and communications dead space. Line-of-sight radio communications are especially difficult if the force is deployed on the same side of a mountain that curves out. Even FM radios located on the summit of the mountain have difficulty

communicating with radios located further down the mountain slope due to dead space.

Retransmission

Since even a small unit may be spread over a large area, retransmission sites may be needed to maintain communications and increase range. Retransmission sites can greatly assist in maintaining and increasing range of communications in the mountains. These sites require extensive preparation, and since the retransmission team must work away from the main body, it must have enough personnel to protect itself and haul all its gear to the retransmission location.

These sites require extensive preparation and support to ensure the survival of personnel and the continued maintenance of equipment. Batteries, antennas, guy wires, rations, water, weapons, ammunition, and personnel gear are heavy. These retransmission teams need to constantly relocate to keep up with the main body despite the fact that the main body will generally be moving over easier terrain.

Retransmission systems are often placed on the highest accessible terrain to afford them the best line of sight between stations. However, through simple analysis, these locations are often predictable and make them more vulnerable to enemy interdiction. The importance and difficulty of maintaining adequate communications in mountainous terrain requires commanders to devote additional resources for the protection of these limited assets. Operators must maintain their skills in the proper use of cover and concealment, noise and light discipline, and other operations security measures.

Relay transmission

Physical range limitations, difficulties in establishing line-of-sight paths due to intervening terrain, and limited retransmission capabilities often make it difficult to establish a brigade and larger-sized radio net. However, commanders can, if within range, enter subordinate nets and establish a temporary net for various contingencies.

In the mountains or if the mobile subscriber equipment network is not yet fully developed, commanders should consider the increased need for the improved high frequency radio family of amplitude modulation, or AM, radios and single-channel tactical satellite communications terminals for extended distances.

Aircraft

Using command and control (C2) aircraft can assist in overcoming ground mobility restrictions and may improve communications of units on the ground. In the mountains, terrain masking, while making flight routing more difficult, may provide the degree of protection needed to allow an increased use of aircraft. To avoid radar or visual acquisition and to survive, C2 aircraft must use the same terrain flight techniques employed by other tactical aviation units. This flight method often degrades FM communications and reinforces the requirement for radio relay or retransmission sites.

Landline Communications

Landline communications in the mountains can also pose serious problems. The time needed to emplace and remove field cable lines can be doubled and the amount of line needed can be doubled. Wire lines are laid along roads, river valleys, and other accessible areas of terrain. It is much harder for personnel manning line elements and those that service, guard, and protect field cable communication lines to find their bearings in the mountains.

Satellite Telephones/SATCOM

Satellite telephones are excellent for emergency communications in the mountains. Advantages include lightweight, mobile en route communication; they can penetrate foliage, and they have a virtually unlimited range. These systems have limitations also: batteries are very limited; they are difficult to encrypt; and they are not always available in every unit, especially at smaller unit levels.

Audio, Visual, and Physical Signals

Audio, visual, and physical signals can be quick and effective if standing operating procedures are established prior to the operation. Leaders can use simple audio signals, such as voice or whistles, to locally alert and warn.

Sound travels farther in mountain air. Although this effect may increase the possibility of enemy detection, interrupting terrain, wind conditions, and echoes can restrict voice and whistle commands to certain directions and uses. Like audio signals, visual signals such as pyrotechnics and mirrors have limited use due to enemy detection, but may work for routine and emergency traffic at the right time and place.

Blowing sand or snow, haze, fog, and other atmospheric conditions may periodically affect range and reliability. Units should use hand-and-arm signals instead of the radio or voice whenever possible, especially when close to the enemy.

A tug system is a physical method of signaling between members of a roped climbing team. However, tug systems are often unreliable. Separate tug lines can be installed in static positions by tying a string, cord, or wire from one position to the next. Soldiers can pass signals quietly and quickly between positions by pulling on the tug line in a prearranged code.

Considerations for Maintaining Antennas in the Mountains

Antenna Icing and Proper Grounding

Antenna icing, a common occurrence at high elevations, significantly degrades communications. Ice may also make it difficult to extend or lower antennas, and the weight of ice buildup, combined with increased brittleness, may cause them to break. Antennas should have extra guy wires, supports, and anchor stakes to strengthen them to withstand heavy ice and wind loading.

All large, horizontal antennas should be equipped with a system of counterweights arranged to slacken before wire or poles break from the excess pressures of ice or wind. Soldiers may be able to remove wet snow and sleet that freezes to antennas by jarring their supports or by attaching a hose to the exhaust pipe of a vehicle and directing the hot air on the ice until it melts. However, Soldiers must exercise great care to ensure that the antenna is not damaged in their attempts to dislodge the ice.

Ground rods and guy wires are often difficult to drive into rocky and frozen earth. Mountain pitons are excellent anchors for antenna guys in this type of soil. In extreme cold, ropes can be frozen to the ground and guys tied to these anchor ropes. Adequate grounding is also difficult to obtain on frozen or rocky surfaces due to high electrical resistance. Where it is possible to install a grounding rod, it should be driven into the earth as deep as possible or through the ice on frozen lakes or rivers. Grounding in rocky soil may be improved by adding salt solutions to improve electrical flow.

Mountain Line-of-Sight Communications

When possible, select communications sites that have a single, narrow mountain crest between them. Aim the transmissions at the highest peak.

Keep the sites away from the mountain base.

- Deploy radios away from the mountain base to a distance at least equal to the distance of the slope between the base and mountain crest.
- Deploy radios to commanding heights to improve the line of sight to the top of the intervening mountain.
- Deploy the radios where they can communicate over a single mountain rather than a series of peaks and defiles.
- When confronted with a large, domed mountain, deploy the radios away from the base of the mountain and on high ground.
- Consider the use of nonstandard retransmission sites when planning for communications in areas of operation that do not facilitate direct line-of-sight communications. (Know the operating frequencies for low-level voice intercept teams, overwatch positions, and observation posts.)
- Use Falcon View, Google Earth, or other geographical mapping technologies for performing line-of-sight analysis while planning.

Satellite Phone Communication

- Know the dialing procedures for the satellite phone.
- Know the numbers to dial when using the satellite phone as an alternate, contingency, or emergency method of communications.
- Limitations of satellite phones include battery life, lack of encryption capability, and lack of commonality and availability between units and partners.
- In order to account for all satellite phone components, it is essential to conduct a thorough precombat inspection.

Power Considerations/Batteries

- Use fresh batteries before departing on each new mission.
- Consider interoperability and commonality of batteries when planning for initial load and numbers for resupply.
- In colder environments, shortened battery life greatly reduces the reliability of man-packed systems that rely on constant voltage input to maintain maximum accuracy.

Radio	Battery	Qty.	Total Battery Weight (lbs)	Temperature-Dependent Run Time (Best Runtime/lb) –30 to –4°F	–4 to 32°F	32 to 130°F	>130°F	Comments/Req. Adapters
AN/PRC-148, MBITR	MBITR Battery (rechargeable)	1	1.0	Unknown	Unknown	8 hr	Unknown	Can only be charged between –4 and 122°F
	BA5590	1	2.3	2 days	2 days	2 days	2 days	J-6686/U
	BA5390	1	3.0	1 day	3 days	3 days	3 days	J-6686/U
	BA8140	1	3.0	Unusable	Unknown	3 days	Unknown	J-6686/U; cannot be submerged
	BA8180	1	6.0	Unusable	4 days	10 days	9 days	J-6686/U; cannot be submerged
AN/PRC-117	BA5590	2	4.6	12 hr	12 hr	18 hr	15 hr	
	BA5390	2	6.0	18 hr	18 hr	27 hr	23 hr	
	BA8180	2	12.0	Unusable	54 hr	90 hr	80 hr	
RT-1523 (ASIP)	BA5590	1	2.3	17 hr	17 hr	26 hr	21 hr	
	BA5390	1	3.0	26 hr	26 hr	39 hr	33 hr	
	BA8180	1	6.0	Unusable	78 hr	130 hr	116 hr	

All run times are estimates based on the CECOM Power Optimizer for the Warfighter's Energy Requirements (POWER) calculator (version Beta 1.07.05.06) and individual usage. These estimates are provided to assist in planning and are approximate.

Figure 4-1. Battery-use table for planning initial load and resupply

External Power

- Consider using an adapter (J-6686/U) to enable the use of BA-5590/5390 or BA-8140/8180 with AN/PRC-148 (MBITR)/AN/PRC-152 (Falcon) batteries to decrease the number of batteries required for the mission.
- Be aware of run-time changes at different temperatures for different batteries.
- Power radios with any battery that provides 12 volts.

External Power Amplifier

- A RAMP-25 external power amplifier provides 25 watts of transmit power.
- A RAMP-25 used with an AN/PRC-148 (MBITR) or AN/PRC-152 (Falcon) provides almost the same transmit capability as the larger, heavier AN/PRC-117 but with less weight and longer operating times on the same types of batteries.
- Use a RAMP-25 for FM line of sight, VHF communications, and SATCOM.

Troubleshooting Communications

Follow the ABCs:

A. Check *Antenna.* (Is the antenna tight? Is the antenna elevated as high as possible?)

B. Check *Batteries* (connections clean and proper).

C. Check all *Connections* (check/clean every connection).

Chapter 5

Medical

Injuries or illnesses in mountainous terrain can be more serious than in other environments because of the harsh atmosphere, limited evacuation areas, and difficulty in providing security at evacuation sites. Even a relatively minor injury, easily treated on flat ground, may become the "main effort" of an element in a mountainous environment. The vast variances in temperature in many mountainous environments from day to night can cause Soldiers and leaders to be concerned about cold-weather and hot-weather injuries within the same 24-hour period.

Take basic precautions to limit injury and illness before beginning an actual combat mission. While analyzing the situation, every Soldier should visualize the terrain, mentally choose evacuation sites and landing zones and pick-up zones (PZs), and generate an estimate to determine the impact that an immobile or seriously wounded Soldier might have on the element. The decision to evacuate a wounded Soldier should be made by the leaders only after considering every aspect of the effects of an evacuation on the mission and the men. While medical personnel should be consulted for advice, the decision to conduct an evacuation must be made by the tactical leader.

Basic pre-mission preparation should focus on preventable injuries, recognition of illness and injury, and training to ensure every Soldier can recognize and treat injuries commonly associated with a mountainous environment. Every element must address/brief evacuation of injured Soldiers and have primary, alternate, and tertiary plans to remove Soldiers from the battlefield. Although helicopters are readily available on the battlefield, it is important to remember that mountain weather can adversely affect medical evacuation (MEDEVAC) operations. Consideration for high winds, fog, percentage of useable illumination, and other climatic conditions are part of pre-mission planning.

Tables 5-1 through 5-7 contain information concerning the illnesses and injuries that may be encountered in mountainous environment operations and provide courses of action for their prevention and treatment.

Immersion Foot	
What is it?	Prolonged exposure to cold, wet conditions. Inactivity, damp socks, and boots speed onset and severity.
Symptoms	Cold, numb feet; may progress to hot with shooting pains; swelling, redness, and bleeding in severe cases.
Treatment	Re-warm and dry feet by exposing to warm air; do not allow victim to walk on injury; do not rub, moisten, or expose area to extreme heat; evacuate.
Prevention	Keep feet warm, clean, and dry with frequent sock changes; wet socks should be dried out as soon as possible to allow them to be reused; wipe vapor barrier boots out once per day (minimum); dry boots overnight by stuffing with paper towels.

Table 5-1. Immersion foot

Hypothermia	
Causes	• Dehydration • Poor nutrition • Diarrhea • Decreased physical activity • Cooling after sweating • High winds • Immersion in water • Wrong clothing (type, amount, etc.) • Unpredicted change in weather
What is it?	Excessive heat loss from exposure to a low ambient temperature, wetness, high humidity, and wind; causing lowering of body's core temperature; serious medical condition requiring medical attention. ***Early recognition of this condition is the key*** to preventing advanced serious medical conditions.

Symptoms	• Shivering • Slurred speech • Stumbling • Apathy • Nausea • Delirium • Acetone breath (fruity) • Stops shivering (advanced) • Unconsciousness • Weak vital signs (body shutting down)
Treatment	**Mild** • Reduce the cold and add heat (change to dry clothing, get into warming shelter, enter sleeping bag, etc.). • Provide food and warm liquids. **Severe** • Evacuate ASAP to definitive care. • Treat victim very gently. Provide warm, sweet drinks. • Breathe warm air into the victim. • Use Hibler Pack—apply padded heat sources.
Prevention	• Proper use of cold-weather clothing and equipment. • Anticipate the need for warming shelters, change of clothing, etc. • Adequate hydration and nutrition.
DO NOT: • Attempt field rewarming unless medical help is more than 6 hours away. • Allow physical activity. • Attempt CPR compressions. • Assume a cold victim is dead even if he appears to be dead.	

Table 5-2. Hypothermia

Chilblain	
What is it?	Excessive exposure to cold temperature that is marked by inflammatory swelling of hands and feet accompanied by severe itching and burning sensations and sometimes ulceration; usually affects individuals with a history of cold limbs in summer as well as in winter.
Symptoms	Swollen red tissue (in light-skinned individuals) or darkening of the skin (in darker-skinned individuals). This injury DOES NOT involve freezing of tissue.
Treatment	Warm affected area with direct body heat; do not massage or rub affected area; do not wet the area or rub it with snow or ice; do not expose affected area to open fire, stove, or any other intense direct heat source.
Prevention	Proper use of cold weather clothing and equipment; proper hydration and nutrition.

Table 5-3. Chilblain

Acute Mountain Sickness (AMS)	
What is it?	A collection of nonspecific symptoms that can resemble the flu, carbon monoxide poisoning, or a hangover. Typically occurs at altitudes above 8000 feet.
Symptoms	• Dizziness • Shortness of breath • Headache • Insomnia • Upset stomach • Depression
Treatment	• Slow or halt ascent. • Rest; aspirin or other over-the-counter medications may help. • Eat and ensure individual is hydrated. • Diamox may help. • Descend if symptoms do not subside
Prevention	Maintain a slow ascent rate. Work high and sleep low; altitude increases of more than 1000 feet per day are not recommended; some prescription medications can aid acclimatization; adequate hydration and nutrition

Table 5-4. AMS

Frostbite	
What is it?	Freezing of body tissue. The ambient temperature MUST be below 32ºF for frostbite to occur. **Superficial:** Only the outer layer of skin is affected. **Deep:** More tissue is involved; can be down to and include the bone.
Symptoms	**Superficial:** Waxy white or gray skin (pink or red in dark-skinned individuals) with pliable underlying layers. **Deep**: Tissue is white or bluish and firm to the touch and will not move over underlying layers.
Treatment	**Superficial:** Field treatment is to warm affected area with direct body heat or use water at temp of approximately 98–104ºF; once thawed, do not allow tissue to refreeze. **Deep:** Field treatment is the same as for superficial AS LONG AS YOU ARE SURE THAT THE INJURY WILL NOT REFREEZE. NEVER moisten or rub with snow/ice; do not expose to intense heat sources.
Prevention	• Proper use of cold weather clothing and equipment. • Use contact gloves to handle equipment; use approved gloves to handle POL products (petroleum, oil, lubricants, etc.). • Keep face and ears covered and dry; avoid tight, restrictive clothing; adequate hydration and nutrition. • Avoid alcohol and tobacco products.

Table 5-5. Frostbite

High-Altitude Pulmonary Edema (HAPE)	
What is it?	Lungs fill with fluid (blood serum) that leaks from capillaries. Also known as dry-land drowning—as the lungs fill with fluid, the individual begins to lose the ability to get oxygen into the bloodstream. Manage altitude illness.
Symptoms	In the early stages, shortness of breath during exertion and an infrequent cough; as it develops, shortness of breath at rest, gurgling respirations (rales), and a frequent cough that produces pink or white frothy sputum; fever; looks similar to pneumonia.
Treatment	Rapid descent of 2000–4000 feet immediately; oxygen, medications, or Gamow bag may temporarily help, but rapid descent is the only definitive treatment; Diamox helpful in early stages.
Prevention	Maintain a slow ascent rate. Work high and sleep low; altitude increases of more than 1000 feet per day are not recommended; some prescription medications can aid acclimatization; adequate hydration and nutrition.

Table 5-6. HAPE

High-Altitude Cerebral Edema (HACE)	
What is it?	Increased intracranial pressure (swelling of the brain) caused by fluid leaking from capillaries.
Symptoms	• Headache • Nausea • Dizziness • Loss of appetite • Fatigue • Insomnia • Severe headache and vomiting (in severe cases)
Treatment	Rapid descent of 2000–4000 feet immediately; oxygen, medications, or Gamow bag may temporarily help, but rapid descent is the only definitive treatment; dexamethasone (Decadron) may help with symptoms, but is only temporary.
Prevention	Maintain a slow ascent rate. Work high and sleep low; altitude increases of more than 1000 feet per day are not recommended; some prescription medications can aid acclimatization; adequate hydration and nutrition.

Table 5-7. HACE

Helicopter Evacuations

Helicopter evacuations are common in mountainous terrain because of the difficulty involved in moving even a single litter patient. It might require an entire platoon to move one man and his equipment in near-vertical terrain. The ability to call for a MEDEVAC and establish a PZ to remove casualties from the battlefield is a task that every Soldier should be able to accomplish.

If helicopters cannot land because of the slope or ground conditions/ obstacles, then a hoist mission may be the only possible alternative. The ground element must ensure that the terrain surrounding the evacuation PZ is secure and that the enemy situation allows for the rotary wing evacuation before bringing a helicopter into the area. Leaders will be required to make hard choices when the subjective danger to the element (enemy contact, crash, exposure, etc.) may be too great to attempt a hoist or MEDEVAC

mission. Elements must be prepared to move wounded with them if evacuation is not possible or advised based on the situation.

A realistic assessment by both medical personnel and tactical leaders should jointly determine if a MEDEVAC would be attempted. Severity of wounds, medical supplies on hand for sustainment, projected weather, and enemy situation are all key factors to consider before attempting a "high risk" MEDEVAC.

The 9-Line MEDEVAC Format

The following information is necessary when requesting a MEDEVAC for casualties. Know the SOP in your area of operations:

- **Location:** Grid coordinates will contain the six-digit grid location preceded by the 100,000-meter grid identification.
- **Radio/Frequency/Call sign:** The frequency and call sign should be that of the radio at the site of the unit requesting the MEDEVAC.
- **Patient category of precedence:** Be prepared to classify the casualty's priority to be evacuated.
    - **Urgent:** Within 2 hours to save life or limb.
    - **Priority:** When casualty's medical condition will deteriorate and become urgent within 4 hours.
    - **Routine:** Requires evacuation but patient's condition is not expected to deteriorate for several hours.
    - **Tactical immediate:** Evacuation needed so as not to endanger tactical mission.
- **Special equipment/Emergency medical supplies:** List your requirements.
- **Number and type of casualties:** Self-explanatory.
- **Security of pickup site:** Describe conditions of security.
- **Site marking:** Describe marking method used.
- **Patient nationality and status:** Self-explanatory.
- **Nuclear, biological, and chemical (NBC) contamination area:** Give location of NBC area.

Helicopters in Mountainous Terrain

The use of helicopters in mountainous terrain calls for an early, close examination in pre-mission planning as well as continuous consideration during any operation. When possible, directly coordinate evacuation limitations and capabilities with the aviation unit that will likely support your operation before you begin an operation.

In mountainous terrain, winds can have a significant impact and may be radically different from the windward to the leeward side of any terrain. When advising helicopters on wind conditions (speed and direction), ensure complete analysis on how the terrain may affect this advisory, and pass that information to the aircraft when applicable.

For the helicopter to land safely, the ground should be relatively level and the slope should not exceed 7 degrees, as shown in Figure 5-1. However, observation and utility helicopters can terminate at a hover over ground slopes exceeding 7 degrees to load or offload personnel or supplies. Large utility and cargo helicopters also can land on terrain with a slope ranging from 0 degrees to 7 degrees. At slopes ranging from 7 to 15 degrees, direct pilots to hover, as appropriate. Make landings upslope whenever possible, and avoid landing down slope.

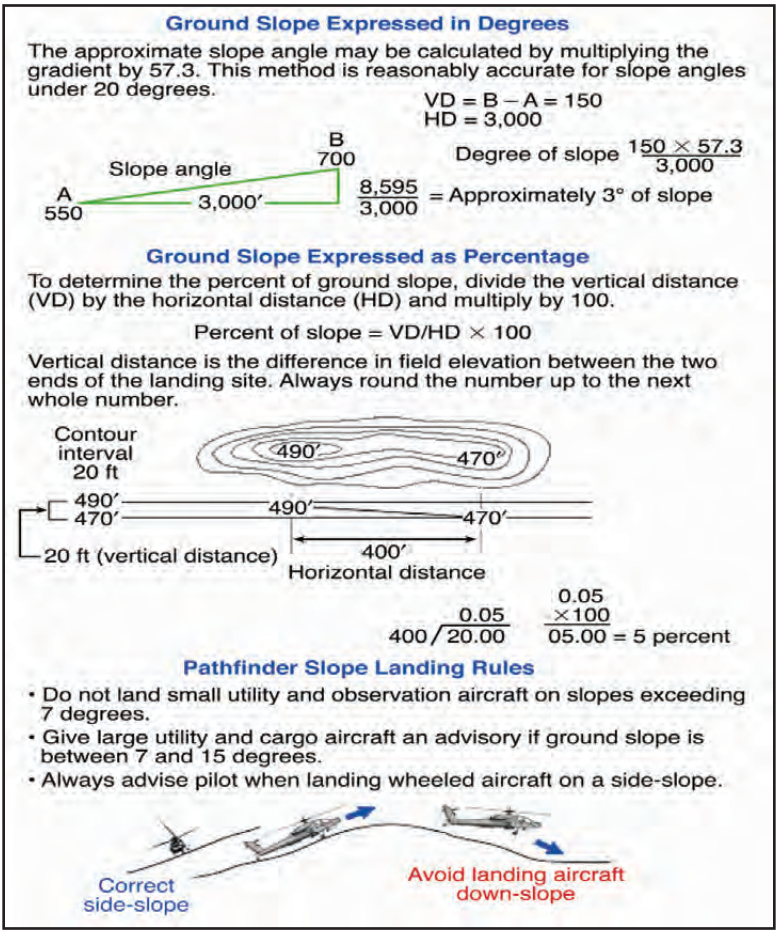
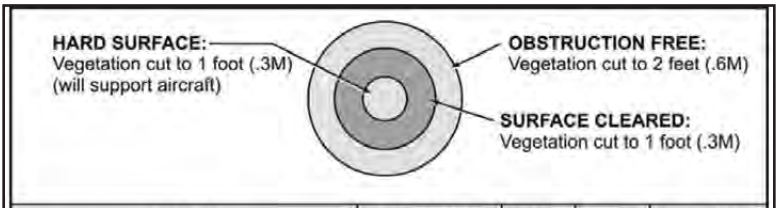


Figure 5-1. Ground slope and slope landing rules



LANDING POINT	MINIMUM DIAMETER OF LANDING POINT	HARD SURFACE	SURFACE CLEARED	OBSTRUCTION FREE
SIZE 1 - Light Observation OH-58D OH-6	25M	5M	15M	25M
SIZE 2 - Light Utility and Attack UH-1H H-65 AH-1W	35M	10M	20M	35M
SIZE 3 - Medium Utility and Attack UH-60 H-2 AH-64	50M	15M	35M	50M
SIZE 4 - Cargo CH-47 CH-53	80M	15M	35M	80M

Figure 5-2. Helicopter landing zone requirements

SKED Litters

SKED litters are common equipment for most units and have great capabilities as well as some limitations. The SKED litter is effective for packaging a patient for vertical (hoist) evacuations but does not normally provide cervical-spine immobilization without other specialized equipment. When available and necessary, use the SKED litter with a backboard to provide cervical spine support.

Patients should be "packaged" with supervision from medical personnel, when possible, and protected from further injury from the environment by leaving safety equipment (helmet, eye protection, etc.) in place when applicable. It also may be necessary to place individuals inside of a sleeping

bag, space blanket, or other cold weather clothing for protection from cold weather injuries during evacuation. Evacuations may take hours, and cold weather effects can be compounded by rotor wash and high winds.

Each SKED basic rescue system typically comes complete with the following equipment (see Figure 5-3):

- **SKED stretcher:** This stretcher is fabricated from a special plastic formula that is both flexible and durable. Securing straps with steel buckles sewn into the stretcher through brass grommets contribute to its strength and durability.
- **Cordura backpack/towing harness:** This durable backpack includes shoulder straps and pockets for storing the SKED accessories when not in use.
- **Horizontal lift slings:** A pair of 9,000-pound tensile strength slings are provide for hoisting the SKED stretcher with a helicopter or other haul system in a horizontal position.
- **Vertical lift sling:** For vertical lifting of the SKED stretcher, 30 feet of 3/8" PMI kern mantle rescue rope, with minimum break strength of 5,265 pounds, included with a figure-eight knot in the middle.
- **Steel locking "D" carabiner:** A large steel locking "D" carabiner is included with the system for attaching the stretcher to a hoisting system. The carabiner's rating is 9,000-pounds minimum break strength.
- **Tow strap:** This 6-foot strap with bronze snap hooks on each end attaches the SKED stretcher to the backpack, creating a useful towing harness that can be used in several configurations for towing the SKED stretcher by one or more people.
- **Removable webbing handles:** In addition to the four handles sewn permanently into the SKED stretcher, there are four additional removable handles to allow carrying by up to eight rescuers.

Figure 5-3. SKED basic rescue system

Chapter 6

Mountaineering Mobility Skills

Introduction

Most elements moving in mountain terrain can sustain themselves with very little specialized equipment. With the addition of more specialized equipment, the mission sets and capabilities of a unit can greatly expand. Additional equipment may be heavy and cumbersome, and while adding capacity for increased technical operations, it may limit a unit due to weight and bulk. This chapter demonstrates some of the available equipment, techniques for use, and basic requirements for anyone preparing to engage in any technical mountaineering operation.

It may be difficult to train and maintain proficiency on mountain-related tasks and skills without similar terrain in your predeployment training area and a continual mountain mission. Readiness for technical mountain mobility requires that every Soldier train and maintain some basic skills essential to operation in a mountainous environment. These skills allow commanders at every level to develop plans that are realistic and achievable for operations in mountainous terrain. A rehearsed and refined core group of skills will result in expanded unit capability. Specialized mountain elements or assault climbers who have received specialized training are useful for assisting general-purpose forces to prepare or emplace mountaineering installations such as fixed ropes, haul lines, suspension traverses, and other complex installations.

Increased adaptability and probability for successful mountainous operations exist if all Soldiers become proficient in a few basic tasks and are able to develop a basic understanding of more complex mountaineering installations. This chapter will address the minimum skills necessary for Soldiers preparing to deploy into a mountainous region for combat operations.

Mountaineering Equipment

Mountaineering gear can be highly specialized, expensive, and heavy. There is a broad range of commercially produced products, each having a wide variety of characteristics that can confuse the average nonmountaineering-specific Soldier. Equipment purchased or issued for mountaineering-specific functions should be limited to those tasks. (Never use a rope designated for mountain operations to do tasks such as towing a vehicle.)

Preserve "life-support" equipment so that it is fully functional when needed. Conduct periodic inspections of mountaineering equipment to ensure it is functional and ready to perform its specific intended task. If a piece of mountaineering gear is used—such as a rope, carabiner, or other gear—for a nonmountaineering function, it should be retired from service and clearly marked so that it will not be confused with gear suitable to conduct life-support missions. The need for specialized equipment does exist, but most patrols in a mountainous environment can perform a wide range of tasks using basic equipment.

Weight is a significant concern, and reducing duplication is a key to success. Leaders make decisions based on the assumption that every Soldier will have a specific piece of equipment available if needed. When pooled together, individual equipment allows small elements to build basic installations and have enough equipment to establish belays, haul lines, evacuation lanes for ascending and descending, fixed ropes, and a host of other basic mountaineering functions.

As a rule of thumb, a platoon should have the following equipment to provide it with many options for movement in mountainous terrain:

- One rope each (9 to 11 millimeters), 60 meters in length.
- One complete SKED litter (including a second rope).
- Four squad slings (minimum of 30 feet).

Additionally, every patrol member should have:

- A locking carabiner.
- A 14-foot sling rope.
- A 20-foot section of tubular nylon.

Mountaineering Kits Currently Available to Enhance Operations

The Army mountaineering kits are made up of three separate but integrated kits of state-of-the-art, commercial equipment that meet the highest industry standards. The separate kits enable the commander to tailor the equipment to the mission environment.

The **high-angle mountaineering (HAM) kit** is designed for a minimally trained infantry brigade combat team platoon (40 personnel) moving through steep terrain, void of ice or snow, on rope installations established by assault climbers. The HAM kit provides each Soldier in the platoon with a harness, locking and nonlocking carabiners, sewn webbing runners, 7-millimeter accessory cord, and a belay/rappel device. There are also static installation ropes, a rope cutter, and a rope washer (see Figure 6-1).

Figure 6-1. HAM kit

A trained assault climber team of three personnel uses the **assault climber team (ACT) kit** to establish rope installations. Then minimally trained Soldiers can move over these using the HAM kit. The ACT kit provides each Soldier in the assault climber team with a harness, locking and nonlocking carabiners, sewn webbing runners, mechanical ascenders, chock pick, assault climber bag, 7-millimeter accessory cord, and a belay/rappel device. There are also dynamic climbing ropes and rock protection equipment, including spring loaded camming devices and chocks (Figure 6-2).

Figure 6-2. ACT kit

Assault climbers are responsible for the rigging, inspection, use, and operation of all basic rope systems. They are trained in additional rope management skills, knot tying, and belay and rappel techniques, as well as using specialized mountaineering equipment. Assault climbers are capable of rigging complex, multipoint anchors, and high-angle raising/lowering systems. Units should employ basic mountaineers whenever possible when operating on moderate class 2-4 terrain and ACTs whenever operating on hard class 4 or 5 terrain. Leaders may consider having their reconnaissance and surveillance personnel, including Soldiers assigned to reconnaissance platoons and snipers, as qualified assault climbers. (For additional information on knowledge and skills required of assault climbers, see Field Manual 3-97.61, *Military Mountaineering,* August 2002.)

The **snow and ice mobility (SIM) kit** (Figure 6-3) offers enough equipment to outfit a 40-man platoon operating in an ice and snow environment. The use of the SIM kit, in most cases, requires specialized training and significant rehearsals before use.

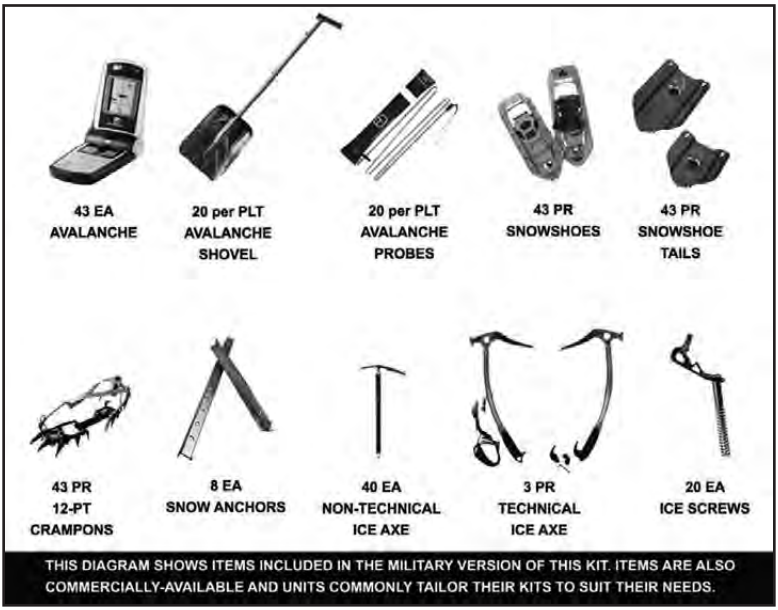


Figure 6-3. SIM kit

The equipment contained inside the HAM and ACT kits allows leaders to have increased flexibility in planning and execution of operations in a mountain environment. The remainder of this chapter will focus on the basic skills required for operating in a mountainous area with limited equipment and training.

Experienced, school-trained mountaineers can quickly teach basic skills and are valuable to any element. If none are available, an internal capacity may have to be developed. It is key for the individual and leader to understand their limitations in skills and equipment. A few trained and experienced mountaineers may be able to successfully supervise and safely train a much larger element. Every Soldier should develop a core set of skills that allows him to participate as a part of the team, even if not fully trained on every task.

Core tasks that should be refined to allow flexibility in training are:

- Knots.
- Anchors.
- Belays.

- Descending.
- Ascending.
- Basic installations (transport tightening system, Z-pulley, munter-hitch for lowering).

Knots

While there are hundreds of knots with very specific applications, there are a few basic ones that provide Soldiers with knots suitable for almost any task in conducting basic military mountaineering operations. Soldiers should practice these knots until they have mastered them in daylight, in darkness, and while wearing gloves. Soldiers should consider building a basic repertoire of knots that includes:

- Double figure 8.
- Figure 8 slip.
- Clove hitch (middle of the rope).
- Clove hitch (end of the rope).
- Prusik.
- Square knot.
- Rappel seat.

Double figure 8 (see Figure 6-4). Use a double figure 8 loop knot to form a fixed loop in the end of the rope. You can tie a double figure 8 at the end of the rope or anywhere along the length of the rope. This knot is formed by two ropes parallel to each other in the shape of a figure 8 with no twists in the figure 8. Fixed loops are large enough to insert a carabiner. When you dress the knot, leave at least a 4-inch tail on the working end.

Figure 6-4. Double Figure 8

Figure 8 slip knot (see Figure 6-5). The slip knot is used to form an adjustable bight in the middle of a rope. This knot is in the shape of a figure 8. Both ropes of the bight pass through the same loop of the figure 8. The bight is adjustable by means of a sliding section.

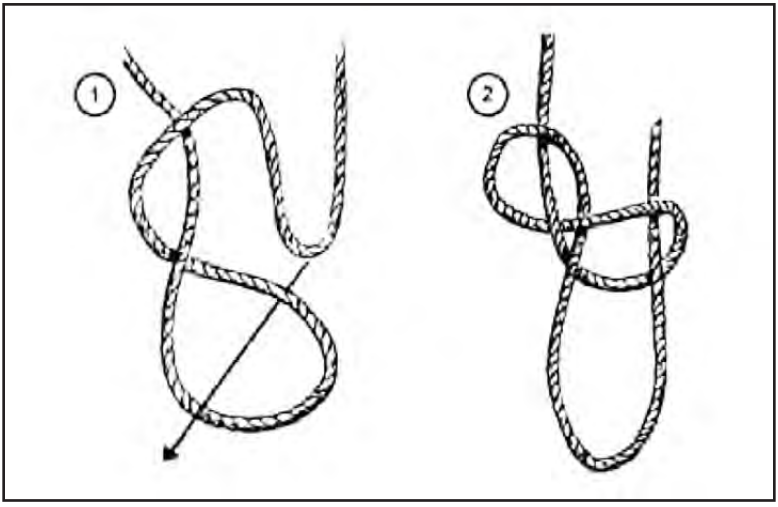


Figure 6-5. Figure 8 slip knot

End-of-the-rope clove hitch (see Figure 6-6). This is an intermediate anchor knot requiring constant tension. Make two turns around the anchor (1). A locking bar runs diagonally from one side to the other. Leave no more

than one rope width between turns of rope (2). Locking bar is opposite direction of pull. When you dress the knot, leave at least a 4-inch tail on the working end.

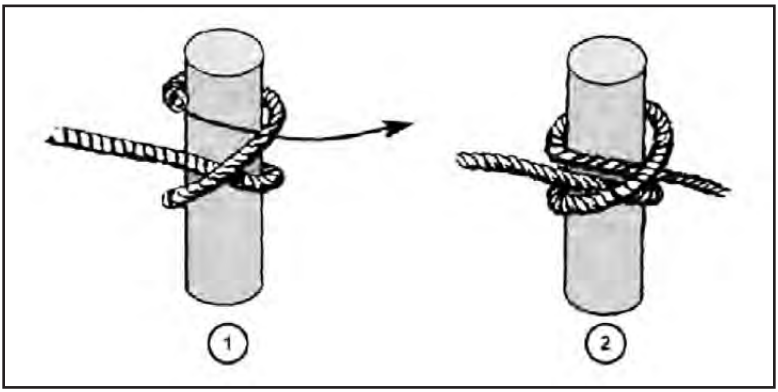


Figure 6-6. Clove hitch (end of the rope)

Middle-of-the-rope clove hitch (see Figure 6-7). This knot secures the middle of a rope to an anchor. The knot forms two turns around the anchor (Steps 1 and 2). A locking bar runs diagonally from one side to the other. Leave no more than one rope width between turns (Step 3). Ensure the locking bar is opposite the direction of pull.

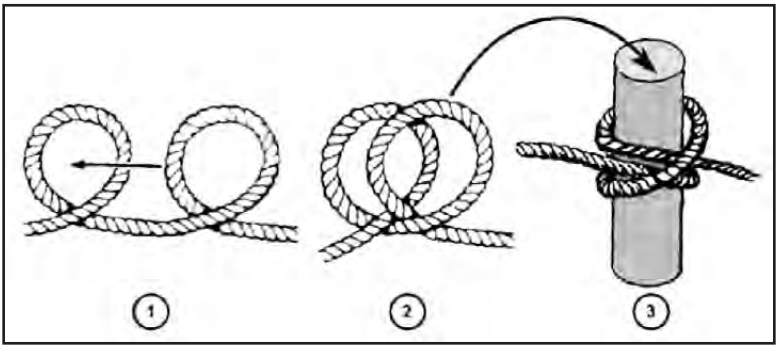


Figure 6-7. Middle-of-the-rope clove hitch

Middle-of-the-rope prusik (see Figure 6-8). The middle-of-the-rope prusik attaches a movable rope to a fixed rope anywhere along the length of the fixed rope. To make this knot, make two round turns with a locking bar

perpendicular to the standing end. Ensure the wraps do not cross and that the overhand knot is within 6 inches from the horizontal locking bar. Ensure the knot does not move freely on the fixed rope.

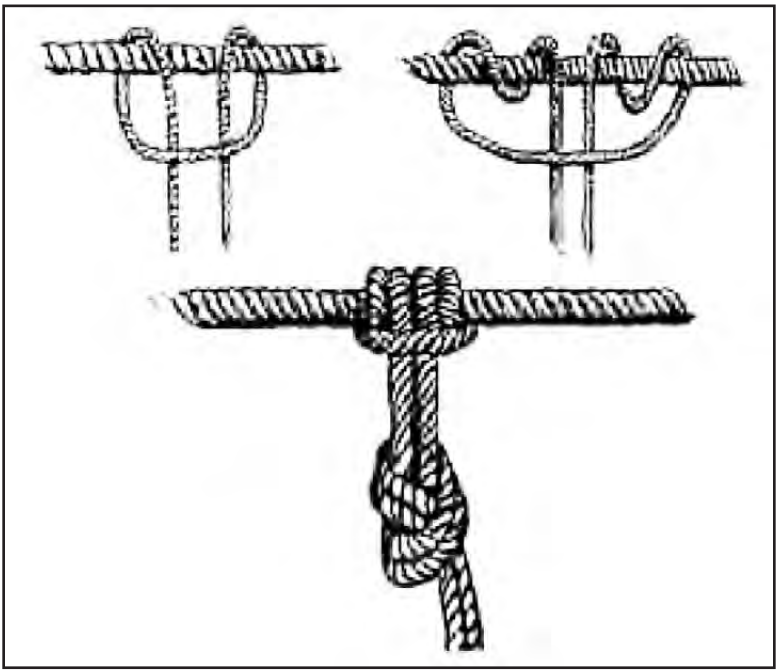


Figure 6-8. Middle-of-the-rope prusik

Square knot (see Figure 6-9). This joins two ropes of equal diameter: two interlocking bites, running ends exit on same side of standing portion of rope. Each tail is secured with an overhand knot on the standing end. When you dress the knot, leave at least a 4-inch tail on the working end.

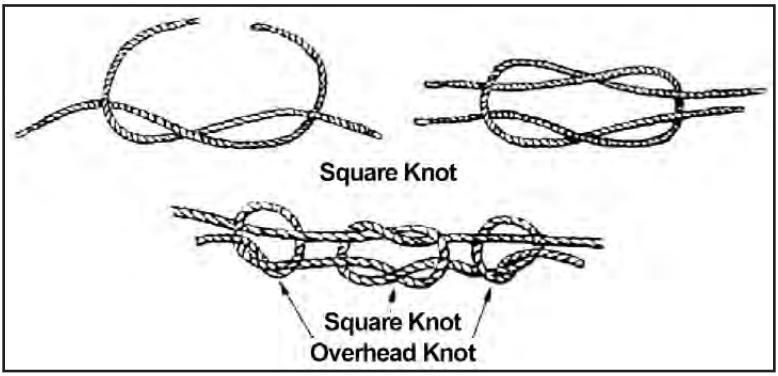


Figure 6-9. Square knot

Rappel seat (see Figure 6-10). The rappel seat is an improvised seat/rappel harness made of rope and used in rappelling and climbing. It usually requires a sling rope 14 feet or longer.

Tying the rappel seat:

- Step 1. Find the middle of the sling rope and make a bight.
- Step 2. Decide which hand will be used as the brake hand and place the bight on the opposite hip.
- Step 3. Reach around behind and grab a single strand of rope. Bring it around the waist to the front and tie two overhands on the other strand of rope, thus creating a loop around the waist.
- Step 4. Pass the two ends between the legs, ensuring they do not cross.
- Step 5. Pass the two ends up under the loop around the waist, bisecting the pocket flaps on the trousers. Pull up on the ropes, tightening the seat.
- Step 6. From rear to front, pass the two ends through the leg loops creating a half hitch on both hips.
- Step 7. Bring the longer of the two ends across the front to the nonbrake hand hip and secure the two ends with a square knot safe tied with overhand knots. Tuck any excess rope in the pocket below the square knot.

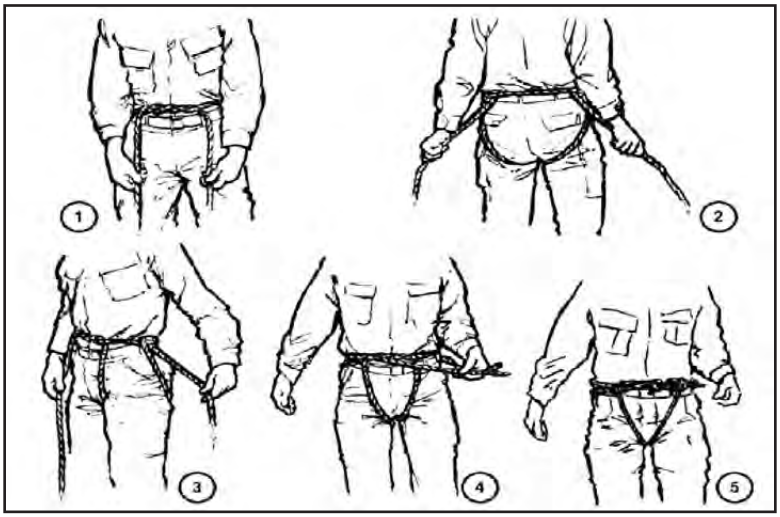


Figure 6-10. Rappel Seat

- The rappel seat can be tied for use with the left or right hand (Step 1).
- Leg straps do not cross, and centered on buttocks and tight (Step 2).
- Leg straps form locking half hitches on rope around waist. Square knot properly tied on right hip (Step 3) and finished with two overhand knots.
- Tails must be even, within 6 inches (Step 4).
- Insert a carabiner properly around all ropes, with opening gate opening up and away (Step 5). Carabiner will not come in contact with square knot or overhand knot.
- Rappel seat is tight enough when a fist cannot be inserted between the rappeller's body and the harness.

Anchors

Whether ascending, descending, hauling, hoisting, or lowering, a working knowledge of anchors is required to be successful. Establishing anchors is a core skill for anyone who plans to operate in a mountainous area. Anchors can be natural or manmade. Examine every anchor closely and evaluate its worthiness before use.

When choosing anchors, it is important to consider what forces will be applied to the anchor when the point is loaded or, in the case of a fall, "shock loaded." When choosing anchors you must also consider if the primary anchor has a "backup" alternate and tertiary anchor as well. When possible, use redundant and self-sufficient anchors to provide the widest margin of safety. The tactical situation may not allow the use of redundant and independent systems. Leaders will have to evaluate risk to determine if the anchor is used or if alternate course of action determined.

When using natural anchors, you must always be looking and practicing your anchor placement and evaluation skills. Most natural anchors consist of trees, boulders, rock horns and outcroppings, and whatever else nature provides for use in your operation. A skilled mountaineer will try to locate anchors that are not likely to fail and if they do fail, present little subjective danger to others in the climbing team. When anchors are poor quality such as a tree with a shallow root system, climbers should place additional anchors close together to mitigate the potential hazards associated with the weak or less than optimal anchor point. Natural anchor points may also be deceiving, and a rock horn that appears to be sturdy and suitable can crack off due to the effects of weather, rock composition, fracturing, and a variety of other reasons.

Manmade anchors (Figure 6-11) are typically easier to evaluate but often unavailable in the location of the operation. Vehicles may provide an excellent and movable anchor point in many situations. Ensure vehicle attachment points are load bearing and redundant. Manmade anchors, such as a deadman and pickets, offer a good option when the conditions and soil type are suitable. Easiest to use of the manmade anchors are camming devices, chocks, stoppers, and an assortment of devices designed to fit into a crack and protect mountaineers in one or more directions. Some artificial anchors such as a chock may provide adequate protection in a downward direction but no protection for an upward pull. Mountaineers must evaluate forces, pulls, friction, and drag placed on anchors and anticipate this during placement. More than one artificial anchor may be required to ensure protection (anchors) stay in the intended position as climbers move above and below the anchor point.

A few rules to remember with respect to anchor points are:

- Use more than a single anchor point when possible.
- Anchors should be redundant and self-sufficient when possible.
- Attach hardware, ropes, and slings as low as possible to anchors.
- Consider the implications of failure and mitigate effects with placement.
- Rig anchors so points are not shock loaded if an anchor fails; avoid slack between points.
- Test anchors before use when the tactical situation allows.
- Continually inspect anchors.
- Pad sharp edges and protect ropes and hardware from damage.
- Use slings, runners, or webbing to "straighten the lane," thus reducing friction and unnecessary drag on the rope.
- A chock pick (anchor removal tool) may be required, especially if anchors are shock loaded in a fall.

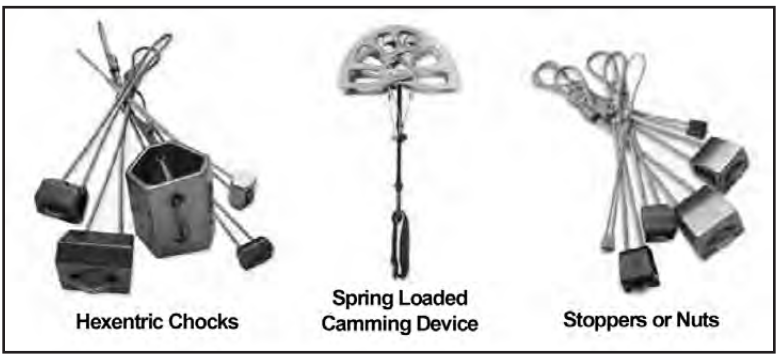


Figure 6-11. Anchors/spring-loaded camming device

Rock projections often provide suitable protection. These include blocks, flakes, horns, and spikes. If rock projections are used, their firmness is important. Check rock projections for cracks or weathering that may impair their strength. Avoid using the projection as an anchor if any of these signs exist.

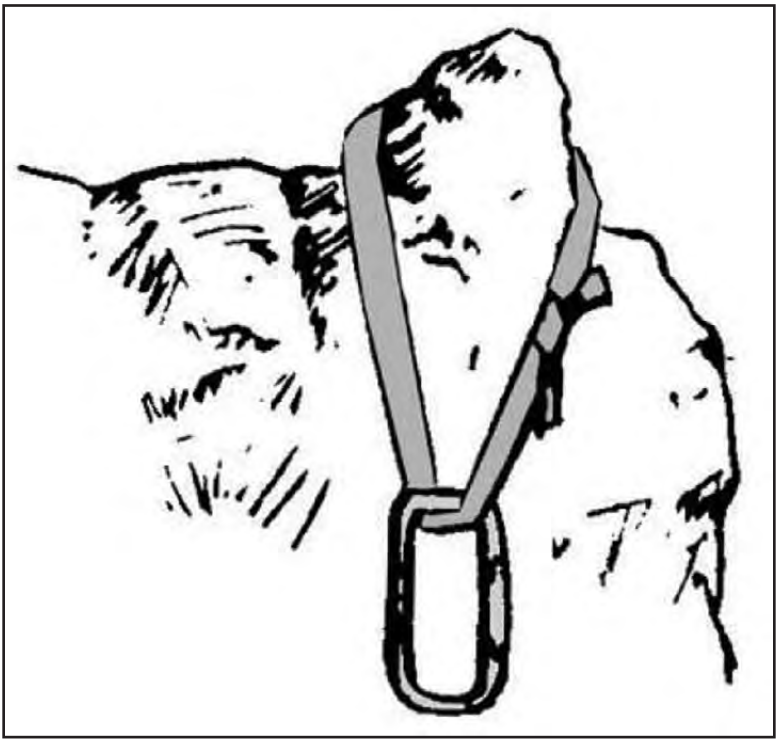


Figure 6-12. Rock projection

Trees (see Figure 6-13) are the most widely used of all natural anchors. Check trees carefully for suitability:

- In rocky terrain, trees have a very shallow root system. Pushing or tugging on the tree to see how well it is rooted can check this. Anchor low to prevent excess mechanical leverage on the tree.
- Use padding on soft, sap-producing trees to keep sap off ropes and slings.

Figure 6-13 Anchors cord around tree/rock

Belays

Belaying is a method of managing the rope in such a way that, if one person falls, corrective action (belaying) enables the fall to be "arrested" by another rope team member (belayer). One person climbs at a time, while being belayed from above or below by another. The belayer manipulates the rope so that friction, or a "brake," halts a fall. Other uses for belay techniques are to control the descent of personnel and equipment on fixed-rope installations and for additional safety on rappels and stream crossings.

Belaying is a skill that requires practice to develop proficiency. Setting up a belay may appear confusing to the beginner, but with practice, the procedure should become second nature. If confronted with a peculiar problem during the setup of a belay, try to use common sense and apply the basic principles stressed throughout this text. Remember the following key points:

- Select the best possible terrain features for the position and use the terrain to your advantage.
- Use a well-braced sitting position whenever possible.
- Aim and anchor the belay for all possible load directions.

- Follow the "minimum" rule for belay anchors—***two for a downward pull, one for an upward pull.***
- Ensure anchor attachments are aligned, independent, and snug.
- Stack the rope properly.
- Choose a belay technique appropriate for the climbing. Use a guide carabiner for rope control in all body belays.
- Ensure anchor attachments, guide carabiner (if applicable), and rope running to the climber are all on the guide-hand side.
- Keep the brake hand on the rope when belaying.

Sitting Body Belay

The sitting body belay is the preferred position and is usually the most secure (Figure 6-14). The belayer sits facing the direction where the force of a fall will likely come from, using terrain to his advantage, and attempts to brace both feet against the rock to support his position. It is best to sit in a slight depression, placing the buttocks lower than the feet and straightening the legs for maximum support. When perfectly aligned, the rope running to the climber will pass between the belayer's feet and both legs will equally absorb the force of a fall.

Sometimes the belayer may not be able to sit facing the direction he would like or his feet cannot be braced well. The leg on the guide-hand side should then point toward the load, bracing the foot on the rock when possible. The belayer also can "straddle" a large tree or rock nubbin for support, as long as the object is solid enough to sustain the possible load.

Figure 6-14. Sitting body belay

Standing Body Belay

Use this belay on smaller ledges where there is no room for the belayer to sit. What appears to be an unstable position can actually be quite secure when placements of belay anchors are at or above shoulder height to support the stance when the force will be downward.

For a body belay to work effectively, the belayer must ensure that the rope runs around the hips properly and remains there under load when applying the brake. The rope should run around the narrow portion of the pelvic girdle, just below the bony high points of the hips. If the rope runs too high, the force of a fall could injure the belayer's midsection and lower rib cage. If the rope runs too low, the load may pull the rope below the buttocks, dumping the belayer out of position. It also is possible for a strong upward or downward pull to strip the rope away from the belayer, rendering the belay useless (Figure 6-15).

To prevent any of these possibilities from happening, clip the belay rope into a carabiner attached to the guide-hand side of the seat harness (or bowline on a coil). This "guide carabiner" helps keep the rope in place around the hips and prevents loss of control in upward or downward loads.

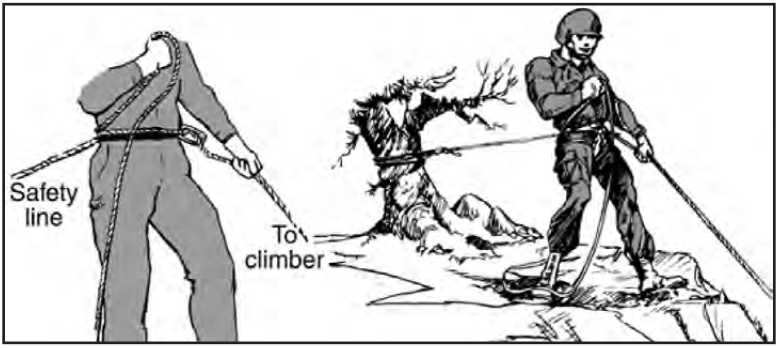


Figure 6-15. (Left) Guide carabiner for rope control in a body belay/ (Right) standing body belay

Descending

Steep terrain during tactical movement may be impossible to bypass and too steep or difficult to move down without the use of ropes.

Using basic equipment available to the element, descent should be possible using one of the basic techniques. Because the Soldier is unattached to a positive hookup during hasty rappels and body rappels, these can be hazardous, and serious injury could occur if balance or control of the rope is lost. A squad sling also is a fast and effective way to move individuals and teams down and requires little training. A squad sling generally consists of a section of tubular nylon with a sewn loop in each end. Rapidly anchor these slings to allow untrained troops the ability to grab the sling and use friction and balance to lower themselves, or ascend, when required, over terrain that is treacherous, slippery, or difficult to get over. Of course, adequate natural anchor points such as a tree, rock horn, etc. must be available to anchor the rope or sling before descent or ascent.

Conditions and severity of the terrain may dictate a more deliberate means of rappelling. Soldiers should train and periodically practice rappelling using one or more of the three recommended techniques shown here.

Hasty Body Rappel (Figure 6-16)

Use the hasty rappel only on moderate pitches. Its main advantage is that it is easier and faster than other methods. Wear gloves to prevent rope burns.

- Step 1: Facing slightly sideways to the anchor, the rappeller places the ropes horizontally across his back. The hand nearest to the anchor is his guide hand and the other is the brake hand.
- Step 2: To stop, the rappeller brings his brake hand across in front of his body, locking the rope. At the same time, he turns to face up toward the anchor point.

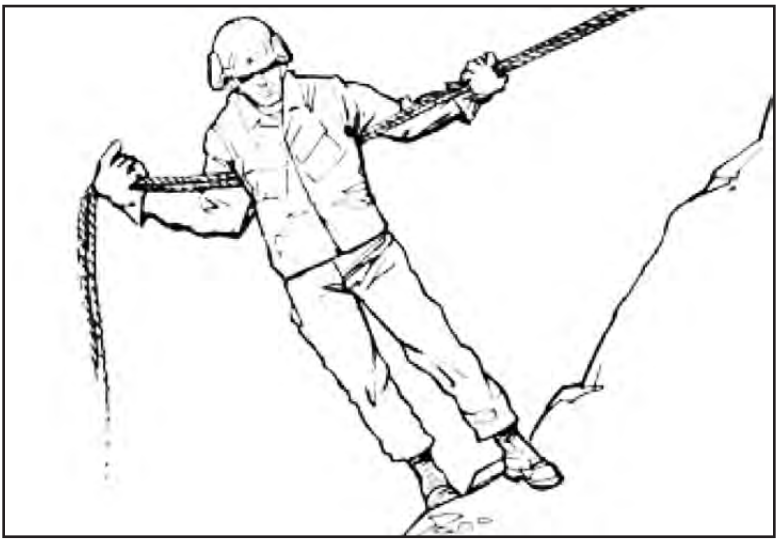


Figure 6-16. Hasty body rappel

Body Rappel (Figure 6-17)

Turn up the uniform collar to prevent rope burns on the neck. Wear gloves to prevent rope burns and other clothing to pad the shoulders and buttocks.

- Step 1: Face the anchor point and straddle the rope.
- Step 2: Pull the rope from behind, run it around either hip, diagonally across the chest, and back over the opposite shoulder.
- Step 3: The rope then runs to the brake hand, which is on the same side of the hip that the rope crosses (for example, the right hip to the left shoulder to the right hand).
- Step 4: Lead with the brake hand down, face slightly sideways. The foot corresponding to the brake hand precedes the guide hand at all times.

- Step 5: Keep the guide hand on the rope above to guide—not to brake.
- Step 6: Lean out at a sharp angle to the rock.
- Step 7: Keep legs spread well apart and relatively straight for lateral stability, and keep back straight to reduce friction.
- Step 8: To brake, lean back and face directly toward the rock area; feet should be horizontal to the ground.

Note: Do not use hasty rappels and body rappels on pitches that have overhangs. Feet must maintain surface contact.

Note: Hasty rappels and body rappels are not belayed from below.

Figure 6-17 Body rappel

Seat-Hip Rappel

The seat-hip rappel (Figure 6-18) differs from the body rappel in that the friction is absorbed by a carabiner that is inserted in a sling rope seat and fastened to the rappeller. This method provides a faster and more frictional descent than other methods. Wear gloves to prevent rope burns.

An alternate technique is to insert two carabiners opposite and opposed. Then insert a locking carabiner into the two carabiners with opening gate on the brake-hand side. Then run the rope through the single carabiner. This helps to keep the rappel rope away from the harness.

- Step 1: To hook up for the seat-hip method, stand to one side of the rope. If using a right-hand brake, stand to the left of the rappel rope facing the anchor; if using a left-hand brake, stand to the right of the rappel rope. Place the rappel rope(s) into the locking carabiner; slack is taken between the locking carabiner and anchor point and wrapped around the shaft of the locking carabiner and placed into the gate so that a round turn is made around the shaft of the locking carabiner (Figure 6-18). Pull any remaining slack toward the uphill anchor point.
- Step 2: If a single rope is used, repeat step 1 to place two round turns around the shaft of the locking carabiner. Face the anchor point and descend using the upper hand as the guide and the lower hand as the brake. This method has minimal friction and is fast and safe. Take care to hook the rope correctly into the carabiner to avoid the rope opening the gate. Loose clothing or equipment around the waist may accidentally be pulled into the locking carabiner and lock (stop) the rappel. For this reason, the rappeller must tuck in his shirt and keep his equipment out of the way during his descent.

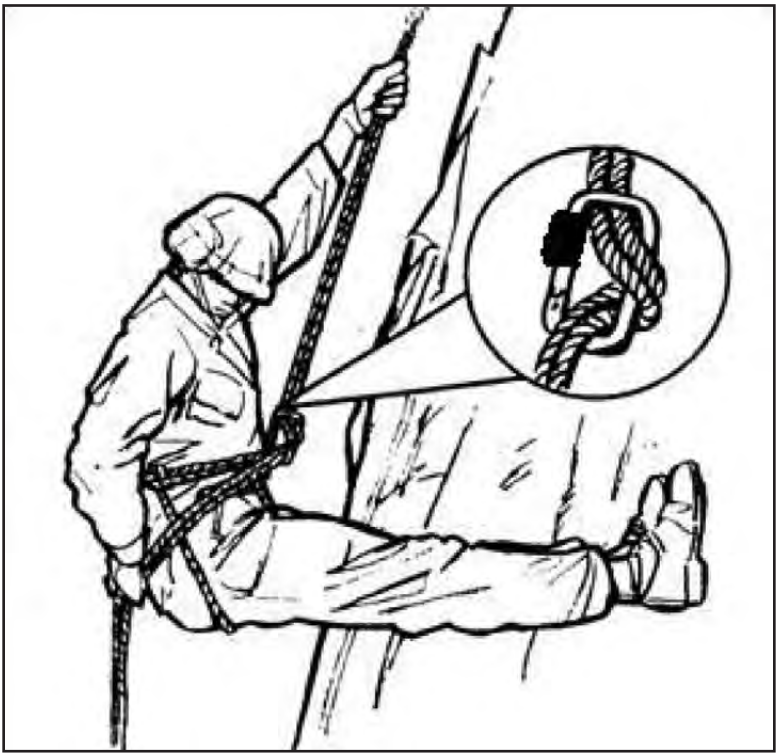


Figure 6-18. Seat hip rappel

When first descents require a rappeller to go down a line that has no safety or belay person on the bottom, a technique that ensures the safest execution is using an autoblock that offers the greatest amount of control and is an exceptionally effective technique for descending when both hands may be needed to complete other tasks. The autoblock can also be used in conjunction with most belay and rappel devices with few modifications.

Autoblock (see Figure 6-19) is used to attach a moveable piece of rope or webbing to a fixed rope that is easy to release under tension. It requires the rappeller to be hooked up with a one of the following (ATC, figure 8, or locking carabiner), and the autoblock is situated on the brake hand side below the device. The rappeller must continually mind the wraps that are secured to the harness via the locking carabiner. Auto-block requires a minimum of four turns. Ensure your practice and rehearse use before attempting tactical use.

Figure 6-19 Autoblock

Ascending

Ascending is perhaps the most difficult action performed by the mountain team. While a climb up a shallow ravine or small cliff scattered with handholds can be accomplished with little or no equipment, more complex ascents require additional equipment, planning, rehearsals, and a deliberate plan to achieve success. Trained teams may go ahead of the main body and install anchors and lanes for negotiation of more complex terrain. A simple fixed rope is little more than a hand line and could suffice in assisting elements overcome an obstacle that makes movement difficult but is not so steep so that an unanchored fall by a team member would result in serious injury. More permanent fixed lines may be installed to aid troops on terrain where a fall would likely result in injury or death. These lines require each Soldier to attach himself to the line by the use of safety line. This safety line should be capable of passing anchors and have either carabiners or ascenders attached to the end of the rope. Typically a carabiner is sufficient for most fixed rope ascents, with the exception of a sheer vertical line where ascenders are required.

Use of ascenders for a vertical ascent is a complex operation and must be rehearsed before attempting on an actual operation. When ascenders are not available, a prusik knot may be used but is even more difficult to use without the mechanical advantage afforded by an ascender.

Basic Installations

With a few basic installations, a unit can use ropes to traverse horizontal obstacles found in a mountain environment or wherever these exist, including urban areas. A few basic installations may provide a base to

expand your expertise and to develop new techniques to assist in mission accomplishment. It may be necessary to place a taught rope over a crevasse, canyon, or water obstacle, or from one elevated area to a higher or lower area in urban terrain.

Transport Tightening System

Using a transport tightening system to secure a rope that can span the obstacle provides a ready means to move Soldiers and equipment across impediments commonly found in mountainous terrain.

A simple transport tightening system allows a tightening of a rope using the mechanical advantage gained by placing a fixed loop in the rope with a carabiner installed (Figure 6-20). The running end of the rope is passed through the carabiner and a pull team assembled to apply tension before tying the installation off for use.

The far side is secured using a tensionless anchor that allows the rope to be dispersed on numerous wraps around an anchor point, preventing a situation where a tightened rope may be difficult to untie once the installation has been placed under pressure (Figure 6-21). Some people refer to this as a "rope bridge," as it is often used to cross water obstacles for dismounted elements.

The tension on the installation can vary depending on how it will be used. It may be little more than a hand line to guide Soldiers across a difficult area, or it could be pulled taut and used to haul personnel and equipment up or down a horizontal or slightly vertical obstacle. This installation should be rehearsed prior to use, and anchors must be closely evaluated to ensure they will accommodate the intended load and pressure applied by the tightening team.

Fig 6-20. Transport tightening system

Figure 6-21. Tensionless anchor

Hauling-Z Pulley System

In vertical terrain, hauling a load is often necessary. The load may be logistics supplies, a wounded Soldier, crew-served weapons, or other heavy and cumbersome items. Haul systems may be required to move the load horizontally or vertically and can be set up quickly with basic equipment (Figure 6-22). The installation leader should ensure his anchor(s) will adequately support the load and then maximize the elected site. When terrain and areas are restrictive due to cover, space availability and other factors, placement and sit location must be carefully considered.

To construct the z pulley, simply construct an adequate anchor point and install a carabiner. Route the haul rope that is attached to the load through the carabiner and form the rope into a "z," running it back to the haul rope forward of the anchor. Using a prusik knot and a fixed loop, attach the haul rope to the "z" formed in the line thus gaining a mechanical advantage used to assist in moving the load. A final step in setup is to attach a second prusik with fixed loop to the haul rope at the anchor point. This knot is for safety and must be monitored to allow the haul rope to be pulled freely. This second prusik acts as a safety in case the haul team has to release its pull on the load rope due to any number of circumstances, including enemy fire that causes the team to seek cover.

The rope is pulled by a haul team consisting of a few Soldiers until the forward prusik reaches the anchor. The safety prusik is then set to allow the forward prusik to be moved forward to again gain a new purchase on the rope. The process continues until the load is at the desired location. This is a deliberate and safe way to move a load and can be controlled easily. The size of the area available for work and the length of the rope determine how much can be gained with each pull from the team. Confined spaces present additional challenges. Team members working near the edges must be properly anchored.

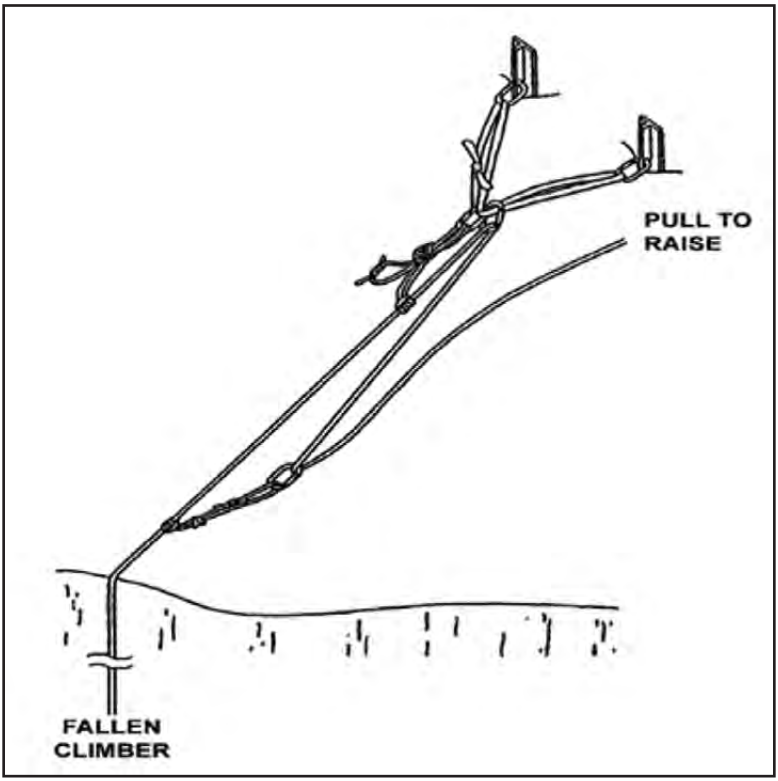


Figure 6-22. Z pulley system

Lowering-Munter Hitch

When loads need to be lowered in a controlled manner, you can use a simple system consisting of a munter hitch to allow the load to move from a higher to lower area with ease and control (Figure 6-23). After establishing a suitable anchor point, you place two carabiners (preferably lockers) into your anchor point. Using a munter hitch on the lowering line containing the load, establish a belay position in close proximity to the anchor point. Using a sling rope and prusik note, attach this to the load rope below the anchor point. This prusik acts as a safety should the belayer fail or the need occurs for the load to stop in mid-descent. The prusik must be monitored at all times to allow the load rope to feed freely through the prusik knot. A second individual is typically used to manage the prusik so the belay man can concentrate on a single duty.

Where more control is needed, additional belay positions can be established using one or more ropes. Another option is to establish a rappel lane allowing a Soldier to control his own descent. An additional belay line can be set up to lower the Soldier in addition to the friction and control provided by his rappelling activities. This is often used where a wide range of work activities (installing anchors, medical care, etc.) must be accomplished during descent.

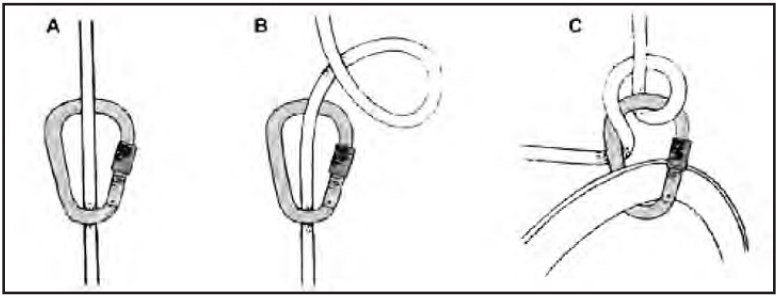


Figure 6-23. Munter hitch

Chapter 7

Mountain Sustainment and Survival

This chapter covers difficulties of sustainment and survival when operating in a mountainous environment. Sustainment in a hostile vertical environment that is subject to sudden and drastic shifts in weather is perhaps the most difficult tactical environment in which to sustain extended operations.

Leaders at every level must ensure proper planning and Soldier discipline in order to be most effective in this environment. The effects of extended mountain operations on individual Soldiers is more than if the same operations were conducted at lower elevations in more forgiving terrain and weather conditions. Enemy combatants may be less of a hazard during extended operations than the physical elements present in a mountain environment. When not used to your advantage, the effects of altitude, weather, terrain, and individual health and fitness level can cripple operations.

Acclimatization of Personnel

The immediate effect of high altitude on personnel is increased breathing and heart rate. This contributes to a perceived increase in exertion and shortness of breath. In simple terms, each breath an individual takes at a high altitude has less oxygen in it than at a low altitude. The reduction in available oxygen decreases a Soldier's ability to adequately function. Tasks requiring moderate to high exertion for several minutes or longer become harder to sustain and fatigue develops more quickly. Recovery from physical fatigue is slower. At altitudes above 3,000 meters (10,000 feet), vision and judgment are impaired and sleep becomes irregular. Over some period an individual can improve function by becoming "acclimatized" to the environment. Acclimatization allows for extended operations at high altitudes. While all Soldiers should maintain a high standard of physical readiness and conditioning, troops scheduled to conduct operations at high altitudes should endure an acclimatization process in order to be effective and help prevent associated high altitude injuries. Mountain-warfare training is not a substitute for the acclimatization process. While stateside acclimatization is possible, de-acclimatization is likely if transport times to theater exceed more than a few days and troops must acclimate in theater.

Acclimatization is required before undertaking extensive military operations. The expectation that freshly deployed troops can go immediately into action is unrealistic and could be dangerous. Even the most physically ready Soldier experiences physiological and psychological degradation when thrust into high elevations. Time should be allocated for acclimatization, conditioning, and training of Soldiers. There is

no shortcut for the acclimatization process, and any attempt to trim or bypass the process usually results in personnel injuries. The duration of the acclimatization process depends on the altitude at which the unit must operate. Troops continue to train during the acclimatization process. Components of the acclimatization process and training include crossing crevasses, route marches, weapons firing, and rock climbing.

As a general rule, most Soldiers can operate in mountains up to 2,400 meters (8,000 feet) with minimal effects; others may take more time to compensate. Acclimatization for mountain operations between 2,400 and 4,200 meters (8,000 and 13,800 feet) usually takes one or two weeks on average, and for operations above 4,200 meters another two weeks is recommended. Acclimatization for higher altitudes (above 5,200 meters [7,000 feet]) is lengthy and rigid and cannot be shortened without serious consequences.

Soldier's Load

Soldier's load is a leadership responsibility regardless of the operating environment. Mountain terrain taxes Soldiers' strength and tests their endurance even more, making the scrutiny of Soldier load even tighter. The leader's involvement in analyzing the Soldier's load and the level of risk involved is the key to determining what is mission essential.

Each mission requires an analysis of the essential items that are necessary for survival and combat operations, including environment, weather, mission purpose and duration, Soldier requirements prior to initiating the mission, and definitive items that compose the Soldier's load. Combat loads in the mountains tend to be stripped as much as possible. Decisions on items such as the amount of food and water taken as well as the configuration of body armor should be determined in cutting weight from the combat load. Inexperienced or new Soldiers to mountain operations may attempt to pack and carry more equipment than needed, increasing the physical strain on their body and exhausting them more quickly. This not only impacts individual performance but also unit performance as well.

Even though conditions experienced during mountain operations are more difficult than in more forgiving terrain and climate conditions, Soldiers are often required to increase their load as opposed to decrease it. The fighting capability of an infantry Soldier is directly related to his load. There is a maximum individual load limit that cannot safely be exceeded if an infantry Soldier is expected to accomplish his combat mission. Overloading the Soldier can expose him to extreme risk. Unit standing operating procedures (SOPs) should dictate what is carried on combat operations and enforce those limits.

Mountain terrain is usually rocky, making it easy to twist an ankle or otherwise have a minor to moderate lower body injury. Soldiers carrying heavy loads are at a greater risk for these injuries. Injuries tend to increase in the winter due to the water, snow, and ice.

The weight a Soldier can carry is based on his weight, the climate, the terrain, and the stress he has faced or is currently facing. Heavy loads, mountain terrain, high altitude, and extremely hot or cold weather combine to sap a Soldier's strength. For planning purposes, the fighting load for a properly conditioned Soldier should not exceed 48 pounds, and the approach-march load should not exceed 72 pounds, including all clothing and equipment either worn or carried.

Even in the most benevolent terrain, fatigue can become an issue. With rough mountain terrain and bad weather, the effects of fatigue multiply exponentially. Without proper rest, fatigue can greatly reduce the effectiveness of an otherwise highly trained unit. While season, climate, and weather conditions impact on items carried in mountain operations, Soldiers should be equipped for the sudden weather changes characteristic of mountain environments.

While assault packs vary by role or function within the unit, leaders determine their exact contents. To assist in managing Soldier load, leaders may consider using the acronym **DROP:**

D – Decide mobility level.

R – Reduce unnecessary gear.

O – Organize resupply methods.

P – Police the ranks (inspect).

Resupply Considerations

Logistics estimates and loads should be planned and customized for the mountain environment, specific locations, and unique conditions. For example, using pack animals requires that loads be broken up according to their carrying capacity.

Mountain weather and terrain slow and complicate all actions, including resupply of ammunition and sustainment items. Supplies are often stored at a forward base in prepared packages of anticipated unit needs. Overages should be built into supply estimates because there is usually a need for a large reserve of items that wear out quickly, such as boots, jackets, and gloves. Contingency plans for additional supplies should be made, including a means for purifying mountain spring or stream water if needed.

A variety of transport means are often required for logistical support. Vehicles are not always available in the mountains to carry ammunition, food, and equipment, but should be considered for use whenever practical. Road transport is often the most reliable. The road network in the mountains is generally a logistician's nightmare. Main supply routes in many areas are generally limited and often do not support vehicles that have a large turning radius. Roads often do not permit two-way traffic. While tactical plans take into account main roads, tactical engagements often occur away from these routes.

At higher altitudes where vehicles cannot be used due to climate and terrain conditions, pack animals may be used for transport of heavy logistical items. Sleds, mules, and horses, in addition to vehicles when possible, are a common site for mountain movement of supplies.

When the conditions get too rough for even the animals, Soldiers must rely on themselves, local personnel, and air-delivered supplies for logistical support. Due to the increased complexity and difficulty in their delivery to a final destination, logistical resupply items are generally pushed as far forward as possible when operating in mountain environments.

Movement of supplies

Movement of supplies for mountain operations is accomplished using one of four means. These include movement by air, vehicle, foot, or animal. Logistical movements down to the end user usually include a combination of movement types. For example, vehicles may transport supplies as far as possible into the mountains and then be carried by foot or animal to their final destination. Helicopters can transport supplies to remote, hard-to-reach locations but can be constrained by altitude and harsh weather. Since air assets are limited in number, in high demand, and cannot be used in extreme adverse weather, a mixture of resources is necessary to ensure reliability and flexibility. Porters are local personnel capable of carrying heavy loads across difficult terrain and may be contracted for use. The following means of transportation may be considered for use in mountain environments.

Foot

The preferred method of transportation of supplies is by any means other than on the backs of Soldiers. Even so, mission, enemy, terrain and weather, troops and support available, time available, and civil considerations conditions often dictate that Soldiers carry all the supplies needed for a particular mission. Litters may be used to help move supplies and equipment while traveling on foot. A litter can help Soldiers move heavier items (such as mortar rounds) through difficult areas and rough terrain. Litters can also be used in conjunction with ropes and pulleys to haul supplies up or down steep slopes.

Contract local personnel may also be available to assist in carrying supplies by foot. If available, these personnel can be used to carry excess supplies up to a particular point and then released. Supplies can also be stored in a cache for later use.

Vehicle

An analysis of mission needs versus transport time, cost, and asset availability often makes movement by vehicle the preferred method of transport. Vehicles may include military vehicles as well as nonstandard tactical vehicles, trucks, cars, four-wheel drive all-terrain vehicles, motorcycles, or other motorized means of transportation. Contract host nation vehicles may also be used for ground transportation movement of supplies in the mountains.

Resupply vehicle convoys are often the target of enemy ambushes. Unprotected convoys can fall into the hands of the enemy, not only depriving friendly forces of the items and straining the logistical system, but also assisting the enemy with compromised ammunition or supplies.

Air

Aerial resupply has become the lifeline of elements operating in mountainous terrain in Afghanistan. The helicopter can provide troop lift, fires, medical evacuation, and resupply to American forces. Effective use of helicopters to conduct resupply operations requires careful thought by planners and risk mitigation by elements on the ground. Ideally, landing zones where cargo and utility helicopters can land are desired. In mountainous terrain, this is the exception rather than the rule.

Movement of supplies by air is often the preferred method for remote, hard-to-reach locations when assets are available and the weather, terrain, and situation allow. Direct communication between the unit and the air delivery asset should be allowed and coordinated to help ensure proper delivery. Supplies transported by aircraft are often configured by unit SOP and the actual drop off of packages from the aircraft accomplished in a variety of ways.

An air drop of supplies in mountain terrain can quickly and easily turn into a resupply nightmare if not well coordinated. Supplies dropped to an area near the actual designated location can mean the difference between an easy, difficult, or a nonrecovery of the supplies. Delivered packages can easily slide down a mountainside, slip off into a deep ravine, or disappear into deep snow if not placed properly. It is often difficult for pilots to identify

and place packages at a precise location in the mountains if they are not in direct communication with the receiving unit.

Air delivery systems are extensively used for resupply in mountain terrain. Deliveries to larger units may be conducted using containerized delivery systems dropped from higher altitudes using parachutes for lowering the supplies. For small-unit operations, air delivered supplies are packaged in smaller bundles and delivered through a variety of methods. Delivery platforms may be U.S. aircraft or the aircraft of other nations. Contract aircraft from host nation or other sources are also used for delivery of supplies. Leaders need to keep in mind that direct communication with host nation aircraft may be difficult or impossible and delivery procedures may not always be what the receiving unit is expecting.

Resupply by helicopter may require loads to be kicked out because suitable landing zones may not be available or too dangerous to stop movement and land in. Careful planning before operations will ensure units can be adequately supplied in an effective manner as supplies are depleted.

Units should consider the following when planning for aerial resupply:

- Established SOPs assist units in contact with rapid resupply.
- Plan for landing and "kick out" to build flexibility into your plan.
- Bundles or "speed balls" should be cross loaded with water, ammo, medical and food items and should be built before infiltration of the element.
- Bundles can be placed inside body bags or other durable containers, but should include an inventory clearly recorded to ensure the proper supplies reach the intended elements.
- Do not fill body bags to capacity; Soldiers on the landing zone may have to retrieve under fire.
- Durable containers (rucksacks, duffels, body bags) can be preloaded but should not be too heavy for movement. Just because you have space does not mean you need to fill the container to maximum capacity.
- Ball ammunition should be loaded into magazines and placed inside bandoliers, then taped together.
- Leave squad automatic weapon (M249) ammo and 7.62 linked ammo inside the bandoleer for ease of movement.

- Medical items placed into speedballs should be from an established SOP.
- A "single serving" medical kit can be vacuum sealed and should include one combat gauze, one ACE bandage, one decompression kit, two tourniquets, two chest seals, and two Kerlix rolls.
- If a vacuum sealer is not available, place medical items inside a sturdy Zip-lock bag.
- Batteries should be placed into 7.62 bandoleers or similar containers that allow them to be easily carried.
- Meals, ready to eat (MREs) should be "field stripped" to reduce weight in most cases.
- Water must be configured based on containers used. Water bottles should be taped together securely and a handle fashioned from 100-mile-per-hour (duct) tape to allow for rapid resupply and movement.
- Duffel bag capacity. Each duffel bag can hold one of the following:
    - Thirty-six MREs (approximate weight 66 pounds).
    - Three cases of 5.56, linked ammo in plastic drums (approximate weight 225 pounds).
    - Three cases of 7.62, (8) 100-round boxes per sandbag (approximate weight 225 pounds).
    - Three cases of 5.56 packed by bandoleer (approximate weight 200 pounds).
    - Seventy one-liter water bottles (approximate weight 152 pounds).

In summary, aerial resupply provides the commander with ability to decrease the need for vehicle-based logistics packages in an austere environment. This reduces the potential for loss of life. The method of aerial resupply is based on the resources available, aircraft, and type of material to be resupplied.

Individual Survival

A mindset that incorporates the disciplines of shooting, movement, communication, and medical care will help Soldiers achieve effectiveness against enemies in a mountainous environment. There are times when the basics of survival overshadow the need to pursue and engage enemy forces. Survival may be an individual task or a group endeavor, depending on the

situation. The ever-present enemy in the mountains is acclimated to the environment, views survival as a lower priority, and is focused on combat operations. Preparation for any situation is the key for survival. Extreme weather conditions may cause Soldiers to focus more on survival essentials, concentrating more effort on "surviving" against the elements so that they can live to fight the human enemy on another day.

Survival essentials are water, shelter, and food. There are many variables, but these constitute the "absolutes." In a mountainous environment, survival is limited to a few hours without shelter. The average Soldier can go for hours or days without water, he may go for days or a week or more without food, but in extreme weather without shelter and protection from the elements, he may not survive more than a few hours. Priority must be given to the essential elements and the environment to determine which tasks are required to sustain life. All of this must be done while constantly considering the presence and actions of enemy forces.

Survival

With training, equipment, and the will to survive, you will find that you are able to overcome any obstacles you may face, even those in a mountainous environment. You will survive. You must understand the emotional states associated with survival, such as "knowing thyself," which is extremely important in a survival situation. It has direct bearing on coping with serious stresses like anxiety, pain, injury, illness, cold, heat, thirst, hunger, fatigue, sleep deprivation, boredom, loneliness, and isolation. These principles are critical to overcoming the altitude, terrain, and other challenging environmental conditions found in the mountains.

You can overcome and reduce the shock of being isolated behind enemy lines by keeping the key word survival foremost in your minds. Use the **SURVIVAL** letters as a help guide you in your actions:

S: Size up the situation. Size up your surroundings; size up your physical condition; size up your equipment.

U: Undue haste makes waste; do not be too eager to move. Plan your moves.

R: Remember where you are in relation to:

- The location of enemy units and controlled areas.
- The location of friendly units and controlled areas.
- The location of local water sources (this is especially important in the desert).
- Areas that will provide good cover and concealment.

V: Vanquish fear and panic.

I: Improvise; the situation can be improved. Learn to use natural things around you for different needs. Use your imagination.

V: Value staying alive; remember your goal—getting out alive. Stubbornness, a refusal to give in to problems and obstacles that face you, will give you the mental and physical strength to endure.

A: Act like the natives; watch their daily routines: when, where, and how they get their food; where they get their water.

L: Live by your wits. Learn basic skills.

The above information will allow you to make intelligent decisions when you are in a survival/evasion situation.

Water Procurement

Water is one of your most urgent needs in a survival situation. No one can live long without it, especially in hot areas where much water is lost through sweating. Even in cold areas, a minimum of two quarts of water a day is needed to maintain efficiency because more than three-quarters of the human body is composed of fluids. Your body loses fluids as a result of heat, cold, stress, and exertion; these fluids must be replaced for you to function effectively. Fluids are especially important in mountainous environments where an extraordinary amount of exertion and stress occur daily.

One of the first objectives for survival is to obtain an adequate supply of water. Keeping Soldiers hydrated in the mountains is a leadership challenge. The sense of thirst is dulled by high elevations despite the greater threat of dehydration. For extended missions, procuring and treating water from the environment may be necessary to maintain hydration and accomplish missions. Possessing the knowledge and equipment to collect and treat water is a vital part of preventing dehydration and illness while reducing a Soldier's load, allowing increased mobility.

Water Contamination

- **Biological contaminants.** Virtually all surface waters are microbiologically contaminated. There are three types of disease-causing micro-organisms: protozoa, bacteria, and viruses. A 1992 study found that 97 percent of U.S. rivers and lakes contain one or both of the protozoan parasites giardia and cryptosporidium. Since micro-organisms are impossible to see, you are taking a chance of getting sick every time you sip straight from a stream or lake.
    - **Protozoa:** Protozoa are the largest of the waterborne bugs measuring in the one-micron range. Giardia and cryptosporidium

are the most infamous of the group. The infective cysts and oocysts of protozoa are extremely robust and can survive for months in a water source. They thrive in domestic and wild animals as well as humans. Cryptosporidia oocysts are known for their resistance to chemical treatment. Most disinfectants are ineffective, and the few that are effective require long dwell times to do the job.

- **Bacteria:** Bacteria are an order of magnitude smaller than protozoa, measuring in the 0.2-micron range. The most well-known bacteria are E. coli; others include Campylobacter, Salmonella, and Shigella. Bacteria are not as hearty, surviving in water only for weeks instead of months. However, unlike protozoa and viruses, which require a host to multiply, some bacteria can grow in water and so can be found in higher numbers than protozoa and viruses. Bacteria, like protozoa, are often carried by both animals and humans. Because of this, many water sources are contaminated with bacteria. Beware especially of sources near agricultural operations.

- **Viruses:** Some notorious waterborne viruses are poliovirus, hepatitis, and Norwalk. Currently, poliovirus only occurs in a few of the poorest countries. Waterborne viruses are very resilient and can survive for months in water. Viruses are generally species-specific; in other words, those that infect animals do not infect humans and vice versa. Because of this and the well-maintained sewage systems in developed countries, not as many water sources are contaminated with viruses. In developing countries with little or no sewage control, the opposite is true. However, as more and more people head for the great outdoors, more rivers, lakes, and streams are at risk of viral contamination.

- **Chemical contaminants.** Filters and purifiers provide microbiologically safe drinking water. The carbon in the filters and disinfectant of the purifiers will absorb or react with chemical contaminates such as herbicides, pesticides, and volatile organic compounds. However, filters or purifiers will not protect you from high chemical concentrations or heavy metal contamination. Do your best to avoid water sources such as mining tailing ponds or those near agricultural operations.

Water Treatment Techniques

Filters:

Filters work by physically removing infectious agents from the water. The organisms vary tremendously in size, from large parasitic cysts (Giardia

and Entamoeba histolytica 5-30 μm), to smaller bacteria (E. coli 0.5 x 3 μm, Campylobacter 0.2 x 2 μm), to the smallest viruses (0.03 μm). Thus, how well filters work depends largely on the physical size of the pores in the filter medium.

Filters have the advantage of providing immediate access to drinking water without adding an unpleasant taste. However, they suffer from several disadvantages: micro cracks or eroded channels within the filter may allow passage of unfiltered water, they can become contaminated, and no filters sold for field use are fine enough to remove virus particles (Hepatitis A, rotavirus, Norwalk virus, poliovirus, and others). In addition, they are expensive and bulky compared to iodine.

Note: There are many filters on the market. Become familiar with your model and its operation.

Identify water chemical treatments:

Chemical disinfection of water depends on the killing of bacteria, Giardia and amoeba cysts, and viruses by the chemical. Halogens (chlorine and iodine) are most commonly used.

The important points are that the killing effectiveness of the chemical is dependent on concentration of the chemical, temperature of the water, and contact time. Decreased concentration (better flavor) or decreased temperature (inevitably the case in the mountains) requires a longer contact time for disinfection. Sediment (cloudy water) increases the need for halogen. Bear in mind that adding flavor crystals to your water will use up the halogen and should only be done AFTER the recommended contact time for disinfection. Remember: "add flavor later."

- **Chlorine** has been used for several centuries for water disinfection. The most common objection to it is the flavor, though there have been some suggestions that it is unreliable in killing Giardia cysts in the commonly used concentrations.
- **Halazone tablets** are convenient and inexpensive, but have several disadvantages. Due to halazone's chemical formulation, reliable disinfection in all conditions requires six tablets per liter for 1-hour contact, resulting in poor flavor. The tablets rapidly lose effectiveness when exposed to warm, humid air.
- **Iodine** has been used to disinfect water for nearly a century. It has advantages over chlorine in convenience and probably efficacy; many Soldiers find the taste less offensive as well. It appears safe for short and intermediate length use (3-6 months), but questions remain about its safety in long-term usage. It should not be used by persons with allergy to iodine, persons with active thyroid disease, or pregnant

women. If iodine treatment tablets are not available, 10 percent Povidone-Iodine (Betadine) can be used in the concentrations of four drops/liter.

Note: Iodine and other halogens appear to be relatively ineffective at killing cyclospora, a troublesome diarrhea-causing bacteria seen in Nepal only in the late spring and summer months. At these times it may be reasonable to prefilter water to remove the large cyclospora (about the size of Giardia cysts) and then treat with iodine.

Use heat to treat contaminated water:

Heat kills microorganisms, and virtually all enteropathogens are readily killed at temperatures well below the boiling point. The process of heating water to a boil makes it hot enough long enough to disinfect it, even at elevations as high as Everest Base Camp. There is no need to boil water for 5 minutes, 10 minutes, or 20 minutes as some guidebooks recommend. Bringing water to a boil is adequate for disinfection.

Field Expedient Water Sources

From moving water:

Select a site that is not downstream from a settlement or heavily used farmland. Look for the clearest water possible. When operating in a glaciated area, be aware of using glacial runoff, as this can contain very fine silt that will clog filters. Even when treated, sediment will cause you to get sick.

From standing water:

Search for water that is clear and free of sediment and algae. Avoid collecting water from the bottom of this type of site to cut down on the amount of foreign matter in the water.

From snow and ice:

Look for clean white snow. When setting up camp, mark off a place where everyone will collect snow for melting to help avoid accidental contamination of the site. You will still need to bring the water to a boil to purify it because many micro-organisms can survive in a frozen state. Avoid discolored snow that has obvious contaminants—i.e., yellow snow.

Techniques to Avoid Cross Contamination

The collection container needs to be different from the storage container. Cross contamination is a large concern with filters because they only filter the water, not the container. Perform techniques for proper container selection. Storage containers should be clean and tight sealing and able to hold boiling water. You should have enough storage space to hold a day's worth of treated water. Wide-mouth openings are easier to fill with boiling water.

Survival water still

For the below-ground still (Figure 7-1) you will need a digging tool. Select a site where the soil will contain moisture (such as a dry streambed or a spot where rainwater has collected), where the soil is easy to dig, and where sunlight hits most of the day.

Proceed as follows:

- Dig a bowl-shaped hole approximately 3 feet across and 2 feet deep.
- Dig a sump in the center of the hole. The depth and perimeter of the sump will depend on the size of the container that you have to set in it. The bottom of the sump should allow the container to stand upright.
- Anchor the tubing to the bottom of the container by forming a loose overhand knot in the tubing.
- Place the container upright in the sump.
- Extend the unanchored end of the tubing up, over, and beyond the lip of the hole.
- Place plastic sheeting over the hole, covering the edge with soil to hold it in place.
- Place a rock in the center of the plastic.
- Allow the plastic to lower into the hole until it is about 15 inches below ground level. The plastic now forms an inverted cone with the rock at its apex. Make sure that the apex of the cone is directly over your container.
- Ensure that the plastic cone does not touch the sides of the hole because the earth will absorb the condensed water.

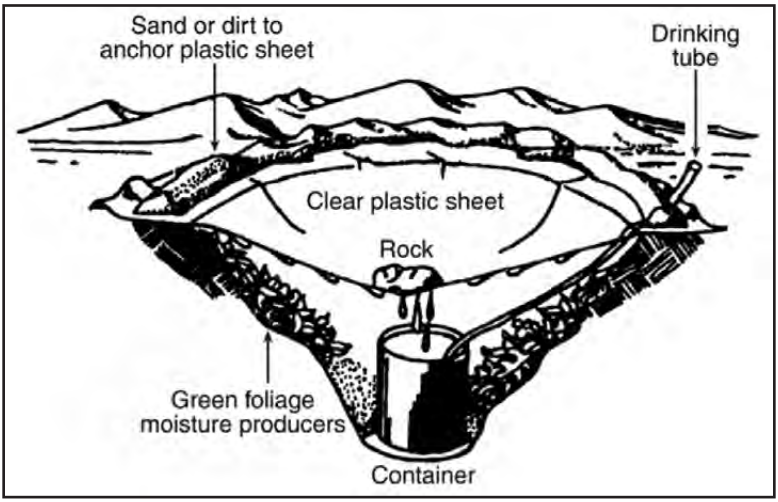


Figure 7-1. Survival water still

Fire Building

A fire can fulfill several needs. It provides warmth and dryness**,** and it can be used to cook food, purify water, and send signals. It also can cause problems when in enemy territory: fire creates smoke seen and smelled from long distances, it generates light that is detectable in day or night, and it leaves signs of occupation. Always remember to weigh the need for a fire against the need to avoid detection by the enemy. When operating in remote areas, always take a supply of matches in a waterproof case and keep them on your person.

When selecting a site to build a fire, consider the following:

- Area (terrain and climate) of operation.
- Material and tools available.
- How much time you have.
- Why you need a fire.
- Nearness of the enemy.

To prepare a site for a fire, look for a dry spot that has the following:

- Protection from the wind.
- Suitable placement in relation to shelter (if any).
- Ability to concentrate heat in a desirable direction.
- Supply of wood or other fire-burning material nearby, if available.

If you are in a wooded or brush-covered area, clear brush away and scrape the surface soil from the selected spot. The cleared circle should be at least 3 feet (1 meter) in diameter so there is little chance of the fire spreading.

Mountain Shelters

Environmental conditions, especially at high altitudes, can change rapidly in the mountains. The ability to seek or build shelter to be protected from the environment may become a survival necessity. Knowing how to construct hasty snow shelters might make the difference between life and death. The temperature inside a snow shelter can be much warmer than the outside temperature, even if the outside temperature is below freezing. The snow cave, lean-to, and fallen tree are three types of hasty shelters, and they are described below.

Snow cave shelter

Step 1: Begin by digging an entrance to crawl through that is large enough for one person. It should be about 3 feet deep and dug directly into the slope. The entrance also should be lower than the main chamber to prevent winds from blowing into the cave (Figure 7-2).

Step 2: Next, dig the main chamber in, upward, and to the sides of the portal. Do not dig down. The outer walls should be no less than 1 foot thick. As you dig, push the snow to the doorway, where another person should help by shoveling that snow outside of the cave. Continue to dig until there is enough room for the number of people in your party to lie down and to sit or stand comfortably. The main chamber should be level and flat (Figure 7-3).

Step 3: After digging the main chamber, create a ventilation hole with an ice axe. After all occupants are inside, place blocks of snow in the doorway to stop wind from blowing inside (Figure 7-4).

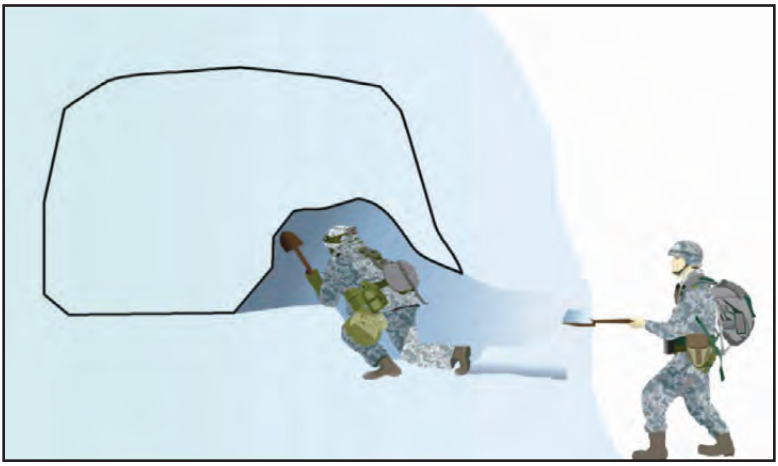


Figure 7-2. Snow cave shelter construction Step 1

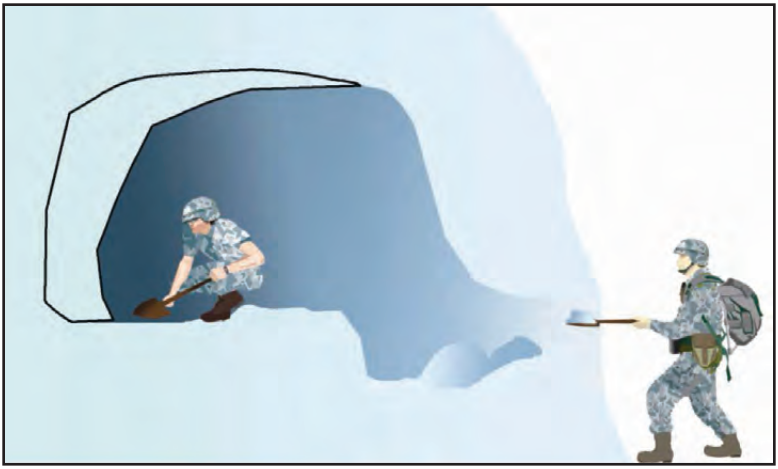


Figure 7-3. Snow cave shelter construction Step 2

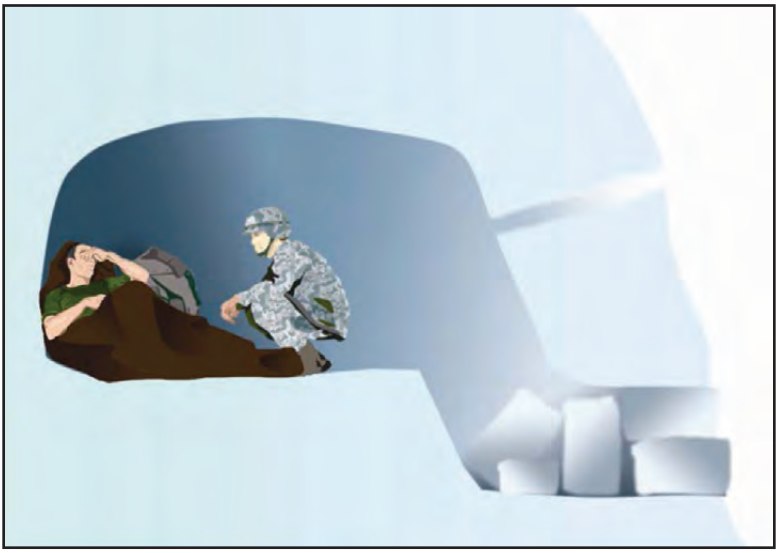


Figure 7-4. Snow cave shelter construction Step 3

Lean-to shelter

Construct a lean-to shelter in a mountainous environment the same way as for other environments; however, pile snow around the sides for insulation. Use ponchos and similar items as field-expedient means to replicate this shelter in alpine areas where vegetation is scarce.

Fallen tree shelter

To build this shelter, find a fallen tree and dig out the snow underneath of it. The snow will not be deep under the tree. If you must remove branches from the inside, use them to line the floor.

Temperature

This section provides information relating to weather and temperature ranges experienced in mountainous environments. Figure 7-5 shows the temperature changes with increased altitude. Figure 7-6 provides data that factors wind chill into air temperature. Wind speed is based on measurements at 33 feet high. If wind speed is measured at ground level, multiply by 1.5 to obtain wind speed at 33 feet in height and then refer to chart.

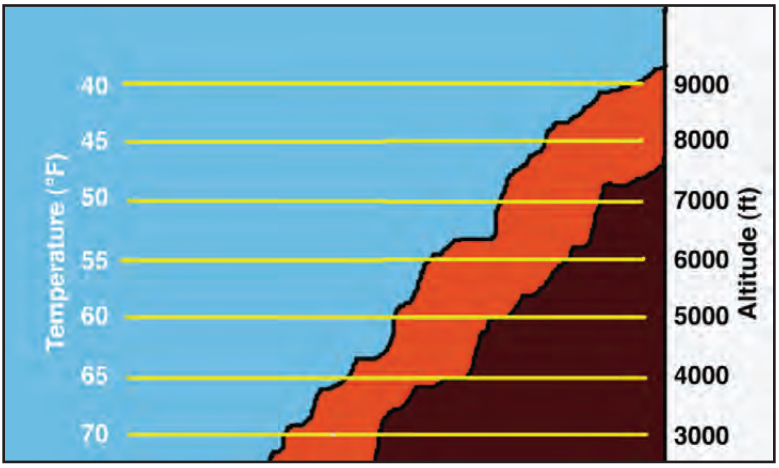


Figure 7-5. Temperature changes with changes in altitude

Air temperature (°F)

Wind speed*	40	35	30	25	20	15	10	5	0	−5	−10	−15	−20	−25	−30	−35	−40	−45
5	36	31	25	19	13	7	1	−5	−11	−16	−22	−28	−34	−40	−46	−52	−57	−63
10	34	27	21	15	9	3	−4	−10	−16	−22	−28	−35	−41	−47	−53	−59	−66	−72
15	32	25	19	13	6	0	−7	−13	−19	−26	−32	−39	−45	−51	−58	−64	−71	−77
20	30	24	17	11	4	−2	−9	−15	−22	−29	−35	−42	−48	−55	−61	−68	−74	−81
25	29	23	16	9	3	−4	−11	−17	−24	−31	−37	−44	−51	−58	−64	−71	−78	−84
30	28	22	15	8	1	−5	−12	−19	−26	−33	−39	−46	−53	−60	−67	−73	−80	−87
35	28	21	14	7	0	−7	−14	−21	−27	−34	−41	−48	−55	−62	−69	−76	−82	−89
40	27	20	13	6	−1	−8	−15	−22	−29	−36	−43	−50	−57	−64	−71	−78	−84	−91
45	26	19	12	5	−2	−9	−16	−23	−30	−37	−44	−51	−58	−65	−72	−79	−86	−93
50	26	19	12	4	−3	−10	−17	−24	−31	−38	−45	−52	−60	−67	−74	−81	−88	−95

*Wind speed is based on measurements at 33 feet high. If wind speed is measured at ground level, multiply by 1.5 to obtain wind speed at 33 feet in height and then refer to chart.

Figure 7-6. Wind chill chart

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Annex A

Field-Expedient Antennas

Field-Expedient Antenna Construction

- To fabricate an expedient antenna, you can use almost any kind of medium-gauge (14- or 16-gauge) insulated wire as an antenna.
    - The calculation for a 1/4-wave-long wire antenna would be 234 divided by frequency in megahertz (MHz). (234/58.00 MHz = 4.03 feet.)
    - An 8-foot wire antenna is good for general communications on frequency modulation (FM)/very high frequency (VHF), 30–88 MHz.
- Cut the wire to the desired length and strip approximately one-fourth inch of insulation off one end. Insert the bare wire into the center connector of the normal antenna connection point. Ensure that the wire does not come into contact with the ground shielding at the antenna connection point.
- Raise the antenna vertically as high as possible, as shown in Figure A.
- If unable to raise the antenna vertically, orient the antenna on the ground with the end pointing in the direction of the receiving station.

Definitions

Knowledge of field-expedient antennas will enable the Soldier to establish lines of communication in mountainous areas with limited vehicle access and where traditional communication equipment cannot feasibly be carried. The types of field-expedient antennas will vary with terrain and mission requirements.

- **Omni-directional.** Radiating energy equally well in all directions, the omni-directional antenna is used when it is necessary to communicate in several separate directions at once. It will also receive in all directions.
- **Bi-directional.** Antennas produce a stronger signal in two favored directions while reducing the signal in other directions. Tactical bi-directional antennas are usually sloping wires and dipoles. They create nulls in the areas not receiving energy. These antennas have to be positioned correctly (by azimuth) in order for them to work.

- **Directional.** Similar to the bi-directional antenna, except it has one of its transmission lobes cut off. Many bi-directional antennas are made directional by the addition of a resistor that sucks up the second lobe.
- **Antenna gain.** Gain is the term used to describe how well an antenna radiates power. It is necessary to know what the gain of an antenna is being compared to before two antennas can be compared. In some cases, an antenna is said to have gain compared to an isotropic antenna and the gain is expressed in decibel isotropic (dBi).
- **Patterns.** Antenna patterns graphically show the radiation for a specific antenna.
- **Insulators.** Insulators prevent the energy being transmitted from the receiver-transmitter (RT) of the radio from escaping out of the end of the wire that you are using as an antenna. If the radio's energy goes out of the end of the wire, your transmission goes nowhere. Tie the end of the wire of the expedient antenna to an insulator and your transmission energy is safe.
- **Resistors.** Resistors make antennas directional and are ideal for expedient antennas. A resistor draws energy from the RT toward it and then shoots it off in the transmission. Ideally, you want a resistor with the wattage of half of the maximum of the radio you are using it on and 600-800 ohm. You can add resistors together to add them together or subtract from each other. Each color band on fabricated resistors represents a certain ohm factor.
- **Grounding.** Grounding performs two functions. First, it provides a path for electrical discharge into the earth to prevent shock to the operator or damage to the equipment. Secondly, it enhances radio signal strength and helps eliminate static. The major consideration for a good ground is the ground stake. A good metal-to-metal connection must be made to complete the path for the ground. Select the ground rod and drive it into the earth. Ensure that there is a bare metal surface to connect the ground strap. Connect the other end of the strap to the ground terminal on the radio to complete the ground path.

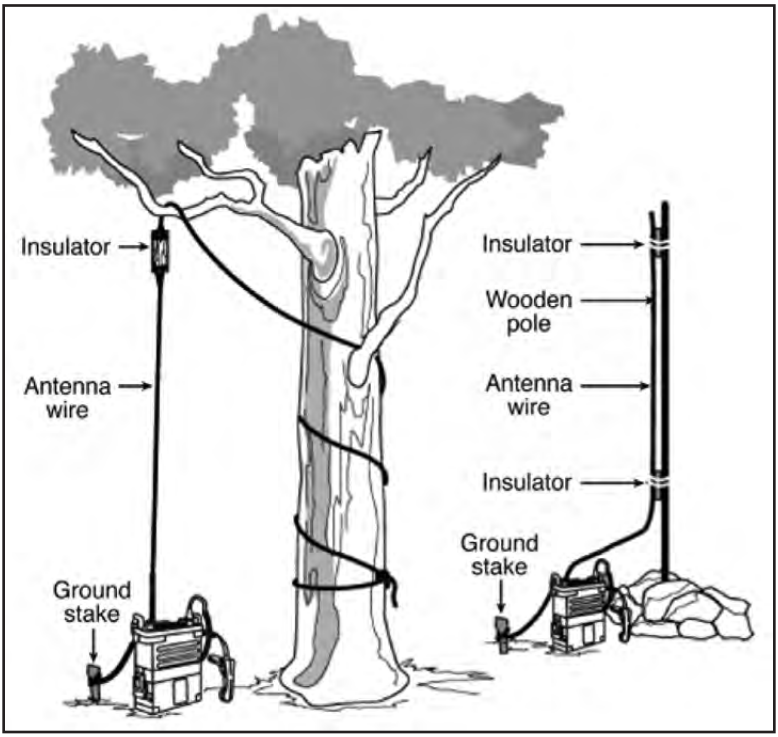

Figure A. Field-expedient antenna construction

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