Army Mountain Warfare School
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Basic Military Mountaineer Course
Student Handout

2018
ARMY MOUNTAIN WARFARE SCHOOL

The proponent for this document is the United States Army Infantry School.

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Soldier's Creed

I am an American Soldier.
I am a Warrior and a member of a team.
I serve the people of the United States and live the Army Values.
I will always place the mission first.
I will never accept defeat.
I will never quit.
I will never leave a fallen comrade.
I am disciplined, physically and mentally tough, trained and proficient in my warrior tasks and drills.
I always maintain my arms, my equipment and myself.
I am an expert and I am a professional.
I stand ready to deploy, engage, and destroy the enemies of the United States of America in close combat.
I am a guardian of freedom and the American way of life.
I am an American Soldier.
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Ram’s Head Device

The Military Mountaineer Badge, commonly known as the Ram’s Head Device, is a representation of a Dall ram head.

In the 1950s, the United States Army Mountain and Cold Weather Training Command at Fort Carson and Camp Hale, Colorado adopted the Ram’s Head Device as the badge worn by their cadre. The badge marked an individual as an expert in mountain warfare.

In 1983, the Vermont Army National Guard Mountain Warfare School was established in Jericho, Vermont. The Ram’s Head Device was adopted as the Military Mountaineer Badge denoting successful completion of the Basic Military Mountaineer Course and awarding of the Skill Qualification Identifier – E “Military Mountaineer.” In 2003 the Mountain Warfare School became the United States Army Mountain Warfare School.

The Army Mountain Warfare School continues to award the Ram’s Head Device to soldiers who complete the Basic Military Mountaineer Course. The Ram’s Head was chosen in recognition of the sacrifices our mountain soldiers made during World War II and the proud tradition of the United States Army’s past mountain warfare training institutions.
Environmental Statement

1) **Responsibility**: It is the responsibility of all Soldiers to protect the environment from damage. Careful planning and preparing for your mission can minimize impact on the environment.

2) **Plan and prepare**: Careful planning can help ensure that impact concerns and safety expectations are met.

3) **Durable Surfaces**: Bivouac and travel on durable surfaces. It is best to use surfaces that are durable or highly resistant to impact. These include rock, sand, gravel, snow, pine needles and leaf litter.
   a) Stay on marked trails unless otherwise directed by an instructor.
   b) Use bridges wherever and whenever possible.
   c) Take rest breaks on durable surfaces.
   d) Ground equipment and eat only in areas designated by the PI.
   e) Avoid fragile areas.
   f) Smoke only in areas designated by an instructor. Police all related refuse.

4) **Avoidance**: Avoid places where impact is just beginning. Use already established well-worn sites.

5) **Reduce Waste**: Pack it in; pack it out. Reducing waste helps prevent animals from becoming habituated to humans and lessens the chances of them becoming nuisances around bivouacs.
   a) Reduce your litter prior to packing it.
   b) Dispose of all waste items in an appropriate manner. If a trash bag is provided, use it. If none is available, pack your trash in your rucksack. Do not attempt to burn or bury trash at any training site.
   c) Properly dispose of what you cannot pack out. Correctly disposing of waste helps prevent pollution of water sources and the spread of illness such as giardia.
   d) Dispose of human waste properly. Use designated latrines only. "Cat Holes" are not authorized.

6) **Leave What You Find**
   a) Avoid damaging trees and plants.
   b) Avoid disturbing wildlife.
   c) Avoid contact with wildlife

7) **Fires**: Minimize use and impact of fires. A fire should be viewed as a tool to be used only when necessary.
   a) Do not start wood fires at any training site unless directed by an instructor.
   b) If authorized, make your fire small and safe.
SECTION I: MOUNTAINEERING

Chapter 1. Characteristics of Mountain Terrain

1) Introduction: Operating in the mountains exposes Soldiers to some of the most unforgiving terrain on the face of the planet. Moving across glaciers, cliffs, ravines and other dangerous obstacles can easily lead to casualties and mission failure for the unprepared. Having the ability to identify various types of mountain terrain and the associated risks will greatly enhance a unit’s ability to successfully conduct mountain operations.

2) Features of Mountain Terrain

   a) Mountains are defined as land masses rising more than 500 meters above the surrounding plain. They can be single peaks, a long ridgeline, or an entire range.

   b) Mountain terrain is characterized by high peaks, deep valley and ravines, fast moving rivers, glaciers, cliffs, steep slopes, and other hazardous obstacles. These features pose unique challenges to the Soldier operating in the mountains.

   c) Glaciers, cliffs, and steep terrain are particular hazards that each require specialized training to move through.

3) Mountain Terrain - Composition

   a) Rock: Different types of rock and different slopes present different hazards.

      - Rock Classifications
         - Igneous: cooled magma
            - Plutonic Rock (intrusive) Granite, slowly cooled, with dense, interconnected crystals. Good climbing, especially along crack systems,
            - Volcanic Rock (extrusive) Basalt, slower cooling extrusions may be solid enough for climbing, but most extrusive rock cools quickly into tuff, a weak rock that breaks down quickly and erodes easily. It is not suitable for climbing.
         - Sedimentary: Formed by layers of sediment in valleys, lakes, and oceans, solidified over time by pressure. There is significant variation in the quality and hardness of the rock. It is generally suspect, and weaker when wet.
         - Metamorphic: Igneous or sedimentary rocks that have been altered physically and or chemically by the tremendous heat and pressures within the earth.

      - Scree & Talus
         - Scree refers to smaller material like mixed gravel and loose dirt (e.g. anything smaller than a human fist). Scree gives way easily under foot.
            - Descending scree is easier than ascending.
            - Kick steps into scree if forced to ascend a scree slope.
            - Another choice is to try to switchback by traversing the slope and gaining a little elevation at a time
            - Take advantage of any larger rock formations that come available as you ascend
o **Talus** refers to mid-sized material (human fist to small boulder).
  - Climbing is easier than descending
  - The best way to climb up is to take a diagonal route. Not only is it less strenuous than the straight-up approach, it's also safer for your partners below you, who could be hit if you dislodge a loose rock.
  - Going downhill on talus can be frustrating, nerve-racking, and hard on the knees. Heavy loads will only compound these problems when moving on talus

b) **Vegetation**
- Vegetation in a mountainous environment depends on soil composition, moisture/precipitation levels, climate, region and elevation.
- **Arid:** In areas that receive little rainfall, there may be little vegetation. Much of the terrain will be composed of hard ground, which is firmly compacted, rocky soil that does not give way under the weight of a Soldier's step.
- **Dense Forest:** In most temperate mountain ranges, the lower elevations are covered in dense forest. These areas can provide good concealment and protection from weather.
  - **Krumholtz** (Twisted Wood): Near tree line, high winds, ice buildup, and poor soil causes the trees to grow in dense mats. The branches may grow together so tightly that you need to walk on top or crawl below them. Navigating through the krumholtz is slow and difficult. Try to identify natural breaks such as old rock slides, creek beds, and existing trails.
  - **Grassy Slopes** are usually composed of small tussocks of growth rather than one continuous field. Grassy slopes are slippery after rain, new snow, and dew. After long, dry spells, clumps of the slope break away more easily. Weight should be distributed evenly; for example, use flat hand push holds instead of finger pull holds.

c) **Snow**
- Deep snow impedes movement and requires troops to be well trained in using snowshoes, skis, and over-the-snow vehicles. Movements will be slowed even for properly trained and equipped troops. Steep, snow-covered terrain presents the risk of avalanches as well.
  - **Snowfields:** As snow goes through cycles of warming and cooling it settles into a denser snow pack. Dense old snow can provide a uniform surface that covers obstacles. The character of the snow can vary greatly with the temperature and sun exposure. Movement on steeper slopes requires an ice ax, crampons, and the necessary training for this equipment.
4) Mountain Terrain Features

a) Draws, Gullies, and Couloirs
- Snow filled gullies can provide easier routes through technical terrain.
- When the snow has melted they are often filled with debris and loose rock. As low points they also act as “funnels” for any falling rock, ice or snow from above.
- Tactically they provide more concealment than the high ground, but troops moving through them are vulnerable to attacks from above.

b) Ridges, Arêtes, and Buttresses
- Ridges are key terrain. The dominating height of ridges permits long-range observation. Small elements on the high ground can control large areas around them.
- Ridges are less threatened by danger from falling objects, and generally are composed of higher quality rock.
- Often more technically challenging than the surrounding terrain, and more exposed to high winds and bad weather.

c) Rivers
- Operations conducted in mountainous terrain may require the crossing of swift flowing rivers or streams.
- Shallow soil and steep slopes can create a flash flood hazard.
- The flow of melt water from glaciers and large snowfields can fluctuate throughout the day. Rivers fed by glacial melt may only be crossable during limited time frames.

d) Mountain Roads
- Roads cut into the sides of steep slopes are often narrow and have tight curves that follow the contours of the hill.
- Narrow roads and movement corridors will limit vehicle traffic to predictable patterns. While simplifying traffic control, maneuvering and recovering vehicles will be problematic.
- Roads on steep slopes are often subject to washouts, landslides, and avalanches.
- Often provide little to no cover.
5) Operational Levels of Terrain

   a) **Level I:** Located at the bottom of valleys and along the main lines of communications. Heavy forces may be able to operate, but maneuver space is often restricted. Light and heavy forces are normally combined since vital lines of communications usually follow the valley highways, roads, and trails.

   b) **Level II:** Level II terrain lies between valleys and shoulders of mountains. It is often accessed by narrow roads and trails that cross the ridge system, which serve as secondary lines of communication. Units must expend more energy, time, and resources to occupy level II terrain, but because it dominates level I terrain it may be necessary to maintain control of the key Level I terrain.

   c) **Level III:** Level III terrain includes the dominant terrain of summit regions. Mobility in Level III is usually the most difficult to achieve and maintain. Level III terrain can control and dominate level II terrain, however, it is usually impossible to maintain presence there, due to logistical requirements and weather. Level III terrain can provide opportunities for well-trained units to attack the enemy from the flanks and rear. Acclimated Soldiers with advanced mountaineering training can infiltrate to attack lines of communication, logistics bases, air defense sites, and command infrastructures. Small elements can observe down into positions in the valley, and direct highly effective fires. Units will require highly specialized mountaineering training and equipment to be able to fully operate at this level.
6) Dismounted Mobility Classification

a) **Class 1** terrain is defined as gentle slopes or easy trails. This terrain is negotiated with simple walking techniques. Class 1 terrain is considered easy terrain.

b) **Class 2** terrain involves off-trail scrambling in steeper, more rugged terrain. Use of hands may be needed to negotiate Class 2 terrain, but generally the likelihood and consequence of a fall is low. Good physical conditioning is required, but no technical solutions are needed for safe movement. Moving a casualty will generally require technical systems. Class 2 terrain is considered easy terrain.

c) **Class 3** terrain usually necessitates moderate scrambling, with use of hands needed for balance. Movement may be easy, but death or serious injury may be the consequence of a fall. Experienced mountaineers will usually travel unroped. Use of fixed ropes or belay techniques may be required for beginners and to cross sections with greater exposure. Basic mountaineers are required for negotiating Class 3 terrain. Class 3 terrain is considered moderate terrain.

d) **Class 4** terrain is steeper terrain that involves belayed climbing or fixed ropes. There is moderate to difficult scrambling which may have some exposure. Serious injury or death can occur if an un-roped fall occurs. Basic mountaineers are needed to negotiate this terrain, with assault climbers finding the route, fixing ropes, and providing belays where necessary. It requires significant time and resources to manage risk for large elements, and is more efficiently traveled by small teams. Class 4 terrain is the most difficult terrain to evaluate and manage risk in. Class 4 terrain can be considered moderate to hard depending on the exposure and the consequences of a fall.

e) **Class 5** terrain is vertical terrain involving hands and feet at all times while moving. This terrain is complex, dangerous ground where significant injury or death can occur from an un-roped fall. Class 5 terrain requires Soldiers to be roped up, use belay techniques, and place intermediate protection. Assault climbers are required to negotiate this terrain. Assault Climbers may be able to travel 1:1 with basic mountaineers, if time is given for rehearsals prior to an operation, but generally only assault climbers will be climbing in class 5 terrain. Class 5 terrain is considered hard terrain when planning.
7) Glaciers

a) Definition
- A moving body of ice that forms on land from the accumulation and compaction of snow, and that flows down slope or outward due to gravity and the pressure of its own weight.

b) Information
- Glaciers cover 10% of the earth's surface.
- A solid river of rock, snow, and ice.
- Forms in areas where more snow falls each year than melts away during warmer seasons.
- After many years of accumulation, repeated exposures to freeze thaw cycles, and the compaction caused by the weight of new snow, the older, deeper snow transforms into solid ice.
- Forms over hundreds of thousands of years.
- Glaciers fill the valleys and follow the path of least resistance down out of the mountains. They often provide the easiest route to travel on when operating in high mountains, however, they are massive, dynamic structures and hold many hazards.

c) Glacier Hazards
- Crevasses: The glacial ice cannot flex as it passes around bends and over changes in the underlying slope. The glacial ice is subjected to tremendous tension. Crevasses develop first as simple fissures, later as gaping rifts. Crevasses are the greatest obstacle and hazard to moving on a glacier. Crevasses form at the roll over where the pitch of the glacier steepens. They also form along the edge of the glacier, where friction with the surrounding rock slows the edges of the glacier. The middle of a glacier generally has the fewest crevasses. On a bend, the outside edge will have more crevasses than the inside. Even as the glacier flows down the valley, crevasses will generally open in the same locations.
- Snow Bridges: Throughout the winter, windblown snow will adhere itself to the lips of the crevasse. It will eventually bridge it, so that the surface of the glacier appears as an unbroken snowfield. This makes detecting crevasses very difficult and dangerous. The strength of a snow bridge varies with temperature. An arch that might support a truck in the cold of winter or early morning may collapse under its own weight during an afternoon thaw.
- Glacial Travel: There are several components to safe glacier travel. One is route planning/finding. From an elevated point, or with aerial or satellite resources, identify a route that avoids the most heavily crevassed sections of glacier. Timing is also critical to safe movement. Solar radiation and warm temperatures will weaken snow bridges. Plan glacial movements during the coolest period of the day, generally from midnight through the early morning hours. In soft snow, snow shoes and skis will disperse the soldier's weight over a greater surface area and reduce the likelihood of breaking through a snow bridge. To reduce the consequence of a crevasse fall, teams should rope up when crossing a glacier. If an individual falls into a crevasse, the team arrests his fall. Rehearse techniques for rescue prior to moving on a glacier. Travel perpendicular to crevasses so that no more than one soldier is on a snow bridge at one time.
- **Moat**: A moat is the gap formed where the snow and ice are melted by the warmer rock along the edge of a glacier. Depending on its size, the moat may be an obstacle to moving on or off of the glacier. There may be only a few places where a snow bridge or a collapsed piece of the glacier bridges the gap. The edge of a moat is often undercut.

- **Bergschrund**: The bergschrund is a large crevasse at the head of a glacier caused by separation of active (flowing) and inactive (stationary) ice. These will usually be seen at the base of a major incline and can make an ascent on that area difficult. It also is where teams should transition from thinking about protecting against crevasse fall to protecting against falling down the slope.

- **Moraine**: A moraine is an accumulation of rock or debris, usually at the edges or the bottom of the glacier. They typically form as steep sided, narrow ridges. The sides can be too steep to climb, with significant loose rock and poorly bonded debris.

- **Icefall**: An icefall is a jumble of crevasses and large ice towers (seracs) that are normally found where a glacier flows over a slope with a gradient change of 25 degrees or more. As the glacier flows down this portion of the valley, the towers will break off, and tumble down the slope. As the rate of movement for the glacier increases, the more unstable the icefall becomes. The movement of the glacier can cause seracs to fall at any time. Time spent exposed to the hazard should be minimized.
Chapter 2. Basic Mountaineering Equipment

1) **Introduction:** There is a wide variety of military mountaineering equipment available both in the military system and off the civilian shelf. The equipment we will use in the course was selected for ease of use and requires minimal training to employ. It was tested to extremely high standards to ensure safety under a variety of adverse conditions. However, the consequences for not understanding and enforcing strict PMCS on your mountaineering equipment can be deadly.

2) **Standards and Ratings**

   a) **UIAA (International Mountaineering and Climbing Federation):** Original worldwide standardizing agency for mountaineering equipment. Serves in an advisory role for equipment and testing.

   b) **CEN (European Committee for Standardization):** Sets standards for all types of equipment. Mirrors UIAA for mountaineering equipment.

3) **Equipment Strength:** Each piece of equipment possesses a different strength rating. Generally, strength is proportional to weight when considering mountaineering equipment. You must consider a piece of equipment’s application when determining desired strength and also maintain the intention of remaining as light as safely possible. All mountaineering items are rated in terms of Units of Force (kN), rather than tensile strength.

4) **Mountaineering Soft Goods:** Rope, cord, webbing and harnesses.

   a) **Ropes:** No one rope is ideal for all applications. Consider the pros and cons of weight and bulk vs. safety and versatility when selecting ropes for a mission. Generally, thinner diameter ropes have less weight and bulk when carrying; however, have a decreased safety margin when loaded over sharp edges compared to larger diameter ropes. In regards to length, greater lengths will offer greater versatility for rappelling or climbing greater distances, however this comes at a price, since the additional weight and bulk cannot be distributed among the team. Dynamic and static ropes come in various diameters: Cord: Static, 5mm to 8mm; Dynamic Rope: 7.8mm to 11mm; and Static Rope: 7mm to 13mm. Weight is generally: 60m x 10mm rope ~ 9lbs.

   * **Kernmantle Rope Construction:** Kernmantle or "jacketed-core" ("kern" means "core" and "mantle" means "sheath") is constructed similarly to 550-parachute cord and are the only approved ropes for military mountaineering. While the jacket may puncture or tear in use, usually enough of the jacket remains to securely hold the core fibers. Kernmantle rope is considered far superior in design, manageability, strength and safety.
o **Static Kernmantle**: Low stretch (2.8%). Static ropes are designed for rappelling, rescue operations, load hauling and rope installations. The rope has a protective sheath woven tightly over a parallel-fiber-bundle core. Due to the internal parallel strand construction of the static rope, there is less spinning and kinking than with dynamic rope.

o **Dynamic Kernmantle**: A dynamic rope is designed for climbing only. The rope has a braided sheath woven over a twisted or braided-strand shock-absorber core. It is well suited for climbing, due to the elastic elongation of the rope during a fall. Dynamic kernmantle ropes have an elongation of about 40 percent *at the point of failure* and come in a variety of sizes, lengths, stretch factors, tensile strengths and fall ratings.

### b) Webbing:

Webbing is a flat or tubular nylon material that ranges in widths from 9 mm (3/8 inch) to 5 cm (2 inches) and has many uses in mountaineering operations. Webbing is lighter than small diameter ropes or cords. It provides better adhesion than cord or rope whose circular cross section can cause rolling. It is well suited for runners (which extend the length of a piece of protection), slings (to carry hardware), etriers or stirrups for aid climbing, improvised harnesses, and other purposes in mountaineering. The strength of the webbing depends on its width and varies in tensile strength from 682 kg (1,500 lbs.) to over 3,200 kg (7,000 lbs.).

- **Tubular Nylon Webbing**: Tubular nylon webbing is constructed of a spiral weave with no sewn seam and has a hollow interior. It is easy to manage and holds knots well. If the intended use is known, it is better to pre-sewn slings, harnesses, runners and etriers. Sewn webbing is 10 to 15 percent stronger than knotted webbing.

- **Flat Nylon Webbing**: Flat nylon webbing has no separation in the webbing. It is more difficult to handle and does not hold knots as well as the tubular nylon webbing. It lies flatter than the tubular type and is not as prone to slipping or rotating. Generally, flat nylon webbing is only used in manufactured harnesses.

### Mountaineering Soft Goods PMCS

- Any time you "back-stack" your rope is a great time to inspect it, simply by running your hands along it and feeling for bumps, soft spots, or anything that might indicate damage to the core.
- Inspect daily before, during and after use for cuts, frays, burns, and damage.
- **Rope Cord**:
  - Inspect sheath—shouldn’t see the core
  - Inspect core—check for gaps, soft spots, excessive stiffness
- **Webbing**: Inspect for
  - Cuts, excessive fraying, and excessive stiffness
c) Care of Rope/Webbing

- The ends should be fused, whipped, or taped to prevent unraveling.

- Keep your rope clean. Be conscious of where you coil and uncoil it. Dirt shortens the rope life by causing internal and external abrasion.

- Always protect your rope at potential abrasion points. When possible, use runners or pads to keep the rope away from sharp edges. Rock crystals, bolt hangers, glass and even pack grommets can cut a rope’s sheath.

- Avoid stepping on the rope. When possible, use a protective rope bag/tarp when transporting and managing it on the ground.

- Wash a dirty rope in cold or lukewarm water using mild soap. Do not use laundry detergent as it can strip the oils from the nylon fibers. Do not use bleach! Do not dry in a dryer! Air-dry your rope away from direct sunlight.

- Store your rope completely dry, free of all knots and coiled loosely away from heat sources and any chemicals. Avoid contact with any petroleum products, bleach, battery acids, and other substances that damage nylon and attract dirt.

- Never use a climbing rope for any purpose other than for what it was intended. It is not for towing cars, trimming trees, working on the roof, etc.

<table>
<thead>
<tr>
<th>Rope Retirement</th>
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<tbody>
<tr>
<td>- After holding a long, hard fall, if it has flat or soft spots, becomes too stiff or shows major sheath damage.</td>
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<tr>
<td>- If you can see the core of the rope.</td>
</tr>
<tr>
<td>- After 1-2 years of heavy use (daily to weekly); 3-5 years of moderate use (weekly to monthly); and 5-7 years of occasional use (less than monthly).</td>
</tr>
<tr>
<td>- Actual rope life varies by rope type, characteristics and manufacturer.</td>
</tr>
</tbody>
</table>
5) **Mountaineering Hardware**: Carabiners (lockers & non-lockers), belaying and rappelling devices, ascenders, climbing protection, snow and ice gear and gadgets.

<table>
<thead>
<tr>
<th>Carabiners. Can be steel or aluminum, oval, d-shaped, bent, and straight or wire gate.</th>
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</thead>
<tbody>
<tr>
<td>Belay/Rappel Device. Can be made of either steel or aluminum.</td>
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<table>
<thead>
<tr>
<th>Ice Axes</th>
<th>Crampons</th>
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</thead>
<tbody>
<tr>
<td>Alpine Mountaineering Axe</td>
<td>General Purpose Crampon</td>
</tr>
<tr>
<td>Technical Ice Tools</td>
<td>Vertical Ice Crampon</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Item</th>
<th>Breaking Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>11mm dynamic rope</td>
<td>10-fall rope, 9 kN impact force</td>
</tr>
<tr>
<td>11mm static rope</td>
<td>~30 kN</td>
</tr>
<tr>
<td>1&quot; tubular nylon webbing</td>
<td>~18 kN</td>
</tr>
<tr>
<td>Sewn webbing/runners</td>
<td>~22 kN</td>
</tr>
<tr>
<td>7mm cord</td>
<td>~11 kN</td>
</tr>
<tr>
<td>Non-locking oval carabiner</td>
<td>~22-30 kN</td>
</tr>
<tr>
<td>Non-locking d-shaped carabiner</td>
<td>~31 kN</td>
</tr>
<tr>
<td>Steel locking carabiner</td>
<td>~53 kN</td>
</tr>
<tr>
<td>Aluminum locking carabiner</td>
<td>~22-30 kN</td>
</tr>
</tbody>
</table>

**Note**: Dynamic ropes are not rated in tensile strength, but by the UIAA drop test standards.

a) **Mountaineering Hardware PMCS**: Check for burrs, nicks, cracks, grooves (worn away material), sluggish operation of moving parts, bent or broken parts, etc. Any deficiencies found in items whose failure could lead to severe injury or death should be replaced immediately. Avoid using petroleum products to lubricate moving parts or protect from rust.

6) **Breaking Strengths of Equipment**: Strengths vary between manufacturers and from year to year based on design changes. Carabiner strength is given with the gates closed.
7) Basic Military Mountaineering Rack (Student Rack)

a) Belay/Rappel Device
b) Aluminum Locking Carabiner
c) Steel Locking Carabiner (2)
d) Non-Locking Carabiners (7)
e) Mechanical Ascender
f) 7mm x 18 ft. Utility Cord (3)
g) 1 in. x 60 in. Tubular Webbing (2)
h) 24 in Sewn Webbing (2)

8) Racking the Equipment

a) There is no one size fits all answer to racking equipment that can be applied to all situations. As a general rule, gear should be racked neatly, with similar items grouped together, and the most needed items easily accessible. Additionally, no equipment should hang below the top of the Soldier's cargo pocket and should not hinder movement.

9) Mountaineering Kits Currently Available to Enhance Operations: The Army mountaineering kits are made up of four separate but integrated kits of state-of-the-art, commercial equipment which meet the highest industry standards. The separate kits enable the commander to tailor the equipment to the mission environment. The breakdown per IBCT is: 15 HAM kits, 2 SIM kits, and 8 ACT kits.

<table>
<thead>
<tr>
<th>High Angle Mountaineering Kit 8465-01-604-6325 ($8,276.10)</th>
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<tbody>
<tr>
<td><strong>Harness, Mountaineering</strong> 8465-01-578-8910 (40 ea)</td>
</tr>
<tr>
<td><strong>Carabiner</strong> 8465-01-578-8898 (80 ea)</td>
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<tr>
<td><strong>Carabiner</strong> 8465-01-578-8906 (80 ea)</td>
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<tr>
<td><strong>Belay Device, Mountaineering</strong> 8465-01-578-7850 (40 ea)</td>
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<tr>
<td><strong>Webbing</strong> 8305-01-578-8909 (80 ea)</td>
</tr>
<tr>
<td><strong>Rope, Kernmantle</strong> 4020-01-577-8686 (1 roll)</td>
</tr>
<tr>
<td><strong>Washer, Rope</strong> 4940-01-582-5658 (1 ea)</td>
</tr>
<tr>
<td><strong>Rope, Cutter, Electric</strong> 4940-01-582-8347 (1 ea)</td>
</tr>
<tr>
<td><strong>Rope, Kernmantle</strong> 4020-01-577-8714 (1 roll)</td>
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</tbody>
</table>

a) High-Angle Mountaineering (HAM) Kit: Intended to outfit 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.
### Assault Climber Team Kit 8465-01-604-6235 ($3,503.96)

<table>
<thead>
<tr>
<th>Item</th>
<th>Part Number</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harness, Mountaineering</td>
<td>8465-01-578-8910</td>
<td>(3 ea)</td>
</tr>
<tr>
<td>Carabiner</td>
<td>8465-01-578-8898</td>
<td>(9 ea)</td>
</tr>
<tr>
<td>Carabiner</td>
<td>8465-01-578-8906</td>
<td>(30 ea)</td>
</tr>
<tr>
<td>Webbing</td>
<td>8305-01-578-8909</td>
<td>(20 ea)</td>
</tr>
<tr>
<td>Belay Device, Mountaineering</td>
<td>8465-01-578-7850</td>
<td>(3 ea)</td>
</tr>
<tr>
<td>Pick, Chock</td>
<td>4240-01-582-5611</td>
<td>(3 ea)</td>
</tr>
<tr>
<td>Rope, Kernmantle</td>
<td>4020-01-577-8686</td>
<td>(1 roll)</td>
</tr>
<tr>
<td>Anchor, Rock, Camming Device</td>
<td>8465-01-578-7534*</td>
<td>(1 set)</td>
</tr>
<tr>
<td>Anchor, Rock, Chock</td>
<td>8465-01-578-6458*</td>
<td>(1 set)</td>
</tr>
<tr>
<td>Assault Climber Bag</td>
<td>8465-01-578-8828</td>
<td>(3 ea)</td>
</tr>
<tr>
<td>Rope, Kernmantle</td>
<td>4020-01-577-8748</td>
<td>(2 ea)</td>
</tr>
<tr>
<td>Ascender, Mechanical</td>
<td>8465-01-579-3239</td>
<td>(3 ea)</td>
</tr>
<tr>
<td></td>
<td>8465-01-579-3245</td>
<td>(3 ea)</td>
</tr>
</tbody>
</table>

**b) The Assault Climber Team kit (ACT):** Used by a trained assault climber team of three personnel to establish rope installations. Once established, minimally trained Soldiers can move over these installations using the HAM kit.
### c) The Snow and Ice Mobility (SIM) Kit:

Offers enough equipment to outfit a 43-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.

### Squad Mountain Leader Kit ($30,146.71)

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Model/Part Number</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harness, Mountaineering</td>
<td>8465-01-579-1066</td>
<td>(12 ea)</td>
</tr>
<tr>
<td>Carabiner, Mountaineering</td>
<td>8465-01-578-8906</td>
<td>(276 ea)</td>
</tr>
<tr>
<td>Belay Device, Mountaineering</td>
<td>8465-01-578-7850</td>
<td>(12 ea)</td>
</tr>
<tr>
<td>Ascentor, Mechanical</td>
<td>8465-01-579-3239</td>
<td>(1 roll)</td>
</tr>
<tr>
<td>Rope Kemmantle</td>
<td>4020-01-577-8686</td>
<td>(6 ea)</td>
</tr>
<tr>
<td>Rope Kemmantle</td>
<td>4020-01-577-8714</td>
<td>(1 roll)</td>
</tr>
<tr>
<td>Webbing</td>
<td>8305-01-578-8909</td>
<td>(48 ea)</td>
</tr>
<tr>
<td>Anchor, Rock, Chock</td>
<td>8465-01-578-6458</td>
<td>(4-8 sets)</td>
</tr>
<tr>
<td>Transceiver, Avalanche</td>
<td>8465-01-578-8902</td>
<td>(12 ea)</td>
</tr>
<tr>
<td>Axe Ice</td>
<td>8465-01-578-7741</td>
<td>(6 ea)</td>
</tr>
<tr>
<td>Crampon w/extend bar</td>
<td>8465-01-578-8908</td>
<td>(12 pair)</td>
</tr>
<tr>
<td>Pulley, Mountaineering Type I</td>
<td>*8465-01-579-0441</td>
<td>(4 sets)</td>
</tr>
<tr>
<td>Piton with hammer</td>
<td>8465-01-579-9558</td>
<td>(12 pair)</td>
</tr>
<tr>
<td>Avalanche Shovel, with probe</td>
<td>4240-01-582-8261</td>
<td>(12 ea)</td>
</tr>
<tr>
<td>Anchor, Rock, Canning Device</td>
<td>8465-01-578-7534</td>
<td>(4 sets)</td>
</tr>
<tr>
<td>Anchor, Snow</td>
<td>8465-01-578-8717</td>
<td>(24 ea)</td>
</tr>
<tr>
<td>Snowshoe, Assault, Military</td>
<td>8465-01-558-9958</td>
<td>(43 pair)</td>
</tr>
<tr>
<td>Washer, Rope</td>
<td>4940-01-582-5658</td>
<td>(1 ea)</td>
</tr>
<tr>
<td>Rope, Cutter, Electric</td>
<td>4940-01-582-8347</td>
<td>(12 ea)</td>
</tr>
<tr>
<td>Anchor, Ice</td>
<td>8465-01-578-643</td>
<td>(12 ea)</td>
</tr>
</tbody>
</table>

### d) Squad Mountain Leader Kit:

Outfits a specialized mountaineering team.
Chapter 3. Cold Weather Clothing

1) Introduction: Quality well maintained cold weather clothing allows us to operate in extreme conditions the enemy cannot. Not only must Soldiers understand how to properly wear the cold weather clothing system, leaders must also understand the differences in individuals and allow some freedom of choice in clothing selection.

2) Methods of Heat Loss

a) Conduction: Direct heat transfer from one object to another. Examples include, touching objects such as cold metal or plastic, as well as sitting or lying on ice, snow, or cold rock. Wet clothing speeds the heat loss. Wet clothing can conduct as much as 240 times the heat from your body as dry clothing. Wet clothing acts much as a wick and if exposed to the wind will drain away heat much faster than the Soldier can generate it. Cotton Kills!

b) Convection: Heat loss due to moving air or water in contact with the skin. Wind chill is an example of convection cooling. Wind-chill is a convection effect upon exposed skin. Wind-chill is the “real feel”, not the actual temperature.

c) Radiation: Infrared energy given off by warm objects. Radiation accounts for about 65% of total body heat loss. 85% of that loss is from the head and neck.

d) Evaporation: The evaporation of perspiration causes heat loss. Wet clothing can cause heat loss by conduction and evaporation. Dressing in layers allows Soldiers to remove or add clothing as needed.

e) Respiration: Heat loss from exhale.

3) Cold Weather Clothing

a) Components

- Base Layer
  - Thin moisture wicking layer worn against skin.
  - Must rapidly move moisture away from skin to prevent heat loss due to conduction.
  - Should be a thin, light weight layer.

- Insulation: Heat retaining layer(s)
  - Insulating materials resist the transmission of heat.
  - Air pockets within the fibers or layers of clothing trap the air warmed by the body and hold it close to the skin.
  - Several thin layers provide more warmth than a single heavy layer.
  - A generous cut will provide more pockets to trap air than clothing with a close fit.

### Cold Weather Clothing Goals

- Provide a barrier against weather
- Heat retention
- Move moisture away from skin
- Dry quickly
- Allow for adequate dexterity
• **Shell**: Outer Layer, wind/weather barrier  
  o Primary barrier between you and the weather.  
  o Must prevent liquid moisture from getting in while allowing for vapor moisture to get out (evaporate).  
  o Must allow for adequate ventilation to prevent overheating.  
  o Must not restrict movement.  
  o Hard Shell vs. Soft Shell.

**b) Ventilation=Climate Control**

- Gets rid of excess heat.  
- Reduces sweating.  
- Allows moisture vapor to escape.  
- Be “Comfortably Cool”.

**4) Cold Weather Conditions**: Wet and dry weather conditions affect the use of cold weather clothing. Temperature and wind velocity amplify the conditions.

a) **Cold-Wet Conditions**: Cold-wet conditions occur when temperatures alternate between freezing and thawing. Freezing and thawing creates mud and slush on the ground. Often rain and wet snow accompany these conditions. During these periods, Soldiers should wear clothing that consists of a water-repellent, wind resistant outer layer and inner layers with sufficient insulation to provide ample protection in moderately cold weather (above 14°F). Waterproof footwear is essential.

b) **Cold-Dry Conditions**: Cold dry conditions occur when the average temperature is below 14°F. The ground is frozen and the snow is dry. Strong winds cause low temperatures to seem colder and increase the need for protection of the body from wind-chill. During these periods, Soldiers should have additional layers of insulation available. This is particularly true when doing sedentary tasks after periods of exertion.
<table>
<thead>
<tr>
<th>Fabric</th>
<th>Advantages</th>
<th>Disadvantages</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Synthetic</td>
<td>Non-cellular synthetic filaments such as polyesters and acrylics absorb very little water and dry quickly. They retain their insulating qualities when wet.</td>
<td>Some types retain odors. Not wind resistant. Can be bulky. Melts with high heat.</td>
<td>Many different forms. Skin layers (underwear, T-shirts). Insulating layers (pile/fleece), hats, gloves, socks.</td>
</tr>
<tr>
<td>Wool</td>
<td>More abrasion and wind resistant than many synthetics. Retains insulating qualities when wet. High friction on snow/ice. Does not melt with high heat.</td>
<td>Heavier, absorbs more water, dries less quickly than most synthetics. Can be bulky.</td>
<td>Skin layers, insulating/outer layers (sweaters, shirts, pants, hats, gloves, socks.</td>
</tr>
<tr>
<td>Down</td>
<td>High quality goose down is the warmest insulating fill available by weight. Most compressible, packs small and maintains its loft when unpacked. Has a longer useful life than other insulating fills.</td>
<td>Loses all its insulating value when wet and is almost impossible to dry in damp conditions. Must be protected from moisture. Expensive.</td>
<td>Very popular for cold-weather jackets and especially for sleeping bags.</td>
</tr>
<tr>
<td>Silk</td>
<td>Most versatile, breathable, durable, and comfortable fiber in the world. It is a natural insulator and possesses the unique ability to draw moisture away from the skin.</td>
<td>Does not dry as fast as some synthetics. Expensive.</td>
<td>Skin Layers.</td>
</tr>
</tbody>
</table>

**Safety Note:** All petroleum-based fabrics melt easily when exposed to heat. These include nylon, polypropylene, capolene, Hollofil, Dacron, Polarguard, Thinsulate and others. Be careful around stoves and fires.
5) C-O-L-D-E-R Acronym

a) **Clean**: Keep Clothing Clean. Clothes matted with dirt and grease lose their insulating property. Change clothing often. All outer garments of the cold weather clothing system are washable. Each item has laundry instruction labels.

b) **Overheating**: Avoid Overheating. Overheating causes perspiration, which in turn causes clothing to become damp. Wear the minimum amount of clothing to avoid overheating. Clothing requirements are different for each Soldier. Adjust clothing based on the air temperature and on the level of activity. Open or remove layers as necessary. It is better to be a little chilled than to be excessively warm. This is especially true before heavy activity.

c) **Layers**: Wear Clothing Lose and in Layers. Tight clothing and footgear restricts circulation and promotes cold injuries. If the outer garments fit tightly, the layers underneath it will restrict circulation. Tight garments lessen the volume of trapped air and reduce the insulation.

d) **Dry**: Keep Clothing Dry. Moisture will soak into clothing from the inside and the outside. Snow and frost that collect on the uniform may melt from the heat radiated by the body. Outer clothing is water repellent and will shed most of the water created from melting snow and frost. The surest way to keep dry is to prevent snow and frost from collecting. Before entering heated areas brush or shake snow off your uniform. Do not try to rub snow off as this works it into the fabric.

e) **Examine**: Examine for Holes, Tears, and Broken Fasteners. Like any piece of equipment, you should inspect your clothing prior to use. Holes, rips or broken parts make your clothing perform less efficiently.

f) **Repair or Replace**: Repair or Replace Damaged Clothing. Damaged clothing should be turned in prior to use so you are prepared to conduct your mission. Re-supply in the field is difficult and not always possible.

6) **Gen III Cold Weather Clothing**: The 3rd Generation of the Army’s Extended Cold Weather Clothing System (ECWCS).

a) **Level 1**: Base layer. A lightweight crew neck shirt and elastic waistband drawers constructed with Polartec® Powerdry® Silk weight material, which is highly breathable and has moisture wicking properties. Desert sand in color. Kit includes two (2) sets.

b) **Level 2**: Grid fleece (waffle). A mid-weight long sleeve shirt and elastic waistband drawers constructed with Polartec® Powerdry® Heavyweight material, which offers stretch to allow for increased comfort during movement, is highly breathable and has moisture wicking properties. Desert sand in color. Kit includes one (1) set.
c) **Level 3:** Fleece jacket. A zipper jacket with raglan sleeves and chest pockets constructed with Polartec® Thermal Pro® material, which creates air pockets that trap air and retain body heat providing outstanding warmth without weight. This material also offers excellent breath ability and the ability to dry quickly. However, this layer is not recommended as an outer garment for use during inclement/windy weather. Foliage Green in color. Kit includes one (1) piece.

d) **Level 4:** Wind jacket. A nylon/spandex zippered jacket with angled chest pockets. Offers wind protection and environmental comfort with low weight and bulk. Quick drying. Kit includes one (1) piece.

e) **Level 5:** Soft Shell Jacket and Trousers. Jacket has center front opening with wind protection flap, collar with cover for an enclosed collapsible hood, raglan sleeves, and two front pockets. Trousers have a front fly opening with wind protection flap, two front pockets, belt loops, and provisions for suspenders. Constructed with Nextec® fabric. Resists penetration by water. Quick drying. Highly durable and breathable.

f) **Level 6:** Wet Weather Jacket and Trousers. The jacket has a front zipper with zipper pass through front middle pockets. An adjustable hood, a visor, and a hide-away collar. Elastic wrist cuffs with a strap for adjustability. The trousers have a front fly opening, two pass through pockets with flaps for water protection, an elastic waistband, and belt loops. A zipper on each leg that goes approximately ¾ of the length of the leg with flap cover for water protection. Elastic leg cuffs with a strap for adjustability. Constructed with 2 Layer Gore-tex® fabric. Waterproof and windproof. Extremely breathable. Sealed seams.

g) **Level 7:** Extreme Cold Parka and Trousers. The jacket has a front double zipper, which permits opening of the jacket from the top or bottom. The jacket has a draw-cord closing hood and bottom. The jacket has two vertical zippered outer pockets and two inner mesh pockets. The trousers have a 3-piece elastic webbing waistband with a front fly opening with 2-way zipper. Trouser has an elastic leg cuff with a full-length 2-way leg zipper. Three Layer Construction. Fabricated with an outer layer, an insulation layer, and an inside layer of lightweight rip-stop material. Water Resistant. Highly durable and breathable. Urban Gray in color.
7) Hand Wear

a) Types
   - **Liners/Inserts**: Thin moisture wicking gloves. “Contact layer”
   - **Gloves**: Modular or non-modular. Provide varying degrees of dexterity and warmth.
   - **Mittens**: Modular or non-modular. Maximum warmth, least amount of dexterity.

b) Hand Wear Considerations
   - Water resistance
   - Wickability / breathability
   - Insulation / heat retention
   - Fit / Dexterity
   - Modularity
   - Ease of donning / removing

c) Nomex Gloves
   - Absorb moisture.
   - Dry slowly.
   - Not very warm.

d) Non-Issued Gloves
   - Mammut
   - Outdoor Research (OR)
   - Black Diamond (BD)

8) Footwear

a) Sock Types
   - **Polypropylene**: Use as a base layer to transport moisture away from the feet.
   - **Insulating**: Use to provide warmth. Should be made out of wool or synthetic materials.
   - **Vapor Barrier Socks**: Vapor Barrier socks (VB socks) keep your feet warm by using heat lost through perspiration. Air out your feet whenever possible. Prolonged wear of the vapor barrier sock without proper foot care could lead to immersion foot.

<table>
<thead>
<tr>
<th>Good Hand Wear Habits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Always wear contact gloves.</td>
</tr>
<tr>
<td>Carry multiple sets for back up.</td>
</tr>
<tr>
<td>Store extra gloves in internal jacket pockets to keep warm/dry.</td>
</tr>
<tr>
<td>Wear the lightest gloves possible to prevent sweating.</td>
</tr>
<tr>
<td>Never touch petroleum products without protective gloves.</td>
</tr>
<tr>
<td>Dry wet gloves as soon as possible.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nomex Gloves</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>General Foot Wear Principles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feet are vulnerable to cold weather.</td>
</tr>
<tr>
<td>They get wet easily, from external moisture sources and perspiration.</td>
</tr>
<tr>
<td>Restricted circulation is often a problem.</td>
</tr>
<tr>
<td>Change socks often / carry extra socks.</td>
</tr>
<tr>
<td>Socks carry out four vital functions: cushioning, insulation, absorption of perspiration and reduction of foot-to-boot friction.</td>
</tr>
</tbody>
</table>
b) Boot Types

- **Intermediate Cold/Wet Boot (ICWB):** worn in mean temperatures ranging between 35-50°F.

- **Plastic Mountaineering Boots:** These boots have several advantages over ICWBs. They are warmer and waterproof. They best can be described as a flexible ski boot that can be used for skiing and ice climbing. They have an inner adjustable boot. They are flexible enough to walk for extended periods, yet rigid enough to provide support for skiing and ice climbing. These boots have a soft, flexible inner boot. The hard shell outer boot has a hinge at the ankle for flex when walking. Both the inner and outer boots have lace-up tightening systems. This system allows the Soldier to fit the boots properly. Remove the inner boots each night and air dry. Use a dry cloth to wipe off the inside of the outer boot and the outside of the inner boot. Avoid getting the boots close to a heat source. Contact with liquid petroleum products will cause damage. In the field, after wiping dry, hang the inner boot from the tent drying lines or place in your sleeping bag. Place the outer boot between the sleeping bag and the pad to keep warm. The range of protection provided by the plastic boot depends on the manufacturer, activity level and gaiter system used. The addition of super-gaiters or over boots dramatically increases the efficiency of the boots. Adjust boots by tightening or loosening the laces, on the shell, the liner or both if laces are present. The fit should be snug but not so tight to cut off circulation to the foot.

- **Leather Mountaineering Boot:** These boots allow for a wider range of motion, more comfort/flexibility, and they also can be waterproofed. Some leather mountaineering boots won’t allow the attachment of crampons. They must be regularly waterproofed and never allowed to dry out completely as cracking can occur. If you are on a mission with no method to dry the boots out, there is a risk of foot injuries.

<table>
<thead>
<tr>
<th>Boot Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Cleaned boots with a cloth utilizing mild soap and water and thoroughly dried.</td>
</tr>
<tr>
<td>- Do not immerse the inner boot.</td>
</tr>
<tr>
<td>- Wipe the gussets and outer boot with a plastic preservative such as Armor-All.</td>
</tr>
<tr>
<td>- Loosely lace them to maintain the shape of the molded plastic.</td>
</tr>
<tr>
<td>- Store boots in a cool dry place away from direct sunlight.</td>
</tr>
</tbody>
</table>
c) **Boot Maintenance**

- Treat leather boots with a non-petroleum product. Petroleum-based products tend to break down the leather and stitching.

- You can usually repair VB boots with tire patching material. When regular patching material is not available use duct tape to prevent moisture from reaching the insulation in the boot. Turn in the boot for replacement at the earliest possible time. Wash the inside of the boots at least once a month with a mild solution of soap and water. Do not clean the boots with an abrasive cleanser. Do not apply polish or paint to any part of the boot, as it will cause the rubber to deteriorate.

- Plastic boots should be inspected for cracks and cuts. Inner boots should be inspected for tears and splits. Ensure that eyelets, hooks, and laces are serviceable.

d) **Gaiters**: Used to prevent snow, ice, mud, twigs and stones from entering your footwear. The use of waterproof fabrics or other breathable materials laminated to the nylon makes the gaiter an integral component of the cold weather clothing system. Gaiters are available in three styles:

- **Nylon Shell**: The most common is a nylon shell that may or may not have a breathable material laminated to it. The open front allows the boot to slip easily into it and is closed with a combination of zipper, hook-pile tape and snaps. It will have an adjustable neoprene strap that goes under the boot to keep it snug to the boot. The length should reach to just below the knee and will be kept snug with a drawstring and cord lock.

- **Full Gaiter**: This gaiter completely covers the boot down to the welt. It can be laminated with a breathable material and can be insulated if necessary.

- **Overboot**: The overboot is specific to high-altitude mountaineering or extremely cold temperatures. It is worn completely over the boot and must be worn with crampons because it has no traction sole.
9) Face Protection

a) **Neck Gaiter:** This item is a tube of material that fits around the neck and can reach up over the ears and nose.

b) **Balaclava:** Wear the balaclava alone as a hat, under the ACH as a liner.

c) **Wool Scarf:** Covering as much of your face as possible with a wool scarf will give some protection. Frost will cover the area over the mouth and nose. Keep the wet area outside the parka. Like the mask, remove the scarf regularly to check for frostbite.

d) **Goggles:** Goggles will also provide protection from the wind and blowing snow.

e) **Sun Glasses**

10) **Headgear:** Heat loss through an uncovered head is extremely rapid, due to the excellent blood supply to the brain. Types of headgear include:

a) **Advanced Combat Helmet (ACH):** The ACH frequently is the designated outer layer of headgear. An additional layer may be necessary. For better protection against the elements, wear the hood under the ACH. If the tactical situation requires full peripheral vision and maximum hearing, neither of these options are acceptable.

b) **Wool Cap:** The issued black watch cap is warm but can be bulky and difficult to fit under a helmet.

c) **Fleece Cap:** The Gen III cap is lighter than the Wool Cap, has better wicking capabilities and fits well under a helmet.

d) **Balaclava:** The balaclava protects against extreme cold and is well suited for stationary activities in Dry-Cold or Wet-Cold conditions.

e) **Helmet liner/wicking skullcap:** You can wear the helmet liner as a separate hat if the tactical situation permits.

11) **Camouflage Clothing:** The use of camouflage clothing is METT-TC dependent. The articles worn will vary from mission to mission and may vary during the mission.

a) White winter camouflage clothing (over whites) consists of trousers, parka with hood, mitten shells and rucksack cover.

b) Use of the white camouflage clothing is dependent on the background, vegetation and the amount of snow on the ground. Wear the complete white suit only when the terrain is completely snow covered. Use mixed clothing, white parka and dark trousers, or vice versa for mottled backgrounds.

c) Soiled camouflage clothing loses its effectiveness. Exercise care when handling stoves, digging in dirt, cleaning weapons and other "dirty" tasks. Avoid scorching or burning the garments. Change or wash your clothing frequently.
d) Over-whites should fit over the winter garments without causing any restriction of movement.

12) Leader’s Responsibilities

a) Many factors will influence the leader’s decision to the clothing and equipment his Soldiers should wear or carry. These include the weather, mission, and general physical condition of personnel and degree of group proficiency. Under normal winter conditions, sixty-five to seventy pounds are the maximum weight a Soldier can carry and still be effective upon reaching his or her destination.

b) Leaders should give particular attention to the additional organizational equipment required for a given operation. The individual Soldier’s combat load in cold weather operations exceeds that of a temperate climate load by more than twenty pounds.

c) The leader must ensure that Soldiers operating in a cold weather environment know how to dress appropriately for their activity level and use that knowledge.

13) Cold Weather Clothing Summary

a) Proper clothing, correctly worn, is necessary for survival and success in mountain operations.

b) Cold weather clothing should be considered a layered system that includes three primary components: Base (wicking) layer, Insulation layer(s) and Outer (weather resistant) shell.

c) Individuals must be allowed to determine their own cold weather clothing needs.

d) Clothing worn should be constantly adjusted IAW activity level to prevent sweating and unnecessary heat loss.
Chapter 4. Basic Knot Tying

1) Introduction: The ability to quickly tie knots correctly under stress and in difficult conditions such as limited visibility or extreme cold is crucial for any unit conducting military mountaineering. Knot tying is the critical task in constructing rope systems and conducting technical movement. Soldiers must understand the strengths and weaknesses of each knot and to which application they are best suited.

2) Basic Knot Considerations: A knot is a temporary condition in the rope. Knots have the ability to untie themselves over a period of time. A permanent knot would be desirable, but no such knot exists. All knots must be repeatedly checked and often re-tied.

   a) Adverse Conditions: Often there is a need to tie a knot under adverse circumstances. You must know which knot is best for the purpose intended and how to tie the knot well. Repeated practice is recommended.

   b) Selection: Strength should not be the sole basis of knot selection. Ease of tying, untying after loading, chances of working loose, and allowance for quick inspection are all factors.

3) Rope Work Terms

   a) Running End: Loose or working end of the rope.
   b) Standing End: Stationary or non-working end of the rope.
   c) Bight: A bend in the rope in which the rope does not cross itself.
   d) Double Bight: A bend in a doubled rope in which the ropes do not cross themselves.
   e) Loop: A bend in the rope in which the rope crosses itself.
       • Overhand Loop: The running end over the standing end.
       • Underhand Loop: The running end under the standing end.
   f) Half Hitch: A loop that runs around an object to lock or secure itself.
   g) Girth Hitch: A bight around an object securing the standing ends.
   h) Turn: A wrap of the rope around an object, providing 360-degree contact
   i) Round Turn: A wrap of the rope around an object 1 1/2 times. You can use it around small diameter trees to prevent the rope from sliding up from the base.
   j) Pigtail: The pigtail is the portion of the running end after the safety knot and the end of the rope. All pigtails will be a minimum of 4 inches long.

<table>
<thead>
<tr>
<th>Single Kernmantle Rope Knot Strengths</th>
</tr>
</thead>
<tbody>
<tr>
<td>• No Knot: 100%</td>
</tr>
<tr>
<td>• Clove Hitch: 60% to 65%</td>
</tr>
<tr>
<td>• Water Knot: 60% to 70%</td>
</tr>
<tr>
<td>• Figure Eight: 75% to 80%</td>
</tr>
<tr>
<td>• Overhand: 60% to 65%</td>
</tr>
<tr>
<td>• Bowline: 70% to 75%</td>
</tr>
<tr>
<td>• Two Half Hitches: 60% to 70%</td>
</tr>
</tbody>
</table>
**Over Hand Knot**

**Purpose:** To be used as a safety knot.

**Steps:**
- Take the running end of the knot and form a loop.
- Place the running end through the loop.
- Dress the overhand knot down to the knot that it is securing.

**Checkpoints:**
- A locking bar that secures the running end to the starting end.
- Minimum 4-inch pig tail.
**Square Knot**

**Purpose:** To join the ends of two ropes of equal diameter when they are under tension.

**Steps:**
- Holding one running end in each hand, place the running end in your right hand over the one in your left hand.
- Pull it under and then back over the top of the rope in your left hand.
- Place the running end in your left hand over the one in your right hand and repeat as in Step 2.
- Dress the knot down and safety it with an overhand knot on each side of the square knot.

**Checkpoints:**
- Two interlocking bights.
- The running ends are on opposite ends of the knot and on the same side of the standing ends.
- Minimum 4-inch pigtails after the overhand safety.
<table>
<thead>
<tr>
<th>Girth Hitch</th>
</tr>
</thead>
</table>
| **Purpose:** To attach a piece of webbing or cord to an anchor or into a harness.  
**Steps:**  
- Take a pre-tied piece of tubular webbing and place a bight over the anchor or harness. The joining knot should be offset.  
- Pass the knotted side of webbing through the bight.  
- Dress the wraps and locking bar down, ensuring the joining knot is offset and out of the girth hitch.  
**Checkpoints:**  
- Two turns around the object with a perpendicular locking bar.  
- The joining knot is offset and out of the turns. |

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
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<tbody>
<tr>
<td><img src="image1.png" alt="Diagram 1" /></td>
<td><img src="image2.png" alt="Diagram 2" /></td>
</tr>
</tbody>
</table>
Figure Eight Bend

**Purpose:** To join the ends of two ropes up to a 5-mm diameter difference.

**Steps:**
- Grasp the top of a long bight.
- With the other hand grasp, the running end (short end) and make a 360-degree turn around the standing end.
- Place the running end through the loop you have just formed creating an in-line figure eight.
- Route the running end of the other rope back through the figure eight starting from the original rope's running end. Trace the original knot to the standing end.
- Remove all twists and crossovers. Dress the knot down.

**Checkpoints:**
- Two ropes running side by side in the shape of a figure eight.
- The running ends are on opposite ends of the knot and on opposite sides of the standing ends.
- Minimum 4-inch pigtails.
Water Knot

Purpose: To join the ends of tubular webbing.

Steps:
- Tie an overhand knot in one end of the webbing.
- Route the other end of the webbing back through the overhand knot. Follow the course of the original overhand knot.
- Ensure all the webbing is lying flat within the knot.
- Dress the knot down.

Checkpoints:
- Two pieces of webbing running side by side in the shape of an overhand.
- The running ends are on opposite ends of the knot and on the same side of the standing ends.
- There are no twists in the webbing.
- Minimum 4-inch pigtails.
**Bowline**

**Purpose:** To anchor the end of a rope.

**Steps:**
- Bring the running end of the rope around the anchor, from right to left, top to bottom.
- With your right thumb facing toward you, form a loop in the standing part by turning your wrist clockwise. Lay the loop to the right.
- Reach down through the loop with your right hand. Pull up a bight from the standing part of the rope. Ensure the standing part of the bight is facing toward you.
- Place the running end of the rope (on your left) through the bight from left to right and bring it back on itself. Hold the running end loosely and dress the knot down by pulling on the standing end.
- Dress the knot down and safety the bowline with an overhand knot.

**Checkpoints:**
- A bight around the standing end, held in place by a loop.
- The running end of the bight is on the inside of the fixed loop.
- Minimum 4-inch pigtail after the overhand safety.
Purpose: To anchor a bight of rope.

Steps:
- Form a bight. Bring the running end of the rope around the anchor, from right to left top to bottom.
- With your right thumb facing toward you, form a doubled loop in the standing part by turning your wrist clockwise. Lay the loops to the right.
- With your right hand, reach down through the loops and pull up a doubled bight from the standing parts of the rope. Ensure that the standing parts are facing toward you.
- Place the running end (bight) of the rope (on your left) through the doubled bight from left to right and bring it back on itself. Hold the running end loosely and dress the knot down by pulling on the standing ends.
- Safety it off with a doubled overhand knot.

Checkpoints:
- Two bights around the two standing ends, held in place by two loops.
- The running end of the double bight is on the inside of the fixed loops.
- Minimum 4-inch pigtail after the overhand safety.
Clove Hitch

**Purpose:** To anchor the end of the rope under tension.

**Steps:**
- Make a turn around the anchor, left to right.
- Bring the rope over the standing part and down continuing around the anchor forming a diagonal locking bar.
- Continue wrapping around the anchor.
- Pass the running end under the locking bar just formed.
- Dress the knot down.

**Checkpoints:**
- Two turns around the anchor with the diagonal locking bar in the opposite direction of pull.
- The running and standing ends exit from the middle of the knot.
<table>
<thead>
<tr>
<th><strong>Clove Hitch: Middle of the Rope (MOR)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Purpose:</strong> To form an anchor in the middle of a rope.</td>
</tr>
<tr>
<td><strong>Steps:</strong></td>
</tr>
<tr>
<td>• Hold the rope in both hands, palms down about 12 inches apart.</td>
</tr>
<tr>
<td>• With the right hand, form a loop away from your body toward the left hand. Hold the loop with the left hand.</td>
</tr>
<tr>
<td>• Again, with the right hand, form a loop away from your body toward the left hand. Hold the loop with the right hand.</td>
</tr>
<tr>
<td>• Place the second loop on top of the first loop that you formed without flipping it.</td>
</tr>
<tr>
<td>• Place both loops over the anchor and pull both ends of the rope in opposite directions.</td>
</tr>
<tr>
<td><strong>Checkpoints:</strong></td>
</tr>
<tr>
<td>• Two turns around the anchor with the diagonal locking bar in the opposite direction of pull.</td>
</tr>
<tr>
<td>• The running and standing ends exit from the middle of the knot.</td>
</tr>
</tbody>
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<tr>
<th><strong>Clove Hitch: Middle of the Rope (MOR)</strong></th>
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<tbody>
<tr>
<td><img src="image1.png" alt="Step 1 Diagram" /></td>
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<tr>
<td><img src="image3.png" alt="Step 3 Diagram" /></td>
</tr>
</tbody>
</table>
**Double Figure Eight**

**Purpose:** To form a fixed loop in a rope.

**Steps:**
- Form a 12-inch bight.
- With the bight, make a 360-degree turn around the standing end forming a doubled loop in your hand.
- Place the bight through the loop.
- Remove all unnecessary twists and crossovers. Dress the knot down.
- *(VARIATION):* A Doubled Double Figure Eight is tied the same, but with a doubled rope.

**Checkpoints:**
- Two ropes running side by side in the shape of a figure eight.
- The knot forms a fixed loop.
- Minimum 4-inch pigtail when tied at the end of the rope.

---

**Double Figure Eight**

1. ![Diagram 1](image1)
2. ![Diagram 2](image2)
3. ![Diagram 3](image3)
4. ![Diagram 4](image4)
**Figure Eight Slip Knot**

**Purpose:** To form an adjustable bight in a rope.

**Steps:**
- Take a bight in the rope. Holding the closed end, grasp the doubled rope below the bight with the opposite hand. Make two twists in the bight (360 degrees) with the top hand.
- Maintaining the two twists, reach through the loop and pull a bight through the loop in your hand.
- Dress down the knot.

**Checkpoints:**
- The knot is in the shape of a figure eight.
- An adjustable bight passes through one loop of the figure eight.
### Middle of the Rope Prusik

**Purpose:** To create a moveable friction hitch.

**Steps:**
- Place a bight of rope over the fixed rope. The closed end of the bight is 4 to 6 inches below the fixed rope. The running ends are closest to you.
- Reach down through the bight pulling both running ends through the bight and continue around the anchor, repeat 2 more times. You will now have three round turns on the fixed rope and a locking bar running across them.
- Dress the wraps and locking bar down to make sure they are tight and not twisted.

**Checkpoints:**
- Three round turns with a perpendicular locking bar.

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>Place a bight of rope over the fixed rope. The closed end of the bight is 4 to 6 inches below the fixed rope. The running ends are closest to you.</td>
</tr>
<tr>
<td>2</td>
<td>Reach down through the bight pulling both running ends through the bight and continue around the anchor, repeat 2 more times. You will now have three round turns on the fixed rope and a locking bar running across them.</td>
</tr>
<tr>
<td>3</td>
<td>Dress the wraps and locking bar down to make sure they are tight and not twisted.</td>
</tr>
<tr>
<td>4</td>
<td>Three round turns with a perpendicular locking bar.</td>
</tr>
</tbody>
</table>

![Middle of the Rope Prusik](image-url)
End of the Rope Prusik

**Purpose:** To create a moveable friction hitch at the end of a rope.

**Steps:**
- With the running end, make three turns around the fixed rope, working to your right and top to bottom.
- With the running end, come back over the standing part and under the fixed rope.
- Come over the fixed rope and make three turns working toward the right, bringing the running end under the locking bar.
- Dress the knot down and stabilize with a bowline.

**Checkpoints:**
- Three round turns with a perpendicular locking bar.
- Stabilized with a bowline within six inches.
- Both ropes between the Prusik and bowline have equal tension.
- Minimum 4-inch pigtail.
Rerouted Figure of Eight

**Purpose:** To tie into the end of a rope.

**Steps:**
- Grasp the top of a 2-foot bight.
- With the other hand grasp, the running end (short end) and make a 360-degree turn around the standing end.
- Place the running end through the loop you have just formed.
- Place the running end around the anchor (or into the harness).
- Route the running end back through the figure eight tracing the original knot to the standing end.
- Remove all unnecessary twists and crossovers. Dress the knot down.

**Checkpoints:**
- Two ropes running side by side in the shape of a figure eight.
- The knot will form a fixed loop around a fixed object or harness.
- Minimum 4-inch pigtail.
- Maximum fist-sized fixed loop around fixed object or harness.
Munter Hitch

Purpose: To form a mechanical belay.

Steps:
- Hold the rope in both hands, palms down about 12 inches apart.
- With the right hand, form a loop away from your body toward the left hand. Hold the loop with the left hand.
- With the right hand, place the rope that comes from the bottom of the loop over the top of the loop.
- Place the bight that you have formed around the rope into the pearabiner. Lock the pearabiner.

Checkpoints:
- A bight passing through a locked carabiner.
- The closed end of the bight is around either the running or standing end.
### Super Munter Hitch

**Purpose:** To create a high friction lower.

**Steps:**
- Tie a Munter hitch with the closed end of the bight on the standing end of the rope.
- Bring the running end of the rope under the standing end and form a bight around the standing end.
- Clip the running end of the bight into the pearabiner and lock.

**Checkpoints:**
- Two bights passing through a locked pearabiner.
- The closed ends of both bights are on the standing end of the rope.

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**Auto Block**

**Purpose:** To create a moveable friction hitch with rope or webbing that is releasable under load.

**Steps:**
- Join a utility rope to form an endless loop, about 24 inches. You may use a standard length sewn runner or tubular webbing.
- Offset the joining knot. Wrap the clean portion of the endless loop around the rope a minimum of 4 times.
- Place both bights into a locking carabiner and lock.

**Checkpoints:**
- Minimum of four turns around the rope.
- Both bights in a locked carabiner.
- The joining knot is offset and out of the turns.

Do not use sewn webbing made of spectra.
**Munter Mule Knot**

**Purpose:** To create a releasable anchor knot.

**Steps:**
- Place a Munter hitch into a locking carabiner.
- With the brake strand(s) of the Munter, create an overhand loop and place onto the load strand(s) of the Munter hitch.
- Bring a bight through the overhand loop capturing the load strand(s) creating a slip knot.
- Dress the slip knot down against the Munter hitch.
- Pass the tails through the bight of the slip knot.
- Dress the bight to four to six inches.

**Checkpoints:**
- A bight passing through a locked carabiner.
- The closed end of the bight is around the load strand(s).
- Bight up through an overhand slipknot capturing the load strands.
- Tails passed through the bight of the slip knot.
- The bight is not less than six inches and not tight around tails.
- Tails at least 12 inches long.
Butterfly Coil with Farmer’s Tie Off

**Purpose:** To prepare a rope for carrying on the body.

**Steps:**
- Backstack the doubled rope until you have the approximate center bight.
- Place the center bight over your head and drape it in front, over your shoulder so it hangs no lower than your waist.
- With the rest of the doubled rope in front of you make doubled bights placing them over your head in the same manner as the first bite, ensuring you alternate from side to side (right to left, left to right etc.) while maintaining equal length bights.
- Continue coiling until you have approximately two arms lengths of rope left. Carefully remove the coils from your neck/shoulders holding the center in one hand.
- With the two ends, wrap the coils a minimum of three times ensuring the first wrap locks on itself.
- Pass a doubled bight from the two loose ends up through the apex of the coils, pull the two loose ends through the doubled bight and dress it down.
- Place the Butterfly Coil on your back.

**Farmer’s Tie Off:**
- Place the Butterfly Coil on your back.
- Separate the two loose ends.
- Bring one over your right shoulder and one over left shoulder.
- Continue down under your arms and across your back.
- Ensure the rope crosses over the coils.
- Secure the two ends in front with a square knot without overhand safeties.

**Checkpoints:**
- Coils uniform and even, within 6 inches.
- A minimum of three turns around the coils, with the first one locking on itself.
- A double bight through the top of the coils, securing the standing ends.
- A minimum of one wrap around the body and the coils tied off with an unsafetied square knot.
- Minimum 4-inch pigtails.
Butterfly Coil with Farmer's Tie Off

1. Start with a loop.
2. Make another loop and pull through the first loop.
3. Tie off the ends.
4. Twist the loops around the body.
5. Secure the knot.
6. Adjust to fit.
Field Expedient Seat Harness

**Purpose:** To form a seat harness out of tubular webbing for rappelling or climbing.

**Steps:**
- Take a piece of tubular webbing 22 feet long.
- Find the middle of the piece of the webbing and form a bight.
- Pass the bight between your legs from rear to front and pull it up to beltline level.
- Wrap the right and left tails of webbing around each respective leg from rear to front ensuring that the tails do not cross over one another.
- Pass the tails through the bight at belt level and wrap them back onto themselves.
- Wrap the remaining lengths of webbing around your body above the hips and continue to wrap in opposite directions.
- Join the tails together just above the hip using a square knot with overhand safeties.

You can use an expedient seat harness with or without a chest harness. Construct the harness from 22 feet of 1 or 2 inch tubular webbing. Inspect the webbing before and after each use. Use the field expedient seat harness when falls are very likely or you will be operating on steep terrain for long period.
Chapter 5. Rope Management

1) **Introduction:** Mountaineering ropes are vital tools for a unit operating dismounted in the mountains. Soldiers must understand how to properly coil and carry the rope so it is easily accessible and ready to be deployed at a moment’s notice. The quicker a unit can put a rope into use and negotiate an obstacle, the more effective they will be at accomplishing their mission.

2) **Procedures to Uncoil a Rope**

   a) Uncoiling/Back-Stacking. When you need to use your rope, you must be able to uncoil and lay it on the ground properly to avoid kinks and snarls.
      - After you have untied the Farmer’s Tie-off, unfold the coils, drop the ends of the rope and lay the coil on the ground.
      - After you have uncoiled the rope and it is lying on the ground, you should back-stack the rope to minimize kinks and snarls.

   b) Take one end of the rope in your left hand.
   c) Run your right hand along the rope until both arms are outstretched.
   d) Next, lay the end of the rope in your left hand on the ground.
   e) With your left hand, re-grasp the rope next to your right hand and continue laying the rope on the ground.
   f) The rope should be stacked in a neat manner on the ground.

3) **Procedures to Throw a Rope**

   a) To ensure that the rope will not become kinked and snarled when thrown, it should be back stacked.
   b) Tie off the bottom end of the back stacked rope to ensure that you do not lose the entire rope over the edge.
   c) Single butterfly coil 10-12 coils.
   d) A few preliminary swings will ensure a smooth throw. The swings should be made with the arm nearly extended and the coil should be thrown out and up. When possible, the rope should be thrown so that the running end is thrown into the wind. In a strong crosswind, the direction of throw can be angled into the wind so that the rope will land on the desired target.
   e) As soon as the rope starts to leave the hand, the thrower shouts the warning "Rope" to alert those below his position.

**Note:** Do not look up if you hear the command "rope" above you.
4) Procedures to Coil and Carry a Rope

a) Coiling the Rope: Allow each loop to lie naturally, as you coil, rather than forcing it into a neat looking coil. This will reduce twists and kinks when you use it.

b) Butterfly Coil: This method is excellent for carrying a rope when you have to climb or carry the rope for a short distance. The Butterfly coil can be started from the middle (called a double butterfly) or from the end (single butterfly).

- **Hand Method** (Double Butterfly)
  o Back-stack the doubled rope until you have the center bight.
  o With this bight in your left hand (the center of the rope) run your right hand along the rope until you have approximately one arm length of rope.
  o Let go of the bight in your left hand and re-grasp next to your right hand, palm up. Run your right hand along the rope until both arms are outstretched.
  o Bring your hands together, laying the rope in your left hand. Continue doing this, ensuring that the rope re-enters your hand from the same direction it exited.
  o Continue coiling bights until you have approximately twelve to fifteen foot tails.
  o Carefully remove the coils from your neck/shoulders holding the center in one hand.
  o With the two ends, wrap the coils a minimum of three times ensuring the first wrap locks in it.
  o Pass a double bight from the two loose ends up through the top of the coils, pull the two loose ends through the double bight and dress it down.
  o Finish using the farmer's tie-off.

- **Buddy Team Method**
  o Back-stack the double ropes until you have the center bight.
  o One team member stands with his feet shoulder width apart, arms down, waist bent, palms facing ground.
  o The other member wraps the rope around the hands and neck of the first man.
  o Continue coiling bights until you have approximately twelve to fifteen foot tails.
  o The team member whose was coiling the coils around the first team member grabs the center of the coils, removes the coils off the first member's neck.
  o With the two ends, wrap the coils a minimum of three times ensuring the first wrap locks on itself.
  o Pass a double bight from the two loose ends up through the top of the coils, pull the two loose ends through the double bight and dress it down.
  o Finish using the farmer's tie off.
• Neck-Shoulder Method
  o Back-stack the double ropes until you have the center bight.
  o Place the center bight over your head and drape it in front, over your shoulder so it hangs no lower than your waist.
  o With the rest of the double rope in front of you, make double bights placing them over your head in the same manner as the first bight, ensuring you alternate from side to side (right to left, left to right etc.) while maintaining equal length bights.
  o Continue coiling bights until you have approximately 12 to 15 foot tails.
  o Carefully remove the coils from your neck/shoulders holding the center in one hand.
  o With the two ends, wrap the coils a minimum of three times ensuring the first wrap locks in it.
  o Pass a double bight from the two loose ends up through the top of the coils, pull the two loose ends through the double bight and dress it down.
  o Finish using the farmer's tie off.

• Farmer's Tie Off
  o Place the Butterfly Coil on your back.
  o Separate the two loose ends.
  o Bring one over your right shoulder and one over left shoulder.
  o Continue down under your arms and across your back.
  o Ensure the rope crosses over the coils.
  o Secure the two ends in front with a square knot without overhand safeties.

c) Coiling the 18-foot, 7mm Utility Cord
  • Bring the two ends of the rope together, ensuring there are no kinks in the rope.
  • Place the ends of the rope in your left hand with the two ends facing toward you.
  • Coil the doubled rope in a clockwise direction forming 6-8 inch coils, until an approximately 12-inch bight is left.
  • Wrap that bight around the coil, ensuring that the first wrap locks on itself.
  • Make 2-3 wraps.
  • Feed the bight up through the bights formed at the top of the coil. Cinch down.
  • Hang the bight on a carabineer IAW SOP.
Chapter 6. Anchors

1) **Introduction:** Safe anchors are a fundamental component to mountaineering. Your ability to quickly and safely establish a strong anchor with minimal gear will greatly enhance your unit’s mobility in the mountains. Anchors are used to belay climbers, lower casualties, and establish numerous types of rope installations.

2) **Natural Anchors**

   a) **Natural Anchors** should be considered for use first. They can be strong and often simple to construct with minimal use of equipment. Trees, boulders and other terrain features are already in place and simply require a method of attaching the rope. However, natural anchors should be carefully evaluated for stability and strength before use. Sometimes the rope is tied directly to the anchor, but under most circumstances a sling is attached to the anchor and then the rope is attached to the sling with a carabiner(s).

   b) **Trees:** Trees are the most widely used of all natural anchors. They must be carefully checked 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 leverage on the tree.
      - Use padding on soft, sap producing trees to keep sap off ropes and slings.

**Trees Used as Anchors**
c) **Boulders**: Boulders and rock projections make ideal anchors. The rock can be firmly tapped with a piton hammer to ensure it is solid. Loose rock formations are not stable. Talus and scree fields indicate that the rock in the area is not solid. Pad all areas around the rock formation that could cut the rope or sling.

![Boulder/Rock Projection Used as an Anchor](image)

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d) **Chockstones**: A chockstone is a rock that is wedged in a crack because the crack narrows downward. Chockstones should be checked for strength, security, crumbling and should always be tested before use. All chockstones must be solid and strong enough to support the load. They must have maximum surface contact and be well tapered with the surrounding rock remaining in position.

- Chockstones are directional. They are secure when pulled in one direction but may pop out if pulled in another direction.
- A creative climber can often make his own chockstone by wedging a rock into position and tying a rope or sling to it.
- Slings should not be wedged between the chockstone and the rock wall since a fall could cut the sling.

![Chockstones](image)
e) **Rock Projections:** Rock projections often provide suitable protection. These include blocks, flakes, horns, and spikes. If rock projections are used, their firmness is important. They should be checked for cracks or weathering that may impair their strength. If any of these signs exist, the projection should be avoided.

f) **Tunnels and Arches:** Tunnels and arches are holes formed in solid rock and provide one of the more secure anchor points because they can be pulled in any direction. A sling is threaded through the opening hole and secured with a joining knot or girth hitch. The load-bearing hole must be strong and free of sharp edges (pad if necessary).

g) **Bushes and Shrubs.** If no other suitable anchor is available, routing a rope around the bases of several bushes can use the roots of bushes. As with trees, the anchoring rope is placed as low as possible to reduce leverage on the anchor. All vegetation should be healthy and well rooted to the ground.

3) **Single Point Anchor Techniques**

a) **Slinging Techniques:** There are many methods used to attach slings (webbing) or cords to a natural anchor. Whichever method is used, the knot is set off to the side where it will not interfere with normal carabiner movement. The carabiner gate should face away from the ground and open away from the anchor for easy insertion of the rope.
Note: When a locking carabiner is unavailable, two non-locking carabiners can be used with gates opposite and opposed. Correctly opposite and opposed gates should form an "X" when opened, with the gates on opposite sides, and the noses on the same end.

Correctly Opposed Carabiners

- **Single Loop Method:** Drape the sling or cord over the anchor. Untying the sling or cord and routing it around the anchor and then retying is still considered a single loop method.

- **Double Bight Method:** Wrap the sling or cord around the anchor and connect the two ends together with a carabiner(s).
  - A doubled-double figure of 8, or similar knot, can be used to isolate each strand. This adds redundancy to the anchor, and creates a master point.

- **Girth Hitch:** Attach the sling around the anchor with a girth hitch. Although a girth hitch reduces the strength of the sling, it allows the sling to remain in position and not slide on the anchor.
b) Anchoring With the Rope

- **Direct:** The climbing or installation rope can be tied directly to the anchor using several different techniques. This requires less equipment, but also sacrifices some rope length to tie the anchor. The rope can be tied to the anchor using an appropriate anchor knot such as a bowline, three-loop bowline or a rerouted figure eight. Round turns can be used to help keep the rope in position on the anchor.

  - **High Strength Tie Off:** The high strength tie off is used to anchor the rope on high-load installations such as bridging. The wraps of the rope around the anchor absorb the tension of the installation and keep the tension off the knot and carabiner. The anchor is tied with a minimum of two wraps to absorb the tension. The rope is wrapped from top to bottom. A fixed loop is placed into the end of the rope and attached back onto the rope with a locking carabiner. The tie off should be tested to ensure wraps don’t slip under load. If so, continue adding more wraps until the carabiner and knot remains loose under load.

![High Strength Tie-Off (AKA Tensionless Anchor)](image)

4) Artificial Anchors

a) **Artificial Anchors** become necessary when natural anchors are unavailable. Choosing and placing good anchors requires a great deal of practice and experience. Artificial anchors are available in many different types such as pitons, chocks, bolts, Spring-Loaded Camming Devices (Cams), ice screws, deadmen, and snow pickets. Anchor strength varies greatly. The type used depends on the terrain, equipment, rock and ice quality and the load to be placed on it.

b) **Pitons:** Pitons have been in use for over 100 years. Although still available, pitons are not used as often as other types of artificial anchors due primarily to their impact on the environment. Most climbers prefer to use chocks, cams, and other artificial anchors rather than pitons because they do not scar the rock and are easier to remove.

- **Advantages**
  - Depending placement, pitons can support multiple directions of pull.
  - Pitons are less complex than other types of artificial anchors.
  - Pitons work well in very thin cracks
• **Disadvantages**
  o During military operations, the distinct sound created when hammering pitons is a tactical disadvantage.
  o Due to the expansion force of emplacing a piton, the rock could spread apart or break causing an unsafe condition.
  o Pitons are more difficult to remove than other types of artificial anchors.
  o Pitons leave noticeable scars on the rock.
  o Pitons are easily dropped if not tied off when being used.

• **Piton Placement:** The proper positioning or placement of pitons is critical. A properly sized piton for a rock crack will fit one-half to two thirds into the crack before being driven with the piton hammer. As pitons are driven into the rock the pitch or sound that is made will change with each hammer blow, becoming higher pitched as the piton is driven in.

**Note:** Eye protection should always be worn when driving a piton into rock.

![Piton Placement Diagram]

• **Removing Pitons:** Attach a carabiner and sling to the piton before removal to eliminate the chance of dropping and losing it. Tap the piton firmly along the axis of the crack in which it is located. Alternate tapping from both sides while applying steady pressure. Pulling out on the attached carabiner eventually removes the piton.
c) **Chocks:** Chock craft has been in use for many decades. A natural chockstone, having fallen and wedged in a crack, provides an excellent anchor point. Sometimes these chockstones are in unstable positions, but can be made into excellent anchors with little adjustment. Chock craft is an art that requires time, technique and practice to master. Imagination and resourcefulness are key principles to chock craft. The skilled climber must understand the application of mechanical advantage, vectors, and other forces that affect the belay chain in a fall.

- **Advantages**
  - Tactically quiet installation and recovery.
  - Reusable unless severely damaged.
  - Light to carry.
  - Easy to insert and remove.
  - Minimal rock scarring as opposed to pitons.
  - Sometimes can be placed where pitons cannot (expanding rock flakes where pitons would further weaken the rock).

- **Disadvantages**
  - May not fit in thin cracks, which may accept pitons.
  - Often provide only one direction of pull.
  - Practice and experience necessary to become proficient in proper placement.

- **Placement:** The principles of placing chocks are to find a crack with a constriction at some point, place a chock of appropriate size above and behind the constriction and set the chock by pulling down on the chock loop. Maximum surface contact with a tight fit is critical. Chocks are good for a single direction of pull.
  - Avoid cracks that have crumbly (soft) or deteriorating rock. Some cracks may have loose rock, grass and dirt, which should be removed before placing the chock. Look for a constriction point in the crack and then select a chock to fit it.
  - When selecting a chock, choose one that has as much surface area as possible in contact with the rock. A chock resting on one small crystal or point of rock is unsafe. A chock that sticks partly out of the crack is dangerous. Ensure that the chock has a wire or runner long enough; extra ropes, cord or webbing may be needed to extend the length of the runner.
  - Parallel-sided cracks without constrictions are a problem. Chocks used in this situation rely on camming principles to remain placed. Weighting the placement with extra hardware is often necessary to keep the chocks from dropping out.
Testing: After seating a chock, test it to ensure it remains in place. A chock that falls out when the climber moves past it is unsafe, dangerous and offers no protection. To test it, firmly pull the chock in every anticipated direction of pull. Some chock placements fail in one or more directions; use pairs of chocks in opposition.

d) Spring-Loaded Camming Devices (Cams): Cams are spring-activated camming device. It was developed to provide reliable placements in cracks where ordinary chocks are difficult or impossible to place, (i.e. parallel-sided cracks, flaring cracks and cracks under roofs). Cams can be placed quickly and be very convenient (saving time and effort in places where protection is needed and ordinary chocks would be tricky and time consuming to place)

Placement: Cams are easy to place. Just hold it like a hypodermic syringe, pull the trigger, place it in the crack and release the trigger.

Removal: Pull the trigger and gently remove
- **Miscellaneous**
  - There should be as much surface area as possible between the camming lobes of the device and the rock.
  - Avoid placing the lobes on small crystals.
  - The cams should always be placed between 1/3 and 2/3 of its expansion range. If the bar must be pulled all the way, back to get it into the crack, it may be impossible to remove. Use a smaller size.
  - Do not place cams any deeper into the crack than necessary. It may be impossible to reach the trigger for removal.
  - When placed behind flakes or in deep cracks, cams have been known to "walk up" into the crack out of reach, as a result of rope action. Cams should be extended with a runner in such placements.
  - Cams should always be placed so the direction of pull is parallel to the shaft or it can rotate and pull out.
  - Cams produce tremendous force on the rock when loaded. The rock around the placement must be solid. Avoid placements behind thin or loose flakes.

**e) Bolts:** Bolts are used where cracks are not available.

- Bolts provide one of the most secure means of establishing anchors. The rock should be inspected for evidence of crumbling, flaking, cracking and can be tested with a hammer. Placing a bolt with a hammer and a hand drill is a time-consuming and difficult process that requires drilling a hole in the rock deeper than the length of the bolt. This can takes up to 20 minutes for one hole in hard rock. Battery powered or even gas-powered drills can be used to greatly shorten drilling time. However, their size and weight can make them difficult to carry.

- A hanger and nut are placed on the bolt; the bolt is inserted and then driven into the hole. A climber should never hammer on a bolt to test or "improve" it, since this permanently weakens it. Bolts should be used with hangers, carabiners and runners.

- Some bolts are available in which the sleeve is hammered and turned into the rock (self-drilling), which bores the hole. Split bolts and expanding sleeves are the most common types of bolts. Surgical tubing is useful in blowing dust out of the holes. Nail type bolts are placed by driving the nail with a hammer to expand the sleeve against the wall of the drilled hole.

**Note:** Safety glasses should always be worn when placing bolts.
f) Snow and Ice Anchors

- **Ice axe:** The ice axe can be a superb anchor in suitable snow conditions. However, oftentimes snow is either too hard or too soft for an ice axe anchor to be effective. Other anchors must be found.

- **Snow pickets:** Snow pickets are stakes, angled or T-shaped, made of aluminum with holes drilled along its length for carabiner attachment. They can be used as stakes or buried in the snow as dead-men (see dead-men). They are made in a variety of lengths to suit snow conditions.

- **Dead-men:** A dead-man is a rectangular aluminum plate. Bury or pound a dead-man in the snow at an angle approximately 45-degrees away from the direction of the load. A steel cable with a loop in the end to clip into, runs perpendicular from the plate toward the belayer. Set the dead-man in the snow. Arrange the suspension to pull harder on the inner end.
  
  o The harder it is loaded, the deeper it is buried when loaded. This sounds like it provides absolute security in very soft snow, but there are some problems. If a dead-man is not set at the proper angle, it can pull out. It can dig into the snow until it hits ice or an old hard crust that causes it to glance off and pull out.
  
  o When working in soft snow, bury the dead-man as deep as possible. In hard snow, it is necessary to hammer the plate in or to cut a suitably shaped slot. Remember: do not disturb the snow between the plate and the direction of pull except to cut a slot for the cable. Cut this narrow slot in all types of snow. Viewed from above, the wire must be at right angles to the plate. If possible, test-load the anchor to ensure proper seating.

![Snow Deadman](image-url)
• Other Deadman-Type Anchors
  o Bury an ice axe or picket horizontally or vertically across the slope as deep as possible. Tie into the middle (horizontal placement) or end (vertical placement) of the shaft.
  
o A buried pack can also make a good anchor.

• Snow / Ice Bollard: The bollard or horseshoe anchor is the most valuable. This constructed "horn" is simple and efficient. The major drawback is construction time.

  Bollard

  o The strength of a bollard depends on its size and to the hardness of the snow or ice. Even in soft snow, a properly constructed bollard can hold hundreds of pounds, and on ice, it can be so strong that the rope is the weak link.
  
o A bollard on ice needs to be only one foot in diameter, but on soft snow, is must be broader and deeper. Ten feet across and eighteen inches deep. If the snow is compactable, you should pack it down before you cut a groove for the rope. Do not leave any slack in the anchor rope and make sure you shape the slot like the head of a mushroom so that the rope cannot jump out.

• Ice screws: Use ice screws to establish anchor points. Ice screws are threaded and are placed into the ice by hand and then turned like a screw.

  o Clear away any bad ice before placing a screw.
  o It is possible to place a 22cm long screw in just a few seconds.
  o It is ideal to place the ice screw so that the hanger is flush with the surface of the ice.
Ice Screw Placements

- Placing the ice screw at a positive angle will reduce the stress in both the ice screw and the ice. Reducing these stresses will allow the ice screw placement to hold more load during a fall.

- To use multiple screws in a load-sharing anchor, join them together using the same techniques as you would for rock anchors. Offset screws to avoid fracturing the ice.

g) Earth Anchors

- **Dead-man**: A "dead-man" anchor is any solid object buried in the ground and used as an anchor. An object that has a large surface area and some length to it works best. Large boulders can be used, as well as a bundle of smaller tree limbs or poles. As with natural anchors, ensure timbers and tree limbs are not dead or rotting and that boulders are solid. Equipment, such as skis, ice axes, snowshoes, and rucksacks, can also be used if necessary. In extremely hard, rocky terrain a variation of the dead-man anchor can be constructed by building above the ground. The sling is attached to the anchor, which is set into the ground as deeply as possible. Boulders are then stacked on top of it until the anchor is strong enough for the load. Though not as strong as when buried, this method can work well for light-load installations as in anchoring a hand line for a stream crossing.
Dead-man Anchor

- **Picket holdfast:** The picket holdfast is easier to construct but will not hold as well as the dead-man. Drive pickets (at least 2 meters long and 8 cm in diameter) one meter into the ground and 1 to 2 meters apart. Align one behind the other, each 90 degrees to the direction of pull. Tightly lash the head of each picket (except the last one) to the base of the one behind. Tie the anchor to the base of the picket closest to the load.

5) Vehicle Anchor Considerations

a) Vehicles can often afford quick and secure anchor points provided there is sufficient access. Care must be taken to ensure that parking brakes are applied, wheels are adequately chocked, and secured so the vehicle cannot be driven. One must also make certain that appropriate attachment points are selected and care is taken to protect all rope and webbing from sharp edges. Always be cautious and conservative when using vehicles as anchors for any technical rope work.
Use Caution When Using Pintle Hitch

Do Not Use Brush Guard

Tie Down Points

Clevis Hitch

Bumper

Sling Load Points

Clevis Hooks

Bumper

Around Tire From the Top
6) Multiple Point Anchors

a) Joining the strength of many single anchor points together may be necessary when the individual anchors are not substantial enough for the load on their own. You may construct these systems with natural, artificial or a combination of both types of anchors. The preferred technique is called pre-equalized. For use the direction of pull must be reasonably predictable.

b) Considerations of Equalizing Multiple Point Anchors

- **Angles:** The angle formed by the rope or runner going to the load effects the weight distribution to the anchors of a dual anchor arrangement.

![Tension in Multiple Anchor Rigging](image)

**Effects of Angles on Anchors**

- **E.R.N.E.S.T Principles:** The principles of “ERNEST” should be applied to all multi-point anchors when possible.
  - **E:** Equalized so that forces are distributed equally among all anchor components.
  - **R:** Redundant so that all elements are backed up. Failure of a single component will not result in overall anchor failure.
  - **N/E:** No extension. In the event of single component failure the remaining component(s) will not be shock loaded.
  - **S:** Solid. All individual components are solid, as well as the surrounding rock or features in which they are placed. Not all components are placed in the same crack or feature.
  - **T:** Timely. Anchors should be established in a timely manner so that you can get on with the mission.

  - Soldiers must exercise sound judgment if using anchors that do not satisfy the “ERNEST” principal and must understand any resulting limitations and weigh the consequences and likelihood of failure.
c) **Methods of Equalizing Multiple Point Anchors**

- **Pre-equalized Systems:** With an endless loop, clip one strand through a carabiner in each anchor. Pull a bight down between each anchor and adjust all the bights in the direction of force. Tie them off with a double figure eight loop.

  - Pre-equalizing two natural anchors such as trees oftentimes does not require the use of carabiners at the anchor. To use this method simply attach one end of a cord or short length of rope to one tree with a bowline, then attach the other end to the other tree in the same way. Then grasp the rope in the direction the anchors will be loaded and tie a double figure of eight loop. Ensure angles are appropriate.

![Pre-Equalized Anchor](image)

- **Self-Equalizing Systems**

  - This is potentially used when equalizing two very solid anchors such as bolts that are fairly close together. A self-equalizing anchor will maintain an equal load on each individual point as the direction of pull changes. A self-equalizing anchor should only be used when necessary because if any one of the individual points fail, the anchor will extend and shock-load the remaining points or even cause complete anchor failure.
d) Techniques for Rappel Anchors

- Non-Retrievable Rappel Point
  - Rappels less than ½ The Rope Length.
    - Double the rope and tie a triple bowline to anchor.
    - Use correct anchor knot for selected site (i.e. three loop bowline, two-loop figure eight, MOR clove hitch with bowline, etc.).
  - Rappels Greater Than ½ the Rope Length.
    - Use two ropes.
    - Tie the end of the rope off correctly.
    - Repeat with the second rope.
    - Tie knots at ends of rope to prevent from rappelling off.

- Retrievable Rappel Point
  - Retrievable Rappels Less Than ½ the Rope Length.
    - Place the middle of the rope around or in the anchor.
    - Tie a knot at both ends of the rope to avoid rappelling off the end.
    - Use both sections of the rope to descend.
    - When finished, untie the knot, and pull on one section of the rope to retrieve.
    - If the rappel rope catches on something when pulled and one end is out of reach, you have the choice of leaving the rope or climbing unroped to free it. To avoid this, the first person untangles the rappel ropes while descending and those following will attempt to do the same. Before the last person comes down, someone pulls one end of the rope to make certain it can be retrieved easily.
  - Retrievable Rappels Greater than ½ the Rope Length
    - Join the ends of two ropes together with a flat overhand knot with 12-18" pigtails.
    - Tighten each strand of rope individually.
    - Place the joined ropes around the anchor with the joining knot offset.
    - When you reach the bottom of the rappel pull on the end of rope that has the joining knot closest to the edge, so as not to pull it back around the anchor.
    - Pull the rope steadily so the free end will not whip and wrap around anything.
    - Call "ROPE" loudly before the rope falls during training when needed.
    - When the top anchor is set back from the edge, take the end of the rope to be pulled and walk away from the cliff to lessen the angle of the rope and allow it to be pulled more easily.
    - Tie knots at ends of rope to prevent from rappelling off.

Note: Keep track of which rope is "clean" and which rope has a knot tied in it.
<table>
<thead>
<tr>
<th>Anchor Type</th>
<th>Training Site (2 fixed lines)</th>
<th>Retrievable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tree anchor, &lt; half rope length</td>
<td>Triple bowline at tree</td>
<td>Middle of rope at back of tree</td>
</tr>
<tr>
<td>Multi-point anchor, &lt; half rope</td>
<td>Double Figure of Eight clipped to carabiners at</td>
<td>Middle of rope clipped into master point</td>
</tr>
<tr>
<td>length</td>
<td>master point</td>
<td></td>
</tr>
<tr>
<td>Tree anchor, &gt; half rope length</td>
<td>2 ropes, each tied off with bowline at tree</td>
<td>2 ropes joined with joining knot just offset</td>
</tr>
<tr>
<td>Multi-point anchor, &gt; half rope</td>
<td>2 ropes, each tied with double Figure of Eight</td>
<td>2 ropes joined and clipped to carabiners at</td>
</tr>
<tr>
<td>length</td>
<td>clipped to carabiners at master point</td>
<td>master point, joining knot just offset from</td>
</tr>
<tr>
<td></td>
<td></td>
<td>master point</td>
</tr>
</tbody>
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Chapter 7. Mountain Travel Techniques

1) Introduction: The ability to move efficiently and effectively in broken mountainous terrain is what separates trained mountain units from the untrained. Soldiers must have the knowledge and skills to move through steep, rocky or snow covered terrain in order to close with and destroy the enemy. Mountain Soldiers must be comfortable on snowshoes in the winter and on rock in the summer.

2) Fundamentals of Movement

a) Technique
- Keep weight centered over feet at all times.
- Place your foot flat on the ground to obtain as much sole contact as possible.
- Place your foot on the uphill side of grass clumps, small talus and other un-even terrain to avoid twisting ankles and straining your calves.

b) Pace
- Adapted to the terrain.
- The Soldier maintains pace and compensates for changes of slope or terrain by adjusting the length of his stride. A steady and constant pace is enhanced when an interval of three to five paces is kept between Soldiers. This interval helps lessen the "accordion" effect at the end of the file.
- When an effective pace is set, a unit can cover a given distance in a minimal time and be ready to fight.

c) Rest Breaks
- During the first thirty minutes of movement, an adjustment halt should be taken. Soldiers should loosen or tighten bootlaces as needed, adjust packs and add or remove layers of clothing.
- Following the first halt, a party may take a short rest every 1 to 1.5 hours. These halts are kept short to avoid muscles stiffening (one to five minutes).
- Later in the march, longer halts may be necessary due to fatigue or mission requirements. At these halts, Soldiers should immediately put on additional clothing to avoid cooling (it is much easier to keep a warm body warm than to warm up a cold one).
- After a long climb, a rest may be needed to revive tired muscles.
d) Rest Step
- Used for steep slopes, snowfields and in higher elevations. It controls pace and limits fatigue by giving the lungs and legs a moment to recuperate. Pace is kept slow and rhythmic.
- After each step forward, the Soldier pauses briefly, relaxing the muscles of the forward leg while resting his entire body weight on the rear leg. The rear leg is kept straight with the knee locked so that bone, not muscle, supports the weight.
- Breathing is synchronized 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. When the air thins at altitude, it is important to breathe deeply.

Note: If side hill travel is necessary, try to switchback 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.

3) Four Types of Terrain

a) Hard Ground: Hard ground is firmly compacted, rocky soil that does not give way under the weight of a Soldier’s step. It is most commonly found under mature forest canopy, in low brush and areas where animals have beaten out multiple trails.

- **Ascending**: When ascending, these slopes can be traversed rather than climbed straight up. To turn at the end of each traverse, the Soldier should step off in the new direction with the uphill foot. This prevents crossing the feet and possible loss of balance. For small stretches, the herringbone step may be used—ascending straight up a slope with toes pointed out. A normal progression, as the slope gets steeper, would be from walking straight up, to a herringbone step and then to a traverse on the steeper areas.

- **Descending** is best done by walking straight down the slope without traversing. The Soldier keeps his back straight and bends at the knees to absorb the shock of each step. Body weight is kept directly over the feet and the full boot sole is placed on the ground with each step. Walking with a slight forward lean and with the feet in a normal position makes the descent easier.

b) Grassy Slopes: Grassy slopes can be composed of small clumps of growth rather than one continuous field.

- **Ascending**: When ascending, step on the upper side where the ground is more level

- **Descending**: When descending, the traverse technique should be used because of the uneven nature of the ground. A Soldier can easily build up too much speed and fall if a direct descent is tried.

Note: Wet grass can be extremely slippery. The Soldier must be aware of ground cover conditions.
c) **Scree Slopes:** Slopes composed of the smallest rocks are called scree slopes. Scree varies in size from gravel to the size of a man’s fist.

- **Ascending** scree slopes is difficult, tiring and should be avoided. All principles of ascending hard ground and snow apply, but each step is carefully chosen so the foot does not slide down when weighted. This is done by kicking in with the toe of the upper foot (similar to step kicking in snow) so that a step is formed in the loose scree. After determining that the step is stable, weight is transferred to the upper leg. The Soldier then steps up and repeats the process with the next foot.

- **Descending:** The best method for descending scree slopes is to come straight down the slope using a short shuffling step with the knees bent, back straight, feet pointed downhill and heels dug in. When several climbers descend a scree slope together, they should be as close together as possible (one behind the other at single arm interval) to prevent injury from dislodged rocks. Avoid running down scree as this can cause a loss of control. When the bottom of the slope cannot be seen, use caution because drop-offs may be encountered.

d) **Talus Slopes:** Talus slopes are composed of rocks larger than a man’s fist.

- **Ascending / Descending:** When walking in talus, ascending or descending, climbers should always step on the uphill side of rocks and stay alert for movement underfoot. Disturbing unstable talus can cause rockslides. Climbers must stay in close columns while walking through talus so that dislodged rocks do not reach dangerous speeds before reaching lower Soldiers. To prevent rock fall injuries, avoid traversing below other climbers.

e) **Other Terrain**

- **Snow Slopes:** Snow-covered terrain can be encountered throughout the year in many mountainous areas. The techniques for ascending and descending snow slopes are similar to walking on hard ground and scree.

- **Thick Brush:** Brush-filled gullies can provide routes and rally points concealed from observation. On the other hand, steep brushy terrain is difficult to negotiate. Cliffs and steep ravines are hidden traps. Blow downs and thickets can obstruct travel as much as manmade obstacles. When brush must be negotiated, take the most direct route across the obstacle, look for downed timber to use as raised paths or create a tunnel through the obstacle by prying the brush apart, standing on lower branches and using upper limbs for support.

4) **Safety Considerations:** Mountain walking techniques are designed to reduce the hazards of rock fall and loss of control. Carelessness can cause the failure of the best-planned missions.

- Whenever a rock is kicked loose, the warning, "Rock!" is shouted immediately near vertical terrain. Personnel near the bottom of the cliff immediately lean into the cliff to reduce their exposure and do not look up. Personnel more than 3 meters away from the bottom of the cliff may look up to determine where the rock is heading and seek cover. Lacking cover, personnel should anticipate which way the rock is falling and move out of its path.
• If a Soldier slips or stumbles on sloping terrain (hard ground, grass, snow or scree) he must immediately self-arrest, digging into the slope with hands, elbows, knees and toes. If he falls backwards, he must immediately try to turn over onto his stomach with his legs downhill and self-arrest with hands and toes.

• When traveling through steep terrain, Soldiers should be trained in the use of the ice axe for self-arrest. The axe can be used to arrest a fall on solid ground, grass and scree as well as snow. It may also be used as a third point of contact on difficult terrain. If not in use, the ice axe is carried in or on the rucksack.

5) Move on Snowshoes

a) Snowshoe Technique

• **Striding Technique:** In taking each stride, the toe of the snowshoe is lifted forward conserving energy by lifting no higher than is necessary to clear the snow. The tail slides over the snow. If the front of the snowshoe catches, the foot is pulled back to free it and then lifted before proceeding with the stride. The best and least fatiguing method of travel is a loose-kneed, rocking gait in a rhythmic stride. Avoid stepping on or catching the other snowshoe.

  o **Gentle Slopes:** On gentle slopes, climb straight up to ascend.

  o **Steep Slopes:** Ascend steeper terrain by traversing and packing a trail across it. When climbing, the snowshoe is placed as horizontally as possible in the snow. On hard snow, the snowshoe is placed flat on the surface with the toe of the higher one diagonally uphill to get more traction. Traction is very poor on hard-packed or crusty snow. If the snow is hard enough to support the weight of a person it is better to remove the snowshoes and proceed on foot.

  o **Turning:** When turning around, the best method is to swing the leg up and turn in the new direction.

  o **Additional Considerations:** Step over obstacles such as logs, tree stumps, ditches and small streams. Take care not to place too much strain on the snowshoe ends by bridging gaps, as the frames may break. In shallow snow, there is a danger of catching and tearing the webbing on tree stumps or snags. Wet snow will frequently ball up under the feet, interfering with comfortable walking. Knock the snow off with a stick or pole when possible. Although ski poles are generally not used in snowshoeing, one or two poles are desirable when carrying heavy loads, especially in mountainous terrain. You may cut off circulation and frostbite may occur if bindings are too tight. During halts, bindings should be checked for fit and possible readjustment.
b) **Training:** Snowshoe training requires little technical skill. You can learn the technique in a few periods of instruction. Stiffness and muscle soreness can be expected, increasing with loads and distances covered. A good conditioning program must be used to develop muscles seldom used in ordinary marching. Training should be progressive, with ample time allowed for the individual to gain proficiency, gradually increasing the distance covered and weight carried or pulled. Train to overcome obstacles such as dense brush, fallen timber, and ditches. Stress breaking trail with frequent changes of lead men. You can accomplish snowshoe training concurrently with other training requiring individual cross-country movement.

c) **Employing and Carrying Weapons on Snowshoes**

- The purpose of using skis or snowshoes in combat is to speed up the movement of individuals over deep snow. This also exposes them to hostile fire for the shortest possible time. Individuals using snowshoes may keep them on through all phases of the attack.

- As friendly forces approach the effective range of enemy weapons, they move by fire and maneuver. Individuals proceed by short rushes on foot, on skis, or on snowshoes, whichever is most feasible. When rushing on foot or on snowshoes, the weapon should be readily available for action.

- When contact with the enemy is not expected, carry your individual weapon across your back with the sling over either shoulder. Keep the butt at the side of or attached to your rucksack (if carried). When contact with the enemy is imminent, sling the weapon around your neck and in front of your body. When you establish contact with the enemy, carry your weapon in both hands so the weapon is readily available for action.

- Under conditions where the depth of the snow is less than 20 inches (50cm) snowshoes might slow you down. Leave snowshoes in the objective rally point if they hamper mobility during the assault. After you seize the objective, recover snowshoes and bring them forward.
Chapter 8. Climbing Techniques

1) Introduction: Military mountaineering provides access to otherwise inaccessible mountainous terrain. Soldiers skilled in mountaineering techniques can accomplish essential missions in difficult terrain. They can serve as guides, observers, snipers, scouts, security elements and assault team members. Historical examples reinforce the importance of developing Soldiers capable of climbing through technical terrain in order to bypass enemy security and defenses guarding less technical avenues of approach. For Soldiers operating in less technical terrain, the skills developed climbing in steeper terrain will translate into confidence, speed, and efficiency negotiating obstacles that require easy scrambling.

2) The Belay

a) The belay is the technique used to arrest a climber’s fall should one occur. A climber is tied into the rope, and a belayer feeds out or takes in rope between them in order to minimize the distance a climber can fall.

b) Movement through technical terrain is usually done as a rope team. Each climber will tie into an end of the rope. The more experienced climber will “lead climb”, climbing up through the terrain, placing pieces of protection and clipping the rope into them, while the belayer feeds out rope. The lead climber may expose themselves to significant fall hazard as they climb above pieces of protection. At a good stance, or on the other side of the obstacle, the lead climber will build a solid anchor, and provide a belay to the second climber, keeping the rope tight to protect against a fall.

3) Concept of a Top Rope System

a) A top rope system is one in which both rope ends are on the ground and the rope runs up to the top of the cliff (or climb) and passes through carabiners in a pre-established anchor point. This enables one Soldier to climb while the other Soldier takes in rope via a mechanical belay. The belayer keeps the rope tight to prevent the climber from falling more than a short distance. This system also enables the belayer to lower the climber back down to the ground after completing the climb.

b) A top rope system is a training tool only. It allows Soldiers to learn the fundamentals of tying in and belaying, and to practice individual climbing techniques without the consequences of a long leader fall, or unroped fall, on steep terrain. It allows one instructor to coach and supervise both the climber and the belayer. It also facilitates learning climbing technique because all of the participants can observe one another.
4) **Tying Into a Harness:** A climber ties into the rope using a rerouted figure eight. The knot should be tied tight to the harness, dressed down, and with sufficient pigtail to ensure it is secure. There are three types of harnesses you may see during this course:

a) The field expedient harness can be used for belayed climbing. Tubular webbing is easily procured within the supply system and may serve multiple functions for the Soldier when not used as a harness. The rerouted figure eight is tied around the “diaper portion” between the leg loops and all of the waist portion of the harness. Extra care must be taken with inspections when using the field expedient harness.

b) The manufactured harness included in the HAM Kit is more comfortable and easier to use than the field expedient harness. It is one size fits all, and the single attachment point in the front simplifies inspection. The rope is tied into the reinforced tie in portion of the harness.

c) The climbing harness used by most instructors and the students in the Advanced Military Mountaineer Course (AMMC) has a separate belay loop joining independent leg loops and a waist portion. This harness has more gear loops for racking equipment, and the vertical belay loop is more convenient for belaying. The rope is tied through the reinforced portions between the leg loops and in the waist.

5) **Positioning the Belayer**

a) The best position to catch a fall is directly below the anchor. The belayer will be pulled straight up, and not lose their balance. However, they should be offset enough that the climber will not fall directly on them.

b) The belayer should be positioned so that the rope will not interfere with the climber as they climb the route and they will not become entangled in it in the event of a fall.

c) The belayer should be protected from hazards, such as falling rock or ice. They should be placed into a protected feature under a roof or bulge, or offset out of the path of any falling objects.

6) **Anchoring the Belayer**

a) Anchoring the belayer will keep them from being pulled off their original stance. It is recommended that the belayer is anchored when:
   - The belayer is inexperienced and may lose control of the belay if they are pulled up.
   - The climber severely outweighs the belayer.
   - It is necessary to keep them from being pulled into hazards and obstructions.

b) If the belayer is not tied into the rope, attach the tie in portion of the belayer’s harness directly to the master point of the anchor. The anchor may be extended with a sling or cord. If the belayer is tied into the rope, it is preferred to attach the belay to the anchor using a clove hitch. The climbing rope is a stronger, more dynamic piece of material, and the clove hitch is easily adjustable. The belayer should be positioned tight to the anchor, so that the pull of a fall will not pull them off balance.
7) **Belaying the Climber:** The belayer is responsible for safeguarding the climber if they fall. There should be minimal slack in the rope at all times, and the belayer must maintain control of the brake strand at all times. Ensure you have a good stance with feet approximately shoulder width apart. Pull down the rope opposite the climber until it is tight with the climber's harness.

a) **Belaying with a Munter Hitch:** The Munter hitch has the advantage of requiring no extra equipment, and maintaining a sufficient level of friction to stop a fall with the brake strand in a variety of positions. Its main disadvantage is that it twists and kinks the rope.

- Place a pear-shaped carabiner into the tie-in portion of the harness. Tie a Munter hitch in the climbing rope and clip it into the carabiner for either a right hand or a left hand brake. Lock the carabiner.
- To take in rope, grasp the brake strand with your brake hand a few inches away from the Munter hitch and with your thumb pointed up. Pull down with your guide hand and up with your brake hand simultaneously until you brake hand is just below your guide hand. With your guide hand grasp both ropes just above your brake hand and then slide your brake hand back down to its original place a few inches from the Munter hitch.
- Reach back up the load rope with your guide hand and repeat.
- In the event of a fall the bight of the Munter hitch will pass from the brake side of the carabiner to the guide hand side. The hitch creates enough friction for the belayer to easily hold the climber's body weight.
- The brake position for the Munter hitch is with the brake strand and the load strand parallel.
- Never let go of the brake strand. The climber's life depends on it.
- To lower the climber back down, place both hands on the brake strand and feed rope slowly back through the Munter hitch until the climber is safely on the ground.

**Note:** Do not put your brake hand too close to the Munter hitch. The potential of getting your fingers caught in the Munter will cause you to lose control of the brake, dropping the climber.
b) **Belaying with a Tube Style Belay/Rappel Device:** (SBG, ATC, Reverso) Tube style devices are the most commonly used belay devices. They do not twist the rope. Attention must be paid to keeping the brake strand in the brake position because they provide very little friction outside of that position.

- Place a locking carabiner into the tie-in portion of the harness. Thread a bight of the climbing rope through the tube slot of the device opposite the side of the keeper loop. Attach both the bight of rope and the keeper loop to the carabiner and lock the gate.

- To take in rope, grasp the brake strand a few inches from the device and with your thumb pointed towards the device. Reach out and place your guide hand on the load strand with your thumb pointed up. Pull down with your guide hand and up with your brake hand simultaneously until your brake strand is approximately one foot away from your waist. Return the brake strand immediately to the brake position (below the device). Move your guide hand down to the brake strand just underneath your brake hand and slide your brake hand back to within a few inches from the device. Reach back up to the load strand with your guide hand and repeat.

- The brake position with a tube style device is down thus creating two sharp bends in the rope that provide necessary friction.

- Never let go of the brake rope. The climber’s life depends on it.

- To lower the climber, remove all slack from the system. Hold the brake strand in the brake position with both hands, and feed rope slowly back through the device until the climber is safely on the ground.
8) Use Climbing Commands

a) Using standardized verbal climbing commands is a necessary safety protocol to ensure both members are ready before any actions are taken. Many commands may seem unnecessary in the top rope setting, with both members of the rope team on the ground. However, they prepare the climbers for communicating when separated by a pitch of climbing.

b) Verbal Commands for Top Roping

<table>
<thead>
<tr>
<th>Belayer</th>
<th>Climber</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>“On Belay”</td>
<td>I’ve inspected my belay position and equipment. My brake hand is on and I will manage the rope as necessary. You may go ahead and climb.</td>
<td></td>
</tr>
<tr>
<td>”Climbing”</td>
<td>I am moving, start taking in rope.</td>
<td></td>
</tr>
<tr>
<td>”Slack”</td>
<td>Feed out rope in my direction.</td>
<td></td>
</tr>
<tr>
<td>”Tension”</td>
<td>Take in rope.</td>
<td></td>
</tr>
<tr>
<td>“Rock” / “Ice” / “Falling”</td>
<td>Intermediate commands. Use as needed.</td>
<td></td>
</tr>
<tr>
<td>“Take”</td>
<td>I’m at the top and ready to be lowered back down</td>
<td></td>
</tr>
<tr>
<td>“I have you”  or “I’ve got you”</td>
<td>The rope is tight. I have both hands on the brake strand and I am prepared to lower you.</td>
<td></td>
</tr>
<tr>
<td>“On you”</td>
<td>I’ve weighted the system and am ready to be lowered.</td>
<td></td>
</tr>
<tr>
<td>“Off Belay”</td>
<td>I am safe, on the ground or attached to a solid anchor.</td>
<td></td>
</tr>
<tr>
<td>“Belay Off”</td>
<td>The rope is free.</td>
<td></td>
</tr>
</tbody>
</table>
9) Fundamentals of Rock Climbing Movement

a) General: The goal of climbing is to move through the steep terrain using as little energy as possible. The ability to see the features, and to link them together is the primary art of climbing.

b) Visually Climb the Route: Visually climb the route first. This allows you to move efficiently and plan exactly how to use each hold. Identify stances and rests.

c) Climbing in Balance: (Fig 8-1) Stand erect with your body weight directly over your feet. Use your hands for balance. Use your skeletal system to support your weight. An upright stance improves footing by developing maximum friction and balance and allows the climber to see their feet.

![Figure 8-1 Climbing in Balance](image)


d) Controlled Motion: Move with economy of effort to avoid fatigue. Climb with your legs instead of pulling with your arms. The more you use your legs, the longer your arms will last. Keeping hands at head level saves arm strength and permits you to lean away from the rock to see holds. Avoid excessively high steps. It will require more force to stand up and be more difficult to maintain your balance all the way through the range of motion. Avoid long reaches. You will be unable to maintain a center of gravity over your feet and will be unable to see your feet to place them on the next holds. Use intermediate holds when available. Try to press down rather than pull up. Seek natural body positions, rather than awkward, tiring ones.

e) Actions if Falling: Sound the command "falling." Do NOT grab the rope. Push yourself away from the rock and keep your hands out toward the rock to protect yourself.
10) Types and Use of Rock Climbing Holds

a) Use of Holds: Choose holds for stability, convenience and size. If questionable, test with a blow from the hand or foot. You should test all suspect holds before committing your full weight to them. Most handholds become footholds as you move up the rock. Avoid using knees and elbows because they are easy to injure and offer very little stability.

b) Foot Holds: (Fig 8-2) Foot work is key to efficient climbing. Look for foot holds directly below your hand holds. The further offset a foot hold is, the more body tension is required to keep your weight on your feet. The most efficient sequence may require replacing the feet several times to maintain counter pressure and balance. Place feet carefully in the desired position and do not move them. With marginal footholds it is mandatory not to rotate or move your foot once it is in place. Even a small change in position may cause your boot to slip. There are two main ways to use your feet.

- **Edging:** If wearing stiff boots, even a small edge, less than .5cm in size, can hold a foot placement. Turn the foot sideways, placing the inside edge of the boot on the hold. The outside edge or the toe can be used as well, but it is not as strong a position as the inside edge.

- **Smearing:** In very flexible boots or rock shoes, the foot may have to point uphill with the boot sole "smeared" or "covering" the small hold. Effective smearing requires maximum friction between the foot and the rock. Maximize sole contact with the rock, and maintain consistent pressure.

- Marginal foot holds that will not normally support a soldier’s weight can still be used effectively, but require a body position that creates pressure against the hold, either using a second rock face to generate counter pressure, as in a chimney, or positive hand holds that can be leaned out on.

![Edging and Smearing](image.jpg)

Figure 8-2
c) **Hand Holds:** The hands can be placed on the rock in many different ways. The role of the hands should be only to keep the climber’s center of gravity over the feet. On low angle rock, the hands may only need to be placed on the rock to help maintain balance. Hand holds in line with the foot holds will require less energy to hold the climber’s weight on their feet.

- **Push Holds:** (Fig 8-3) Push holds are pushed down upon and help the climber keep his arms low. The climber should not limit his use of push holds to the application of down pressure. Pushing sideways, and on occasion, even upward on less obvious holds can prove quite secure. Push holds often work best when used in combination with other holds. They are more difficult to hold onto during a slip.

  ![Side Pressure and Downward Pressure](image)

  Figure 8-3
  Push Holds

- **Pinch Hold:** (Fig 8-4) Pinch a rock protrusion between the thumb and fingers.

  ![Pinch Hold Examples](image)

  Figure 8-4
  Pinch Holds
Pull Holds: (Fig 8-5) Pull holds are those pulled down on and are the easiest holds to use. They are also the most likely to break. This is the most commonly sought handhold. The climber grasps the edge of a crack; corner or knob then leans slightly away from the hold while stepping upward. On small holds, the fingers form to fit the rock. A larger hold, preferably sloping inward, becomes a true handhold for the entire hand. The best and most comfortable of these are referred to as "jugs".

Figure 8-5
Pull Holds
- **Jams:** (Fig 8-6) Jamming technique involves wedging fingers, hands, arms, feet, knees, legs and/or any other portion of the body into cracks and lodging them securely enough to bear weight. Place the hand or other portion of the body into the crack, and then clench or flex it so that it expands, and straighten your arm so that the appendage cams, locking it into place. Jamming or crack climbing is less instinctive, but often more secure than other types of holds. Each movement should be deliberate. Before moving a hand or foot, look ahead, select a prospective place, then move the hand or foot to the new jam position and lock it in place. Cracks come in all sizes, from narrow to wide.

![Fist Jam](image1) ![Fist Jam](image2) ![Hand Jam, Thumb Down](image3)

**Fist Jam**  **Fist Jam**  **Hand Jam, Thumb Down**

![Hand Jam](image4) ![Finger Jam](image5) ![Fingers Cammed](image6)

**Hand Jam**  **Finger Jam**  **Fingers Cammed**

- **Friction Holds:** Friction holds are solely dependent on the friction of hands or feet against a relatively smooth surface with shallow holds. These holds may give a feeling of insecurity. The inexperienced climber may try to correct this by leaning closer to the rock, however, this movement makes them less secure. They often serve well as intermediate holds. Some give needed support during movement to another hold, but would not hold if you stopped.
d) **Combination Holds**: The holds previously mentioned are considered basic and from these you can use any number of combinations and variations.

- **Chimney Technique**: (Fig 8-7) The chimney climbing technique exerts cross pressure between the back and the feet, hands or knees. Insert the entire body into a crack in the rock. By using both sides of the opening and possibly all types of basic holds, move up the crack. These techniques rely on the friction maintained by cross pressure with the body. Maintain as many points of contact as possible.

- **Stemming**: (Fig 8-8) Wide foot work, with the feet used in opposition. On featured face climbs it can offer a temporary rest. It is frequently used in wide chimneys and corners. Use the counter pressure of two hands, two feet, one hand and one foot, to maintain counter pressure. As the climber moves upward, they must maintain that counter pressure, substituting hands on push holds for feet.
- **Lie Back:** (Fig 8-9) A lie back is done by leaning to one side of an offset crack with the hands pulling and the feet pushing against the offset side, creating counter pressure against the wall, allowing the climber to use footholds they would be unable to otherwise.

- **Undercling:** (Fig 8-10) Underclings are commonly used in places where the rock projects outward, forming a bulge or small overhang. An undercling creates opposing pressure between the hands and the feet.
- **Mantling:** (Fig 8-11) Mantling is done by two push holds at once to raise the body onto a ledge when there are few available footholds. Try to use your legs as much as possible, to help the upper body.

Use pull holds until the arms are straight and the elbows can be locked

Work toes up the rock until the arms are extended

Bring one foot up, move one hand forward for balance, begin lifting the other foot

Maintain balance while placing other foot

---

Figure 8-11
Mantling
e) **Down Climbing:** (Fig 8-12) Down climbing is usually more difficult than ascending a given route. Some holds will be less visible when down climbing, and slips are more likely to occur. Rock quality is more difficult to assess from above. Down climbing can lead to an unforeseen dangerous position. When in doubt, use a roped descent.

- On easier terrain, the climber can face outward, away from the rock, enabling him to see the route better and descend quickly. As the steepness and difficulty increase, he can often turn sideways, still having a good view of the descent route, but being better able to use the hands and feet on the holds available. On the steepest terrain, the climber will have to face the rock and down climb using good climbing techniques.

- The climber must often lean well away from the rock to look for holds and plan his movements. More weight is placed on the arms and handholds at times to accomplish this, as well as to help lower the climber to the next foothold. Hands should be moved to holds as low as waist level to give the climber more range of movement with each step.

![Figure 8-12: Down Climbing](image-url)
11) **Climbing on Snow and Ice**: The military mountaineer must be equally adept climbing on both snow and ice. Snow-covered terrain can be encountered throughout the year above 1,500 meters in many mountainous areas. Talus and brush may be covered by hardened snowfields, streams made crossable with snow bridges, and snow filled couloirs may be the path of least resistance to key high ground. Climbing snow is straight forward. The techniques for ascending and descending moderate snow slopes are similar to walking on hard ground, however, a fall on a steep snow slope may be impossible to stop, and end in injury or death. The first priority of snow travel should be preventing a slip or fall. An ice axe, and knowledge of its use, is vital for climbing and crossing steep snow slopes.

a) **Ice Axe** (Fig 8-13)

- **Cane Position**: The ice axe can be used on gentle slopes as a walking stick or cane. The axe is held by the head with the spike down and the pick facing to the rear in preparation for self-arrest. When moving up or down gentle slopes the ice axe is placed in front as the third point of contact, and the climber moves toward it. When traversing, the axe is held on the uphill side, in preparation for a self-arrest.

![Ice Axe Diagram](image)

Figure 8-13
Ice Axe

b) **Climbing Snow in Boots**: Boots can be used to climb moderate slopes when the snow is soft enough to leave clear footprints. Stiff mountaineering boots are critical to safe and efficient snow climbing.

- On softer snow, the Soldier swings his foot into the snow, allowing the leg’s weight and momentum to carve the step. The steps should be angled slightly into the slope for added security. Climbers follow directly in the steps of the trailbreaker, each one improving the step as he ascends.

- Harder snow requires more effort to kick steps, and they will not be as secure. The Soldier may need to slice the step with the side of his boot and use the diagonal technique to ascend.
c) **Descending Snow in Boots**: If the snow is soft and the slope gentle, simply walk straight down. Harder snow or steeper slopes call for the plunge step. The Soldier faces out, steps off, and plants his foot solidly, driving the heel into the snow while keeping his leg straight. He shifts his weight to the new foot plant and continues down with the other foot. On steeper terrain it may be necessary to squat on the weighted leg when setting the plunge step. The upper body should be kept erect or canted slightly forward.

d) **Tips for Snow Travel**
- Often the best descent is on a different route than the ascent. When looking for a firmer travel surface, watch for dirty snow—this absorbs more heat and thus hardens faster than clean snow.
- Travel late at night or early in the morning is best if daytime temperatures are above freezing and the sun heats the slopes. The night’s cold hardens the snow surface.
- Avoid walking on snow next to logs, trees, and rocks as the subsurface snow has melted away creating hidden traps.

12) **Flatfooting with Crampons (French technique)**

a) **Ascending**
- **Cane Position**: (Fig 8-14) When walking on moderate surfaces of 0-15 degrees, widen your stance slightly more than normal walking to avoid snagging a crampon point. As the degree of angle increases on the slope, your feet are shifted outward to relieve stress on ankles and calves. As the slope gets steeper turn sideways so your feet face across the slope.
• **Cross Body Position:** (Fig 8-15) To take a step, lift the downhill (outside) foot in front of and above the uphill (inside) knee, into the "out-of-balance" position. Return to the "in-balance" position. Bring the lower (inside) foot up behind and place in front of the outside foot. Keep your body weight over your crampons. Plant the axe about an arm’s length ahead of you each time before you move another two-steps.

![Figure 8-15](image)

Cross Body Position

• **Changing Direction:** From the position of balance, place the axe directly above your location. Move your downhill foot forward into the out of balance position, to the same elevation as the other foot pointing slightly uphill. Return to the in balance position by moving your foot that is still pointing in the original direction to above and in front of your other foot.

• **Anchor Position:** (Fig 8-16) Grip the axe shaft near the spike with your outside hand. Swing the axe in a smooth arc engaging the pick above and slightly in front of your head. Keep the shaft parallel to the slope. With the other hand, take hold of the axe head in the self-arrest grasp. Pull down and step up to a new in-balance position. Maintain a gentle outward pressure to lock the axe in the ice by setting the teeth.

![Figure 8-16](image)

Anchor Position

b) **Descending**

• **Duck Walk (Cane, cross-body):** (Fig 8-17) Point your toes downhill. Bend your knees. Hold your axe in the cane position. Splaying the feet out will relieve some strain on the calves and ankles when the angle of the slope increases. Hold the axe in the cross-body position for greater security.
- **Flatfooting (Support position):** As the slope increases, use the axe in the support position. Hold the shaft roughly parallel to the slope, pick uphill and spike downhill. Rest the pick tip and spike on the ice.

![Image of Flatfooting](image)

Figure 8-17
Duck Walk (Cane)

- **Descend Diagonally (Axe in Anchor Position)** (Fig 8-18) Turn your feet sideways and descend diagonally. Use the axe in the anchor position. The axe is swung using the outside hand swinging from the shoulder, setting the pick low and to the front. Rotate the shaft as you pass below it.

![Image of Descend Diagonally](image)

Figure 8-18
Descending Diagonally (Axe in anchor position)
13) Steep Snow/Ice Climbing Techniques

a) Front-Pointing with Crampons: The front points of the crampon are used for the steepest climbing. Front pointing is more secure than flat footing on steep ice, but puts more strain on your calves. Front pointing requires stiff boots to be secure.

- **Crampon Placement** (Fig 8-19)
  
  o Good foot work is the foundation of all climbing. Shift your center of gravity over the foot that will remain in the ice. Get into a body position where you can see your foot and where you want to place it in the ice.

  o Identify where you want to place your foot. Just as in rock climbing, look for ledges and features to set your feet on. The points will be more secure, and it will place less strain on your calves.

  o Set the front points into the ice with a firm tap. Pay attention to the alignment of your crampons to the ice. You will have more penetration and a more secure placement if the foot is square to the ice, both vertically and horizontally.

  o Observe the ice around your front points. If it is fractured, you may need to kick again to break away the fractured ice, and set your front points in the solid ice below.

  o Shift your weight onto this foot placement.

  o Keep your heels low, perpendicular to the ice. Engage the secondary points on the crampon (see diagram on next page). Bend at the knees, and bring your center of gravity in until it is over your feet if it is not already.

  o Hold your foot steady. Any movement will break the ice around your crampon points, compromising the placement. Movement of the heel up or down may cause the front points to either slide down out their holes, or cause the toe of the boot to push them out of place.

  o When you are climbing thin ice or rock, set the front points on rock edges or in cracks. Holding the foot in a steady position becomes vital on marginal holds.
b) Ascending with an Axe (Fig 8-20)

- **Low Dagger Position:** Hold the axe with the hand resting on top of the adze. Push the pick into the snow about waist high.

- **High Dagger Position:** Hold the axe by the head, with the pinky toward the pick. Drive the pick into the snow (dagger-style) over your head.

- **Anchor Position:** Hold the axe near the spike and swing as high as possible. Ascend using several small steps until you hold the adze in the high dagger position. On moderate terrain, it is often possible to continue to ascend until you hold the adze in the low dagger position, combining all the techniques to minimize the number on axe placements.
c) **Ascending with Two Ice Axes (Ice Tools):** (Fig 8-21) Steeper ice can be climbed using two ice tools. Technical ice tools have a steeper pick angle for more secure pick placements. Historically, climbers have attached themselves to the tools with leashes to their wrists. Modern ice tools are curved to clear bulges of ice, and include rests for the hands. Leashless climbing allows for more flexibility with tool placements, use of hands, placing of protection, and rope management.
• **Tool Placement** (Fig 8-22)
  o Study the ice for good placements. Look for depressions in the ice where it is less likely to shatter. The tool should be swung firmly, and precisely.
  o Stagger your tool placements vertically, instead of placing them side by side. Placing a tool too close to your previous placement risks shattering the ice around your other pick. Make upward progress with each placement.
  o Plant one tool, move both feet up. Look for natural foot placements and stemming opportunities in order to rest your hands. Set one tool higher. Move both feet again.

  ![Figure 8-22](image-url)

  **Vertical Tool Placements**

• **Body Position**
  o Good body position will maximize the weight on your feet and conserve upper body strength. Focus on relaxing your hands as much as possible.
  o Keep your feet shoulder width apart or slightly less, to reduce the tendency to “barn door” to one side. Stemming can be used as an effective rest.
  o Use several short steps, rather than high stepping. Maintain a center of gravity in line with the high tool. High stepping may be necessary occasionally to get past bulges.
  o Always keep your weight over your feet.
  o Trust your feet and move steadily and confidently.

• **Removing a Stuck Tool**
  o Try to remove it in the reverse of the motion used to set it.
  o Loosen the placement by rocking the tool up and down.
  o If this fails, release your grip on the tool and try to knock it loose by hitting up against the adze or hammer with the palm of your hand.
  o Do not remove a tool by moving it side to side. The pick may break.
14) **Glissading** (Fig 8-23): Glissading is the intentional, controlled, rapid descent, or slide of a mountaineer down a steep slope covered with snow. Whenever possible, gentle, moderate and even some steep slopes should be descended by the glissade. Ideal snow for glissading is solid enough to provide support, but softened on the surface. If the surface is rough, there will be too much friction and you will not be able to slide effectively even on steep slopes.

**a) Standing Glissade:** The technique is similar to skiing. It requires firm snow that your boots will not penetrate, with a soft layer on top that has been warmed by the sun.

- Keep your feet together with knees bent forward slightly to act as shock absorbers.
- Center your weight over the balls of your feet. If you rock too far forward you will trip.
- Center the weight on your heels to slow down.
- Adjust your body position in relation to the slope to keep your weight centered.
- You can slow down by rocking back on your heels and even stop by turning your feet sideways and skidding. Turning is the best speed control.
- Rotate the legs and feet toward the desired new direction.
- Roll your knees and ankles toward the turn. This will angle your boots onto the edges and carve the turn, just like with skis.
- Unweighting will help on high-friction snow or low-angle slopes. Crouch and spring-up to unweight, coming back down on the new edge.

**b) Sitting Glissade**

- Use a sitting glissade when the snow is too soft to slide on with your feet.
- Sit down on the snow slope.
- Use the spike of the ice axe as a rudder to control your speed.
- If self-arrest is needed, always roll towards the head of the ice axe.

![Figure 8-23](image_url)  
Glissading Techniques
15) **Self-Arrest**: The best protection against falling on snow is good route selection, good footwork, and self-belaying with solid ice axe placements. In the event of a fall, there may be a brief window where you can arrest your fall before you gain too much speed. It is critical that the self-arrest, the technique by which you stop your fall on snow, is practiced so that it can be executed immediately and subconsciously.

a) With one hand, grip the head of the axe; hook that thumb under the adze.

b) Grasp the shaft near the spike with your other hand.

c) Hold the axe diagonally across your body with the adze away from your shoulder and the spike next to the opposite hip.

d) You must force the pick of the axe into the slope to self-arrest.

e) Force the pick into the snow with the axe head no higher than the top of your shoulder (if it is higher it will be hard to hang onto). Make sure the head is offset far enough that you will not hit yourself in the face with your adze.

f) Arch your body so that your weight is on your toes and the axe pick.

g) Force your body to arch and bear down on the pick. If you forget, the spike will catch in the snow and wrench the axe out of your hands.

h) Spread your feet for balance. You are stable on three points of support: the axe and both feet. Kick your feet into the snow to create solid footholds before standing.

i) When wearing crampons, raise the feet out of the snow and drive your knees into the snow instead of your feet. If your crampons catch before pick, you may flip over backwards, potentially injuring yourself and putting you in a position where it is difficult to arrest.

**Warning**: Crampons are a major cause of lower orthopedic injuries during falls. If the crampon catches during a fall or glissade it will stop and the momentum of the climber will carry them past it, causing ankle breaks, ligament tears in the ankles or knees, and spiral fractures in the tibia and fibula. **Do not glissade with crampons! Do not practice self-arrest with crampons!**
Chapter 9. Fixed Ropes

1) **Introduction:** Fixed ropes allow Soldiers to access restrictive terrain in order to gain the tactical advantage over the enemy. Units that can quickly install and efficiently move across fixed ropes can use this terrain to establish observation posts, support by fire positions, or emplace ambushes above the enemy. Every squad moving dismounted in the mountains should have the equipment and ability to establish and negotiate fixed ropes as a core mobility task.

2) **Types of Fixed Ropes**

   a) **Simple Fixed Rope:** A Simple fixed rope is a single line secured at the top. Static ropes are preferred for this system. A knotted hand line, rappel lane or a Prusik ascent lane could be classified as simple fixed ropes.

   b) **Fixed Rope with Intermediate Anchors:** A fixed rope with Intermediate Anchors is secured at both ends and at intermediate points along the route.

3) **Install a Fixed Rope with Intermediate Anchors (Starting from the Top)**

   a) **Route Requirements**

      - Suitable routing to avoid obstacles and make travel as easy as possible.
      - Availability of anchors (natural & artificial).
      - Protected route (from rock, icefall and potential avalanches).
      - METT-TC.
      - The route must have safe loading and unloading platforms.
b) **Top Down Fixed Rope with Intermediate Anchors**

- On the top of the cliff or slope, build a suitable anchor and secure the top end of the installation rope.

- Descend the route using the method most appropriate for the terrain.
  - Use the rope as a hand line on moderated terrain.
  - Hasty or Body rappel on Class 3 and 4 terrain.
  - Rig an extended rappel device with an auto block self-belay on Class 5 terrain.

- During the descent, establish intermediate multi-directional anchors and secure the installation rope using any of the following:
  - Double figure eight.
  - Middle of the rope clove hitch.
  - Three loop bowline.

- Secure the rope to the bottom anchor.

c) **Maintenance Responsibilities:** The installing unit is responsible for maintaining the fixed rope, policing the route, inspecting anchor points and protecting the rope with padding. The using unit will report any discrepancies they note to the installing unit for immediate correction. Complete daily maintenance checks on the installation during periods of low traffic volume. If the traffic volume is high, inspect/service more frequently.

4) **Install a Fixed Rope with Intermediate Anchors (Starting from the Bottom)**

a) **Route Requirements**

- Suitable routing to avoid obstacles and make travel as easy as possible.
- Availability of anchors (natural & artificial).
- Protected route (from rock, icefall and potential avalanches).
- METT-TC.
- The route must have safe loading and unloading platforms.

b) **Bottom Up Fixed Ropes with Intermediate Anchors Installation:** (3rd and 4th Class terrain only)

- The installer must find a way to safely reach the top. Some options are:
  - Use a fixed rope previously established by a trained assault climber.
  - If the route is safe, climb it without rucksack while trailing the installation rope, rope will be attached to the installer.
- The installation rope is back stacked with the bottom end anchored and the top end secured to the Soldier.
- The Soldier climbs the route trailing the installation rope, builds an anchor and proceeds to construct a top down fixed rope.

c) **Maintenance Responsibilities:** Inspect anchor points routinely. The using unit will report any discrepancies they note to the maintaining unit for correction. Complete daily maintenance checks on the installation during periods of low traffic volume. If the traffic volume is high, inspect/service more frequently.
5) Move on Fixed Ropes

a) Movement: The number of independent sections built into the fixed rope limits the number of Soldiers that can travel safely. An independent section is a section of rope that has intermediate anchors at both ends.

b) Equipment Requirements: Determine the type and amount of equipment needed for fixed rope travel by considering the following:
   - Type of fixed rope used.
   - Terrain.
   - Soldier’s prior mountaineering training.
   - Soldiers load.

c) Communications: It is imperative for Soldiers to use proper communication while moving on a fixed rope. Only one Soldier at a time will move on a simple fixed rope. When a Soldier clears an independent section while moving on a fixed rope with intermediate anchors, he must inform the next Soldier (either above or below) that he is clear.

d) Methods

   • Hand over Hand
     o The hand over hand method is the simplest to use and requires no equipment.
     o This technique is limited to moving over simple fixed ropes on easy terrain where a fall would not be life threatening.

   • 2 Personal Safeties
     o This method involves having 2 separate girth hitch pieces of webbing attached to the tie in portion of your harness with a single non-locking carabiner in each. Keep the two carabiners attached to the rope at all times unless moving past an intermediate anchor.
     o To move past an intermediate anchor, clip one carabiner at a time above the anchor. When both carabiners are above the anchor, continue movement.
     o A fall while traveling on this setup will be stopped by reaching the anchor below you. Do not use this method when a hard fall could occur.

   Equipment Needed:
   1 - Harness or material for an improvised harness.
   2 - 1 X 24 inch tubular webbing.
   2 - Non-locking carabiners.
• **Single Prusik Method**
  o Use the single Prusik method to move over lower angled terrain on simple fixed ropes. To use this technique use one three-wrap Prusik with a double-double figure eight attached to a locking carabiner at full arm’s length.
  o Use the single Prusik method to move over Simple Fixed ropes where a fall is likely. This technique uses a Prusik with a double-double figure eight attached to a locking carabiner and one safety with a non-locking carabiner, both at full arm’s length. Keep the Prusik above the carabiner while you move so the carabiner will not make contact with the knot and possibly move it.

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**Ascender-Carabiner Method**

- The ascender-carabiner method is the fastest way to travel up vertical and near vertical terrain. The setup includes one ascender and one safety with carabiner. Both are at full arm’s length. While traveling, the carabiner is below the ascender until an intermediate anchor is reached.
- To move past the intermediate anchor, clip the carabiner above the anchor on the fixed rope and then move the ascender above the carabiner on the fixed rope.

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**Equipment Needed:**

- 1 - Harness or material for an improvised harness.
- 1 - Ascender.
- 2 - 1 X 24 inch runners.
- 1 - Non-locking carabiner.
- 1 - Locker.
- **Prusik Ascent:** Use the Prusik ascent system to ascend simple fixed ropes in steep or overhanging terrain.

  o **Rigging for Prusik Ascent**
    - Tie a middle of the rope Prusik with a 7mm utility cord on the climbing rope.
    - No more than arm’s length away, tie a doubled double figure eight.
    - Insert a locking carabiner into the tie-in portion of the harness.
    - Insert the doubled double figure eight into the locking carabiner.
    - Tie a second middle of the rope Prusik with an additional 7mm cord on the rope below the first Prusik.
    - With the second Prusik at waist level, measure down the length of the leg with both strands and tie an overhand knot, creating a large fixed loop between the Prusik and the overhand.
    - Step into the fixed loop with one foot.
    - Attach a non-locking carabiner into the locking carabiner that is in the harness.

**Note:** Tying the Prusik ascent system while wearing the improvised climbing harness is the same as with a commercial harness.

<table>
<thead>
<tr>
<th>Equipment Needed:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Harness or material for an improvised harness.</td>
</tr>
<tr>
<td>2 7mm X 15 foot cords.</td>
</tr>
<tr>
<td>3 Non-locking carabiners.</td>
</tr>
<tr>
<td>1 Locking carabiner.</td>
</tr>
<tr>
<td>2 24 inch tubular webbing.</td>
</tr>
</tbody>
</table>
**Ascending**
- Slide the top Prusik up the rope as far as possible.
- Place all of your weight on the top Prusik by slowly leaning back.
- Lift your leg as high as possible and slide the leg Prusik up to the top Prusik.
- Stand up on the leg Prusik stirrup and repeat the process.
- For safety, tie a double figure eight in the climbing rope below the leg Prusik. Clip the figure eight into the non-locking carabiner that is in the locking carabiner in the harness tie in point.
- Approximately every 10 feet, tie another figure eight knot and replace the previously tied one in the non-locking carabiner. Be sure to clip in the new double figure eight before taking the old one out.
- Untie the old figure of eight knot.

**Overhangs:** This procedure is difficult because your body is pressing the rope against the steep face. If there are no handholds or footholds, pass the Prusiks over the lip of the overhang by pulling out and sliding up at the same time or by tying a new Prusik above the lip, attaching to you and removing the original lead Prusik from the main climbing rope. If the lip of the overhang is not uniformly horizontal, it may be possible to slide the rope to the side where the lip is highest. Then the knot is moved up to the high point of the lip. When the knot is moved back towards the lower part of the lip the knot will be above the lip. If this does not work, it may be possible to get a shoulder between the rope and the steep face and get the knot above the lip.

**Rucksack Removal**
- Girth hitch a piece of webbing through a load-bearing portion of your pack frame to pre-rig your ruck.
- Attach a carabiner to the webbing.
- To discard the rucksack, attach the girth hitched piece of webbing to the rope below your Prusiks. Then remove the rucksack slowly and let it hang.
- Pull up the rucksack after completing the climb.
- The end of the rope must be attached to the Soldier to use this technique.

**Note:** These procedures can be rough on the hands and you should have gloves available. Prusik up static ropes to avoid the stretch of dynamic ropes.
Chapter 10. Rappelling in Mountainous Terrain

1) **Introduction**: Operations in the mountains will often require Soldiers to move down steep, slippery or hazardous terrain. Rappelling allows Soldiers to negotiate this terrain effectively and in a safe manner. Understanding how to establish safe rappel points and move Soldiers down them quickly and efficiently allows units to move through restrictive terrain and gain the tactical advantage over the enemy.

2) **Perform a Hasty Rappel**

   a) Face sideways to the anchor and place the rope across your back. Your elbows trap the rope over your back.
   b) The hand nearest to the anchor is your guide hand, and the other, your brake.
   c) Lean out 90° from the rock.
   d) To stop, bring your brake hand across your chest and turn toward the anchor. It is easier and faster than the other methods, especially when the rope is wet.

   ![Hasty Rappel](image)

3) **Perform a Rappel Using a Rappel Device**: This method is slower than the hasty rappel, however it is more appropriate for steeper terrain. Keep fingers and loose clothing away from the rappel device.

   a) Place a locking carabiner through the tie in portion of your harness.
   b) Face the anchor. If right-handed, stand with the rope to your right. If left-handed, then to the left.
   c) Hold the rappel device with the slots toward you. Place a bight of rope through the slot.
   d) Attach the small hole or cable of the rappel device and the bight of rope into the locking carabiner.
   e) Descend by using your upper hand as the guide and the lower hand as the brake. Grasp the rope in your brake hand with your thumb pointing up and towards the device. Hold your brake hand slightly above the hip.
   f) Brake by closing your hand around the rope.
   g) Keep an "L" shaped body position. Make a smooth descent.

   **Note**: Do not let the rope abrade the harness.
4) **Perform a Rappel Extending the Rappel Device**: There are times when the friction device needs to be further away from the body (rappelling with a self-belay).

   a) Girth hitch a piece of webbing correctly through the harness or place a double bight through the same area.
   b) At the end of this webbing, place a locking carabiner and the rappel device. The rappel device should remain within arm’s reach.
   c) Place the rope correctly through the rappel device.

**Note**: Be extremely careful when rappelling over sharp projections. The extension on the friction device is especially vulnerable to abrasion.

**Note**: The extended rappel device may catch on the surface when going past an overhang. Pay close attention to avoid this.

5) **Perform a Self-Belay Rappel (Rappel device with a Self-Belay)**: Use a Self-Belay when a Bottom Belay is not feasible.

   a) Girth hitch a piece of webbing correctly through the harness.
   b) At the end of this webbing, place a locking carabiner and a rappel device. The rappel device should remain within arm’s reach.
   c) Place the rope correctly through the rappel device.
   d) Place a locking carabiner into the tie in portion of the harness.
   e) Place an auto block on both ropes and secure this into the locking carabiner in your harness (see figure 5).
   f) Make sure that the auto block cannot touch the rappel device when loaded.
   g) Feed the rope from below the rappel device with your guide hand. This may seem a little awkward at first, but with practice, it becomes quite efficient.

6) **Perform a rappel bottom belay**: Areas with Little Chance of Falling Rock (Fireman Belay).

   a) Assume a position at the base of the lane, approximately one pace away from the wall.
   b) Ensure that there is at least 10 feet of rope on the ground.
   c) Grasp the rappel ropes with both hands. You should be able to stop the rappeller quickly, but your grip should not impede him.
   d) If the rappeller yells "Falling," immediately stop the rappeller by pulling downward on the rappel ropes.
   e) Do not wear gloves unless otherwise directed by the Safety OIC/NCOIC. Wear gloves only if weather conditions warrant.
   f) Focus your attention on the rappeller at all times and maintain constant visual and audible contact.
   g) Wear a helmet to prevent injuries from falling objects.
   h) Give all commands loud and clear. Do not look up or down if "ROCK" is yelled. Look directly into the cliff.
7) Proper Rappelling Communication

a) Soldiers should communicate the plan with the rest of the team before conducting the rappel.

b) One person on the top of the lane can feel when the rope is unweighted in order to hook up the next rappeller. The use of one belayer for the entire element can eliminate confusion and commands.
Rappelling
(Extended Rappel w/ Auto Block)

**Required Equipment:**
1. 60 meter static rope
2. Belay device
3. (2) locking carabiners
4. Harness
5. (2) lift tubular webbing

**Diagram Instructions:**
- **Cliff Edge:** Pad if necessary
- **Weaving Girth Hitched** to harness, water knot offset
- **Belay Device**
- **Auto Block:** Knot offset + out of wraps
  - Min. 3 wraps for double rope, 4 wraps for single rope
- **Strapper Knots:** Both ropes joined w/ double overhand, no twists 14-18" apart
Chapter 11. Hauling Techniques

1) Introduction: When working in the mountains, it may be necessary to raise a heavy load such as ammunition or casualties using a mechanical advantage. Hauling systems allow Soldiers to move critical loads up steep terrain while reducing fatigue and injury. Understanding how to establish hauling systems will greatly enhance a unit’s ability to effectively conduct operations in the mountains.

2) Site selection criteria

a) Site selection is governed by many different factors:

- **Working Platform**: Make sure that the loading and unloading platforms are free of loose material, no sharp edges are present and that they are large enough for hauling operations. The loading / unloading platforms are easily accessible and provide a safe working area.
- **Personnel**: Keep Soldiers away from the edge until a safety rope is in place (if appropriate).
- **Terrain**
- **Equipment**
- **Load**
- **Anchors**: Make sure that anchors are available and suitable to handle large amounts of force.
- **Tactical situation**

b) **Hauling Systems**: There are many different hauling systems, ranging from main force (everybody grabbing one end of the rope and hauling) to power winches. One type of hauling system is the Simple 3:1 System, otherwise known as the Z Pulley.

3) Construct a Simple 3:1 Hauling System

a) **Hauling System Theory**

- In theory, the mechanical advantage is 3:1, meaning it takes 1 lb. of force to raise a 3 lb. load.
- In reality, the actual mechanical advantage is less than the 3:1 ratio because of friction.
- Pulleys offer less friction, and therefore higher mechanical advantage, than carabiners.
  - Use pulleys if available.
- The less friction in the system the closer to the theoretical mechanical advantage. Friction is caused by:
  - Rope running through carabiners.
  - Load rubbing against a rock wall.
  - Condition of the rope.
b) Construction of the Z-Pulley System

- **Attach the rope to the load:** Make sure that the attachment point is load bearing and the rope is correctly attached to it directly or with locking carabiners.
- **Anchor Point**
  - Establish an anchor point
  - Attach the rope to the anchor
  - If needed safety yourself to it (i.e. when working near a cliff edge).
- **Anchor Prusik (AP), also called the Ratchet.** Construct the anchor Prusik.
  - Pull up all of the rope until you feel the load.
  - Place the load rope into a carabiner in the anchor.
  - Tie a Prusik on the load rope and secure the two free ends with a Munter Mule to the anchor point with a locking carabiner.

**Note:** The Munter Mule is used in case the load is stuck and needs to be released for lowering.

- **Moveable Prusik (MP) also called the Tractor.**
  - On the load rope, tie a Prusik as close to the edge as the loading platform and available rope allow.
  - Tie a doubled-double figure eight with the utility cord, as close as possible to the Prusik.
  - Place a carabiner into the doubled-double figure of eight.
  - Route the running end of the rope coming from the anchor point through this carabiner.

**Note:** High-efficient pulleys at carabiners are preferred to maximize mechanical advantage.

c) Procedural Points

- You lose mechanical advantage once the MP contacts the AP.
- Locate the anchor far back from the edge for more area to pull.
- Pull all ropes as parallel to the load rope as possible.
- Pull the load slowly, loosen the AP. When the MP reaches the AP, set the AP and move the MP as far down the rope as possible.

**Note:** Close the system at the end of the haul or when you need to walk away by tying and placing a double figure 8 knot in the haul strand into a carabiner at the anchor.

d) Caution Measures

- When using hauling systems and mechanical advantage, it is possible to overload anchors and equipment.
- Mechanical advantage reduces your sensitivity to the load.
- Protect the rope from edges to avoid abrasion and to reduce friction.
4) Use a Simple 3:1 Hauling System

a) Z-Pulley as a Hauling System

- Hauling equipment
  - Use static rope if available.
  - Use a directional to route the load rope properly, avoid contact with the rock or ground if possible.

- Hauling/assisting/rescuing personnel.
  - Use static rope if available.
  - Ensure the system is closed at all times, with no more than the possibility of a 10-15 foot fall.
  - Be aware of the loss of load sensitivity to avoid hanging up the load.

b) Z-Pulley as a Tightening System

- High-Line crossing.
  - Use the Z-Pulley if the loading platform is small during a river crossing or a High-Line crossing.
  - Once the system is tight, leave the MP in place, with the tension held by the AP and close the system.
  - See High-Line, 071-FAFAC014
  - Do not exceed three personnel to tighten system.
Chapter 12. High Lines

1) **Introduction:** A High Line allows a unit to safely cross water obstacles and steep ravines, as well as raise or lower personnel up or down vertical cliff faces. A properly constructed high line can save energy and time moving heavy items up, down or over rugged terrain. In an environment where the enemy has observation over known crossing sights and bridges, units that can construct high lines can achieve freedom of maneuver and seize the initiative.

2) **Safety Considerations**

   a) **System Tensioning**
      - Use no more than three Soldiers to tighten the rope. Using more personnel can over tighten the system and possibly cause failure.
      - Keep personnel away from the edge until a safety rope is in place.

   b) **Loading and Unloading Platforms**
      - Make sure that the loading and unloading platforms are free of loose material, no sharp edges are present and that they are large enough for high line operations.
      - The loading / unloading platforms are easily accessible and provide a safe working area.

   c) **Anchors**
      - Make sure that the anchors are available and suitable to handle large amounts of force created by the tightening system.
      - Protect the ropes from abrasion.

   d) **Additional Height**
      - Bipod poles are sufficient size (diameter and length) to support the load and clear the loading/unloading platforms.

   e) **Belay**
      - Use a relay man if the belayer cannot see the load the entire length of the system.

3) **Site Selection Criteria**

   a) **Anchor:** Near and far anchor are available.

   b) **Loading and Unloading Platforms:** Easily accessible platforms that provide safe working areas. The ideal platform at the near anchor allows construction of the high line without the use of artificial height.

   c) **Clearance:** Allow for space between the load and the rope for easy hauling of troops and or equipment.

   d) **Bi-pod Location:** Where to locate the bipod (if needed), sufficient area to build, load and operate the system.
4) **Equipment Needed to Construct a High Line Traverse**

   a) **Equipment Required for Construction**: (Numbers and lengths may vary due to type and method of installation)

      - Static installation ropes.
      - Locking carabiners.
      - 1 inch tubular webbing.
      - 7mm utility cords
      - Non-locking carabiners.
      - If it is necessary to gain additional height to clear obstacles construct a bipod. You may locate the bipod at either the loading or the unloading platform. This will require additional equipment.

5) **Anchor the Installation Ropes**

   a) **Secure the Installation Ropes**: Secure the installation rope to the far anchor with a bowline or high strength tie off.

   **Note**: The height of the anchor depends on the loading/unloading platforms.

6) **Construct the Tightening System/Near Side Anchor**

   a) **Tightening Systems**

      - **Transport Tightening System**: For speed and simplicity the transport tightening system is the preferred method when trees are available and the working platform is large:

        o Route the running end of the installation rope around or through the anchor.
        o Place a figure eight slip in the installation rope as far away from the near anchor as possible, creating a 12-inch bight. Place a half hitch around the midpoint of the bight securing it in the direction of pull. Place a locking carabiner in the bight.
        o Route the rope through the carabiner, working from the inside to the outside. Route the running end back to the anchor. Have no more than three Soldiers tighten the system.
        o Take the running end of the tightened static rope around the near anchor creating a minimum of one round turn (360 degrees contact with the tree).
        o After the round turn, take up a large bight of rope.
        o Pass this bight under the single strand and tie two half hitches (that form a clove hitch) around the double strand.

      - **Z-Pulley**: When the loading platform is too small to tighten the installation rope with one pull, use a 3:1 simple hauling system (“Z-Pulley”) to tighten it (See Hauling Systems Lesson, for description). This method takes more time to construct and uses more equipment but allows for resetting the tightening system multiple times when more than one pull is necessary to get the high line tight.
7) Construct and Attach the Carrying Sling

a) Carrying Sling: A Carrying sling is one method used when transporting personnel on a High Line; it can be modified as necessary for transporting equipment.

- **Construct a Carrying Sling**
  o Join the two ends of a piece of webbing with a water knot.
  o Place a locking carabiner on the high line and place the webbing into it. Ensure the joining knot is offset and not touching the locking carabiner.
  o Bring the bight at the bottom end of the webbing up (double up the webbing) and clip it into the locking carabiner.
  o The other locking carabiner can now be placed into the two bights.

- **Attach the Belay Rope**
  o Attach a belay rope to the locking carabiner in the double bights. Use a fixed loop (double figure eight).

**Note:** Attach a tag line to the carry sling (from the far side anchor), if the high line is near horizontal to pull the load across.

**Note:** Use two separate installation ropes (for training) and a locking carabiner when moving Soldiers.

8) Construct and Operate the Belay

a) **Construct the Belay / Lower**

- **Belay Rope:** Insure the belay rope is routed from the top of the back-stack pile.

- **Anchor**
  o Build a suitable anchor.
  o The anchor for the tightening system can be used or create another separate anchor just for the belay.

- **Belay Method**
  o The belay/haul line may pass around a tree or through a locking carabiner or pulley to keep it in line with the main installation ropes.

  o Lower the load using an appropriate friction method. The munter hitch provides sufficient friction for most High Line lowering applications. If loads heavier than one man with equipment must be lowered down a steep highline then increase friction by using a super munter. If the munter hitch provides too much friction then use a round turn, terrain belay or redirect as appropriate.
b) **Operate the Belay / Lower:** Whenever a load is lowered down or across a high line, use a belay to control the load. Slowly belay the load. Use the following type of belay system.

- **Soldiers:** Two Soldiers are needed to operate the belay. One is used for rope organization and the other operates the belay when needed.

- **Position the Belayer:** Position the belayer so he can see the load as it moves down. If the terrain blocks the view of the belayer, set up a relay.

9) **Perform Load Attachment**

a) **Attachment of Soldiers**

   - Attach the carry sling to the Soldier by unclipping one bight from the locking carabiner and passing it through the tie in portion of the Soldier's harness, then clipping it back into the carabiner.

**Safety:** Make sure that the Soldier holds onto the carry sling and not the tightened ropes.

b) **Attachment of Equipment**

   - Attach the carry sling to the load by clipping the load into the locking carabiner.
   - Make sure that the load is balanced and tied together correctly.

10) **Operate a High Line**

a) **First Load:** The first load should be a non-critical load. Load should be of similar weight to a human load.

b) **Lowering:** Follow the procedures in Learning Step 8.

c) **Raising System:** Replace the belay system on the belay rope with a Simple 3:1 Hauling System with anchor prusik. Be aware that you reduce your sensitivity to the load when the 3:1 mechanical advantage is in the system. Keep the hauling line and the load rope as close to parallel as possible.

11) **Retrieve the High Line:** In order to recover the equipment used to build the high line one or more Soldiers must remain on the near side and either find some other means to cross the obstacle or rig the high line to be retrieved. Recovery personnel should send all non-essential equipment that may hinder them across with the main body either way. Security for recovery personnel must be maintained.
a) Recovery personnel cross some other way.
- This method is time consuming.
- Soldier(s) must be capable of negotiating the obstacle alone. If the obstacle is a stream, then Soldier(s) must be a strong swimmer. In this case a loose tag line may be used to support the Soldier while swimming.
- If the obstacle is a ravine, the Soldier(s) must be capable of climbing or rappelling down the near side and climbing back up the far side. Main body may be able to assist in climbing the far side using belay systems or hand lines.

b) Rigging High Line for Recovery
- Near side personnel untie the high line system maintaining the near side ends of both the installation rope and belay/tag line rope.
- Far side personnel pull all slack across the obstacle.
- Near side personnel secure the end of the installation line to the anchor:
  - Tie a double figure 8 in the end of the installation rope
  - Secure the double figure 8 to the installation rope around the anchor with a locked carabiner.
- Far side personnel pull the installation rope tight with several personnel and then wrap it around an anchor tree a minimum of two full wraps. Those personnel maintain control of the end of the rope keeping it tight with the tree by hand, or can close out the rope by means of two half hitches similar to the close out on the Transport Tightening System. Another method is for far side personnel to build a new tightening system on their side to tighten the rope.
- Near side personnel attach the tag line to installation line double figure 8 using a locked carabiner and a double figure 8. The tag line remains slack.
- Near side personnel attach themselves to the installation line in the same way the main body and cross the high line.
- Once all personnel are on the far side, the installation rope is unwrapped from the far side anchor and allowed to go slack. If a new tightening system was used it is broken down.
- The tag line is then pulled across the obstacle dragging the installation line with it until both ropes are on the far side. Ensure all knots are removed from both ropes before pulling.

Note: All techniques described in this chapter may be altered for various situations and applications. The information here will give you a basis to work from.
Chapter 13. Additional Height Construction

1) Introduction: Under certain situations, Soldier’s must to have the capability of gaining additional height on their rope system in order to safely and effectively load or unload critical loads. The construction of a bipod or tripod may be necessary to make rope systems more effective and thus increasing a unit’s capabilities.

2) Equipment Needed to Construct a Bipod

   a) Bipod Equipment: Construct a bipod large enough to allow sufficient clearance and strength for any intended load.

   - You need two sturdy poles. The exact size of the poles depends on the type of load and location of the installation.
   - Three or four 18-foot utility cords (the number depends on the diameter of the poles and the width of the finished bipod).

Note: The average size bipod pole should be at least 3 inches in diameter and 9 to 12 feet in length. Poles are stronger if they are fresh cut and green. Avoid dry poles as they are brittle and can snap under extreme loads.

3) Construct a Bipod for Additional Height

   a) Construction

   - Horizontal Wraps
     - Place the two poles in position, as they would be in the finished installation and mark the apex on both poles.
     - Make sure the bipod is high enough.
     - A bipod out of proper alignment can cause a dangerous collapse of the system. Attempt to find natural pockets in which to place the base of the bipod poles.
     - Place the poles side by side.
     - Tie a clove hitch with a utility cord around the left pole, (standing at the base of the poles, facing the top) 3 inches above the apex marking.
     - Leave 18 inches of pigtail.
     - Place the locking bar on the outside edge of the pole. The 18-inch pigtail will exit to the left.
     - Wrap the rope a minimum of six times horizontally around both poles, wrapping down from the clove hitch. All wraps will be made as tight as possible.
     - It may be necessary to join another cord to the first by using a square knot secured with overhand knots. This knot will be positioned on the outside of one of the poles to not interfere with the vertical wraps made next.
     - On the last horizontal wrap around the pole to which the clove hitch is not tied, pass the cord up between the poles.
- **Vertical Wraps**
  - Lift the right pole and spread the legs to the finished width before wrapping.
  - Make a minimum of four vertical wraps around the horizontal wraps.
  - The wraps may cross each other to ensure tightness (See figure 3).

**Note:** Ensure you count wraps on both sides of poles. One side will have less than the other will.
• **Square Knot Tie-off**
  - On the last vertical wrap, pass the rope between the poles above the horizontal wraps.
  - Tie it off with a square knot to the section of rope coming from the clove hitch.
  - The ropes should be so tight that overhand knots cannot be used to secure the square knots in the normal manner. Use overhand knots tied in the tails. (See figure 4)

• **Spreader Rope**: A spreader rope is necessary to prevent the bipod from collapsing when pressure is applied at the apex.
  - Tie a utility cord(s) as low as possible to both poles with a clove hitch and a bowline.
  - If one utility cord is not long enough, join two cords together (See figure 5).

![Figure 5](image)

**Figure 5**

**Spreader Rope**

4) **Equipment Needed to Construct a Tripod**

  a) **Tripod Equipment**: Construct a tripod large enough to allow sufficient clearance and strength for any intended load.
     - You need three sturdy poles. The exact size of the poles depends on the type of load and location of the installation.
     - Three or four 18-foot utility cords (the number depends on the diameter of the poles and the footprint of the finished tripod).

**Note**: The average size tripod pole should be at least 3 inches in diameter and 9 to 12 feet in length. Poles are stronger if they are fresh cut and green. Avoid dry poles as they are brittle and can snap under extreme loads.
5) Construct a tripod for additional height

a) Construction

- **Horizontal Wraps:***
  - Place the three poles side by side, with the widest portion at the base and even with each other.
  
  - Tie a clove hitch with a utility cord around the left pole, (standing at the base of the poles, facing the top) approximately twelve inches from the top of the pole.
  
  - Leave 12-18 inches of pigtail.
  
  - Place the locking bar on the outside edge of the pole.
  
  - Wrap the utility cord a minimum of four times horizontally around all three poles, wrapping down from the clove hitch. All wraps will be made as tight as possible.
  
  - On the last horizontal wrap around the pole to which the clove hitch is not tied, pass the cord up between the poles.

- **Vertical Wraps:**
  
  - Lift the right pole and spread the legs create a space to pass the cord.
  
  - Make a minimum of two vertical wraps around the horizontal wraps between the right and center pole.
  
  - Once the second vertical wrap is complete, pass the cord to between the center and left poles.
  
  - The wraps may cross each other to ensure tightness.
  
  - Repeat the two vertical wraps around the horizontal wraps between the center and left pole.

- **Tie off:**
  
  - Tie it off with a square knot to the pigtail coming from the clove hitch.
  
  - The ropes should be so tight that overhand knots cannot be used to secure the square knots in the normal manner. Use overhand knots tied in the tails.
Chapter 14. Avalanche Awareness

1) **Introduction:** Soldiers operating in mountainous terrain must have a basic knowledge of avalanches and how to avoid them. The ability to identify avalanche areas, identify types of weather causing avalanches and understand actions to take if Soldiers are caught in one is extremely important for units operating in snow covered mountainous terrain.

2) **Identify the Factors Leading to Snow Avalanches**

   a) **Occurrence:** Avalanches occur when the weight of accumulated snow on a slope exceeds the cohesive forces that hold the snow in place. This usually requires elements of the four main factors: terrain, weather, snow and humans.

   b) **Terrain Factors**

      - **Slope Angle:** Slopes as gentle as 15° have avalanched. Most avalanches occur on slopes between 30° and 45°. Slopes above 60° often do not build up significant quantities of snow because they are too steep. As with most rules, there may be exceptions. Evaluate any slope above 30° for stability before movement. Use an inclinometer to estimate the slope angle. Construct a field expedient inclinometer from two equal length ski poles. Mark one pole at the exact center. Join the unmarked pole to the midpoint of the marked pole at a 90° angle. Place the tip of the marked pole on the slope. If the tip of the unmarked pole touches the slope, the angle is approximately 30 degrees.

      - **Slope Aspect:** Snow on north facing slopes is more likely to slide in midwinter. South facing slopes are most dangerous in the spring and on sunny, warm days. Slopes on the windward side are generally more stable than leeward slopes. Leeward slopes tend to form dangerous cornice formations.
• **Ground Cover:** Rough terrain is more stable than smooth terrain. On grassy slopes or scree, the snow pack has little to anchor to. Boulders and trees act as anchors to help hold the snow in place.

c) **Weather Factors**

• **Temperature:** When the temperature is very low, settlement and adhesion occur slowly. Avalanches that occur during extreme cold weather usually occur during or immediately following a storm. At a temperature just below freezing, the snow pack stabilizes quickly. At temperatures above freezing, especially if temperatures rise quickly, the potential for avalanche is high. Storms with an accompanying rise in temperature can deposit dry snow early, which bonds poorly with the heavier snow deposited later. This creates an unstable snowpack. Most avalanches occur during the warmer midday. Due to temperature fluctuations.

• **Precipitation:** About 90 percent of avalanches occur during or within twenty-four hours after a snowstorm. The rate at which snow falls is important. High rates of snowfall, 1 inch or greater, especially when accompanied by wind, are usually responsible for major periods of avalanche activity. Rain falling on snow will increase its weight and weakens the snowpack.

• **Wind:** Sustained winds of 15 mph and over transport snow from the windward aspect of the slope and forms wind slabs on the lee slopes.

d) **Snow Factors**

• Unstable Snow Layers
• New snow greater than 1 foot.
• Crusty, wind packed or iced layer next to soft snow.
• Loose, cold snow.
• Buried surface hoar.
• Depth hoar occurs deep in the snow pack and may act like ball bearings.
• Hollow spaces.
• Settled snow under a crust or water runoff above a crust.

e) **Human Factors**

• **Weight/Overloading:** Most victims trigger the avalanches that kill them.

• **Vibration:** Passing helicopters, heavy equipment and explosions have triggered avalanches.
3) Types of Snow Avalanches

a) Loose Snow: Loose-snow avalanches start at one point on the snow cover and grow in the shape of an inverted V. Occurrences:

- **Dry Loose-snow avalanches** occur at all times of the year in the mountains. They happen most frequently during the winter snow season. They often fall as many small sluffs during or shortly after a storm. This process removes snow from steep upper slopes and either stabilizes lower slopes or loads them with additional snow.

- **Wet loose-snow avalanches** occur in spring and summer in all mountain ranges. Large avalanches of this type, lubricated and weighed down by melt water or rain, can travel long distances and have tremendous destructive power. Coastal ranges that have high temperatures and frequent rain are the most common areas for this type of avalanche.

b) Slab Avalanches: Slab avalanches occur when cohesive snow begins to slide on a weak layer. The fracture line where the moving snow breaks away from the snow pack makes this type of avalanche easy to identify. Slab release is very rapid. Although any avalanche can kill you, slab avalanches are considered more dangerous than loose snow avalanches.

- **Occurrences**
  
  o During or shortly after a storm when slopes are loaded with new snow at a critical rate. The old rule of never travel in avalanche terrain for a few days after a storm still holds true.

  o Most victims trigger the avalanche that kills them. As slabs become harder, their behavior becomes more unpredictable; they may allow several people to ski across before releasing. Many experts believe they are susceptible to rapid temperature changes. Packed snow expands and contracts with temperature changes. For normal density, settled snow, a drop in temperature of 18 F would cause a snow slope 300m wide to contract 1 inch. Early ski mountaineers in the Alps noticed that avalanches sometimes occurred when shadows struck a previously sun-warmed slope.

  o At higher elevations, because of different weather conditions, instability can persist for many days. Slabs release between storms without warning.

- **Formation:** Soft slabs form over widespread areas during heavy storms, are associated with moderate wind speeds, high humidity, and rimed snow crystals. Hard slabs tend to form on lee slopes. It usually requires low temperatures and windblown snow. Frequently, hard slabs form over a weak layer of depth hoar, which fails to support the slab. This accounts for the characteristic hollow feeling and the drop of a few centimeters when the slab fails.
4) Reduce the Risk of Avalanche

a) Protective Measures

- **Avoidance**: Avoiding known or suspected avalanche areas is the easiest method of protection.
- **Stabilization**: Triggering the suspect avalanche slope before movement usually will stabilize it. Suspect slopes are sometimes shot at with artillery or detonated with explosives. Belayed skiers are often used after the explosives.
- **Barriers**: Barriers similar to tank obstructions are often placed in avalanche prone areas to anchor snow to the slope.
- **Group Safety**: Send one person across at a time, with the rest of the group watching. All ski in the same track.

b) Route Selection

- Always allow a wide margin of safety when making your decision. The safest routes are on ridge tops, slightly on the windward side; the next safest route is out in the valley, far from the bottom of slopes.
- Avoid cornices from above or below. Should you encounter a dangerous slope, either climb to the top of the slope or descend to the bottom. Well out of the way of the run-out zone. If you must traverse, pick a line when you can traverse downhill as quickly as possible. When you must ascend a dangerous slope, climb to the side of the avalanche path and not directly up the center.
- Take advantage of dense timber, ridges or rocky outcrops as islands of safety. Use them for rest stops. Spend as little time as possible on open slopes.
- Since most avalanches occur within twenty-four hours of a storm and/or at midday, avoid moving during these periods. Moving at night is tactically sound and may be safer.

c) Stability Analysis: Look for nature’s billboards on similar slopes and the one you are on.

- **Evidence of Avalanching**: Look for recent avalanches on similar slopes.
- **Look for signs of wind loading** or **wind-slabs**.
- **Fracture Lines**: Avoid any slopes showing cracks.
- **Sounds**: Beware of hollow sounds (a "whumphing" noise). They may suggest a radical settling of the snow pack. "People trigger avalanches that bury people. If these people would recognize the hazard and choose a different route, they could avoid the avalanche."
5) React to an Avalanche

a) Survival: If caught, you must fight for your life.

- **Discard Equipment:** Equipment can injure or burden you. Discarded equipment will be an indicator as to your position.
- **Stay on Top:** Swim or roll to stay on top of the snow. Work toward the edge of the avalanche. If you feel your feet touch the ground, give a hard push and try to pop out onto the surface.
- **Going Under:** As your head goes under the snow, shut your mouth, hold your breath and position your hands and arms to form an air pocket in front of your face. Many avalanche victims suffocate by having their mouths and noses plugged with snow.
- **Beneath the Surface:** When you sense the slowing of the avalanche, you must try your hardest to reach the surface. Several victims have been found quickly because a hand or foot was sticking above the surface.
- **Stopping**
  - The snow sets up like cement, and even if you are only partially buried, it may be impossible to dig yourself out. Do not shout unless you hear rescuers immediately above you. In snow, no one can hear you scream.
  - Don't struggle to free yourself. You will only waste energy and oxygen.
  - Try to relax. If you feel yourself about to pass out, do not fight it. The respirations of an unconscious person are shallower, their pulse rate declines and the body temperature are lowered, all of which reduce the amount of oxygen needed.

b) Search Analysis

- **Analysis:** Analysis of the avalanche path can reveal the location of a victim. There are three zones to consider.
  - **Starting Zone:** Victims are not usually found in the starting zone. A victim's position in the starting zone will have a bearing on his final location. If you see a fellow Soldier is caught, watch him to give you a clue to where to start searching.
  - **Avalanche Path:** The snow along the edge of the path will move slower than the center. If the path curves, the snow traveling the longer radius will move slower than the shorter radius. Slower snow areas in the area directly above an obstruction and all areas of heavy snow deposit are likely places to find a victim.
  - **Run-out Zone:** This is where the avalanche slows and stops. This is where the largest deposits of snow are found and is most likely to hold victims.

- **Probable Location:** To plot a victim’s most probable location, you must consider several things:
  - Point Last Seen (PLS)
  - Equipment Clues
  - If you have the PLS, the avalanche path and clues you can draw a line to figure out the victim’s probable path.
c) The Avalanche Transceiver

- **Transceiver:** The operating frequency is the worldwide standard of 457 kHz. There are many different types of transceivers. Most operate with an audio mode and visual display. Check transceivers individual specifications.

- **Function Checks:** At the start of each day, check your avalanche transceivers
  - **Reception:** One member, with his unit on transmit, moves out from the rest of the group. He stops only when the remainder of the party-their units switched to receive-can no longer hear the signal.
  - **Transmission:** The main group now switches their units to transmit, while the person out in front switches to receive. In turn, each party member moves toward the checker and continues past until out of range.

- **Locating Victims**
  - **Lookout:** Do not become a victim. Post a lookout to warn of new avalanches in the same area. If the lookout warns of another avalanche, everyone must immediately turn his transceiver to transmit.
  - **Location:** Decide the most probable victim location.
  - **Get On Line:** Spread the searchers on line at thirty meters intervals. Insure everyone is set to receive at full volume. Move forward, maintaining the interval. Each searcher works independently.
  - **Avalanche Transceiver:** The avalanche transceiver has been designed to make searching as simple as possible. The stronger the signal, the more LED's (inside the arrow) light up and the louder the sound. The large LED above the range dial is the range LED (some transceivers use distance to the victim in the visual display). The distances that are shown on the range scale are not exact measurements but they are a good gauge of the searching distance.
  - **Induction Search Pattern**
    - Search patterns begin when you first receive a signal. At this point LEDs will be faintly flashing. From this point, always hold the beacon horizontal with the arrow pointing away from you. Slowly rotate the beacon from side to side to determine the direction of the strongest signal – (most lights, loudest sound). Once direction is determined, precede in a straight line until the range LED flashes. Continue increasing the sensitivity of the beacon as the search area becomes smaller.

    - At this point, you will conduct a pinpoint grid search pattern. This is nothing more than placing the beacon close to the snow surface, moving it from side to side and forward and backwards to locate the strongest signal. When the strongest signal is determined, quickly spot probe the area up to a meter wide for the victim’s location. Due to the depth of burial, the pinpoint search may have to be done in a higher setting.
d) Probing. Probing is the oldest and least efficient method of searching for an avalanche victim. To coarse probe an area 100 meters by 100 meters, using twenty probers with manufactured probes, it would require about four hours and the success ratio is approximately 70%. A single trained Soldier using an avalanche transceiver can search the same area with a success ratio of 98%.

e) Shovel Crews and Trenching

- Shovel crews assist the probers, relieving them at intervals and digging in likely spots.

- Trenching is for body recovery if a fine probe fails. Before deciding to trench consider the dangers at the avalanche site plus the exceptional effort that trenching requires. Trenches are dug parallel to the contour, down to ground level or to undisturbed snow at intervals of two meters. Digging begins at the run out zone and proceeds uphill. Space the shovel teams along one trench. Throw the snow from one trench into the one just completed.
SECTION II: MEDICAL

Chapter 15. Environmental Injuries

1) **Introduction:** History and current actions have consistently demonstrated that despite technological advancements in Soldier clothing and equipment, the risk for environmental injuries remains high. The ability of Soldiers to perform and thrive in a hostile environment requires training and a detailed understanding of both environmental threats and methods of coping with them.

2) **Risk Factors**

   a) **Previous cold weather injury:** Individuals who have suffered from previous injuries usually have an increased sensitivity and are prone to the injury happening again.

b) **Fatigue:** Physical and mental weariness both contribute to neglect of vital tasks.

c) **Discipline:** Training and Experience. Injuries are entirely preventable in a training environment. Reinforcement of these principles is essential to reduce the incidence of weather related injuries in combat.

d) **Psychological Factors:** Injuries tend to occur in passive, negative and hypochondriac Soldiers. Such people are less active in situations in which activity is unrestricted and are careless about precautionary measures.

e) **Geographic Orientation:** Being acclimated to the cold weather.

f) **Drugs and Medication:** Any drug modifying judgment or the circulatory system can have disastrous effects on individual performance and survival in the cold.

g) **Other Injuries:** Other injuries associated with reduction of blood flow increase the risk of cold weather injuries.

h) **Exposure**

   i) **Dehydration**

3) **Dehydration:** The loss of water by the body.

   a) You lose 1.5 to 2 quarts a day through sweating, breathing and urinating.

   b) Cold weather or altitude increases the loss to 4 or more quarts a day because of low humidity and cold diuresis.

<table>
<thead>
<tr>
<th>Exposure</th>
</tr>
</thead>
</table>
| Conduction: Direct transfer to an object  
| Convection: Cool air moving across warm body  
| Evaporation: Sweating  
| Radiation: Direct heat loss from warm body to environment  

<table>
<thead>
<tr>
<th>Signs and Symptoms of Dehydration</th>
</tr>
</thead>
</table>
| Orange "snow flowers" from urination, dry mouth, tongue and throat, difficulty swallowing, tiredness, weakness, nausea, fainting, dizziness, vomiting, muscle cramping or difficulty focusing eyes.  
| Constriction of the peripheral blood vessels (so the remaining blood goes to more vital organs) increases the probability of frostbite.  
| Severe shock may develop following even minor injuries.  
| Clots may form in the legs and can result in pulmonary embolism.  

Preventing Dehydration

- Make a conscious effort to drink more when it is cold (by the time you are thirsty, you are already dehydrated).
- Drink a minimum of two quarts of water a day. Three or four quarts are necessary with increased exertion or higher altitude.
- Eating snow or ice does not provide enough water and it drains additional body heat.
- Light yellow urine is a good indicator of proper hydration. If using diuretics, compensate with extra water.

Thawing

- Pain
- Swelling
- Blisters up to 36 hours later
- Ecchymosis (Bruising)
- Skin / tissue loss

Treating Dehydration

- Administer fluids orally for mild dehydration and with an I.V. for more serious cases.
- Keep the patient warm, but avoid overheating.
- Loosen clothes sufficiently to allow proper circulation.
- Allow plenty of rest.
- Have trained medical personnel treat & monitor.

Treating Frostbite

- A hospital is the best place for rapid rewarming in a large water bath with the temperature precisely controlled between 110-115°F. Avoid rewarming in a wilderness environment, which results in more tissue loss.
- Loosen constricting clothing and remove jewelry. Do not attempt to thaw. Insulate and protect frozen tissue from cold or trauma. Evacuate to a hospital. If a patient must walk with frostbitten feet, it is better to walk on frozen feet (walking on thawed feet will increase the trauma). Never allow thawed tissue to refreeze. The damage will be worse than before.

Frostbite: Frostbite is frozen tissue cause by exposure to freezing temperatures.

a) Most commonly affected are hands, feet, ears and face. There is sudden blanching (whitening), followed by a momentary “tingling” sensation, then lack of pain and feeling in the affected area. White skin looks pale and waxy, dark-skin, dull and grayish. Tissue feels hard and cold to the touch.

b) Upon thawing, living tissue is very painful; dead tissue is not. Blisters can appear up to 36 hours later. Blisters with clear fluid suggest live underlying tissue; bloody fluid suggests dead underlying tissue. With the most severe frostbite, damage restricts the circulation that the tissue does not blister and commonly is a deep purple color. Dead tissue separates spontaneously within weeks or months. Complete separation of larger extremities may require surgery.

c) Treat Frostbite

<table>
<thead>
<tr>
<th>Frostbite Treatment</th>
<th>Superficial</th>
<th>Deep</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rewarm with hands, armpits, belly</td>
<td>Do not rewarm in the field</td>
<td></td>
</tr>
<tr>
<td>Do not allow to refreeze</td>
<td>Requires rapid rewarming in large bath in a hospital setting (110-115 degrees F)</td>
<td></td>
</tr>
<tr>
<td>Do not use exhaust pipes or open flames</td>
<td>Do not rub or bend</td>
<td></td>
</tr>
<tr>
<td>Do not rub with snow</td>
<td>Do not pop blisters</td>
<td></td>
</tr>
<tr>
<td>Avoid tobacco (vasoconstrictor)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
- Do not massage, rub with snow or apply cold-water soaks. Do not rewarm by exposing to open flame or other dry heat. Do not consume alcohol or tobacco. Alcohol increases loss of body heat and tobacco causes constriction of blood vessels in the extremities.

d) Frostbite Prevention

- Think twice before removing hand gear.
- Think before touching metal (i.e. zippers) with bare skin.
- Be careful when handling fuel ("frostbite in a can").
- If your skin goes numb, rewarmed immediately! Rewarm your face with your hands. Rewarm your hands in your armpits.
- Use the buddy system to check ears and noses.
- Avoid Tobacco. Smoking constricts blood vessels.
- You can prevent frostbite. In extreme circumstances, such as those surrounding an accident, emergency bivouac or unexpected storm, it may be difficult to avoid. There is no reason to get frostbite in a training environment.
- Keep socks and boots dry. Avoid tight fitting clothing, especially boots.
- Rewarm feet by wiggling your toes, walking or running. If necessary, place them skin-to-skin against a buddy’s abdomen.

5) Immersion Foot: A foot injury caused by exposure to water or moisture for prolonged periods.

a) Signs and Symptoms of Immersion Foot
   - Minimal: Red skin, variable sensory changes (numbness, tingling and pain).
   - Mild: Swelling, reversible sensory changes.
   - Moderate: Swelling, redness, blisters, ecchymosis, irreversible nerve damage.
   - Severe: Tissue death.

b) Immersion Foot Prevention: Change socks, dry and massage.
   Avoid prolonged immersion in cold water. When using foot powder, do not let it become caked. Rub off excess powder. Change to dry socks as frequently as required.

6) Hypothermia: Hypothermia is a lowering of the body’s core temperature. Exposed to cold, blood vessels in the skin constrict. This shunts warm blood to the heart and brain (so that they can survive) but allows the body’s periphery to cool.

a) Heat is lost to the environment by four means:
   - Conduction: Direct heat transfer from one object to another.
   - Convection: Heat loss due to moving air or water in contact with the skin.
   - Radiation: Heat is transferred via infrared radiation.
   - Evaporation: Evaporation of perspiration.
b) Heat Production
- You can increase your body temperature by exercise, but it will not compensate for severe heat loss (i.e. cold-water immersion).
- External heat sources.

c) Heat Retention: Accomplished through appropriate clothing and shelter.

d) Signs and Symptoms of Hypothermia: Hypothermia has no absolute diagnostic sign or symptom except a measured low body temperature. Other conditions may mask or mimic hypothermia. The following core temperature range is only a rough guide:

- Mild Hypothermia
  - 98-95°F: Chills, shivering starts, warming exercises, loss of fine finger movement, lagging behind, withdrawal/apathy, and stumbling over rough ground.
  - 95-93°F: Appears capable but uncooperative, extreme errors in judgment, confusion, lethargic, can walk with assistance or stand, and difficulty using hands.
  - 93-90°F: Inability to use hands, not fighting cold, and frequent stumbling and falling.

- Severe Hypothermia
  - 90-86°F: Shivering stops, irrationality (i.e. paradoxical undressing), vital signs below normal, incoherence, cannot stand without assistance.
  - 86-82°F: Vital signs not detectable, muscle rigidity, semi-consciousness.
  - Below 82°F: Unconsciousness, death due to ventricular fibrillation.

e) Hypothermia Treatment: Mild and severe hypothermia are approached as two entirely different problems.

- Mild Hypothermia: Decrease heat loss (insulate from ground, protect from wind, remove wet clothing, cover head and neck, move to warm environment, heat packs at neck, armpits, groin and belly). Increase heat production: exercise, warm sweet liquids and food, fire, hot bath or shower. Do not give alcohol.

- Severe Hypothermia: If conscious, do NOT let the victim exert himself. Exertion can kill due to ventricular fibrillation (v-fib). TREAT VERY GENTLY (a slight bump can cause v-fib). If unconscious, assess pulse and respiration for one to two minutes. If no pulse and respiration, start CPR. Severe hypothermia victims have been successfully resuscitated without brain damage after one and one-half hours of CPR. If transfer to a medical facility is possible within 6 hours, do not attempt to re-warm. The victim is often in a "metabolic icebox." Do hypothermia wrap and evacuate. Even in a hospital, the mortality rate is up to 80%. If transfer is not possible within 6 hours, slowly re-warm ONLY the trunk via skin-to-skin contact with another person in a sleeping bag. Do not immerse in a warm water bath, which can cause re-warming shock. No hypothermia victim is cold and dead; only warm and dead.
f) **Hypothermia Prevention**: A human’s greatest protection against the cold is intelligent behavior. Hypothermia is called the "killer of the unprepared." Most wilderness cases of hypothermia occur in the summer. Preventing hypothermia simply requires enough water, food, clothing and shelter to spend the night.

- Increase heat production through muscular activity and hot liquids.
- Water. Failure to replace lost water results in dehydration. Dehydration is found in all hypothermia cases.
- Food. Eat small amounts throughout the day to maintain a steady energy supply.
- Clothing. Layers should be dry, protect from the weather and allow adjustments.
- Plan for the worst possible conditions and know how to build emergency shelters.

7) **Sunburn**: Sunburn is a thermal burn on the outer layers of skin caused by exposure to ultraviolet radiation from the sun. The four middle hours of the day receive two-thirds of the day’s ultraviolet radiation. Ice and snow reflect UV.

- **Signs and Symptoms**
  - **Mild**: exposure produces redness and slight swelling, especially on the roof of the mouth and under the chin or the nose.
  - **Moderate**: exposure causes pain and blistering.
  - **Severe**: burns can cause chills, fever or headache. Herpes simplex infections ("fever blisters" or "cold sores") often follow sunburn of the lips.

- **Treatment**: For mild sunburn, soothing creams will help. Anesthetic sprays and ointments are effective but carry a risk of allergic reactions. Extensive first or second-degree sunburn may require hospitalization.

- **Prevention**
  - The lighter your skin’s color the more at risk you are.
  - Clothing (including nose shields). Sunscreens filter out some ultraviolet radiation.
  - The SPF (sun protective factor: 2-35+) indicates how much longer you are protected than with no sunscreen at all. Individuals allergic to thiazides or sulfa drugs may also be allergic to sunscreens. You can replace normal sunscreens with hypoallergenic products.
  - Sun blocks stop all ultraviolet radiation. Apply to areas that sunburn easily and are hard to cover (nose, lips and ears).
• Many drugs may increase sensitivity to sunlight. These include sulfonamides and their derivatives (Bactrim and Septra), most tetracycline, particularly oxytetracycline (Vibramycin), which has been recommended for preventing traveler’s diarrhea.

• Ultraviolet exposure is much greater at high elevation than at sea level. At high altitudes, the atmosphere filters out less sunlight. Snowfields and glaciers reflect about 75 percent of the incident ultraviolet radiation, exposing climbers to more radiation. Atmospheric scattering allows ultraviolet radiation to reach climbers shielded from the direct sun.

• Sunburn can occur even on an overcast day or during a snowstorm.

8) **Snow Blindness:** Irritation of the conjunctiva caused by reflection of the sun on the snow ice or water. Clouds do not block UV. Snow Blindness is the result of excessive exposure to ultraviolet radiation on the surface of the eye.

a) **Signs and Symptoms**
   • May develop up to twelve hours later and can last several days.
   • Eyes feel irritated, dry or full of sand.
   • Extreme pain upon moving, blinking or exposing to light.
   • Eyelids swelling; eyes red, excessive tearing and headache.
   • Complications include corneal ulceration and permanent damage.

b) **Prevention**
   • Wear large curved glasses with side covers that block UV radiation from all sides.
   • Goggles are safer but are less comfortable and may fog.
   • You can make emergency lenses from cardboard with a thin slit or pinhole to see.
   • On ice or snow, wear sunglasses even on cloudy days.

9) **Heat Cramps:** Painful cramping of the larger muscle groups (legs, abdomen) caused from heat, dehydration, and/or lack of conditioning.

10) **Heat Exhaustion:** Is caused by loss of body fluids and salt depletion through sweating without adequate fluid replacement.

a) **Symptoms:** Heavy sweating with pale, moist, cool skin, headache, light-headed, nausea/vomiting, tingling sensations, body temperature of 99-104°F, weakness, loss of appetite, cramping, urge to defecate, chills (goose bumps), rapid breathing, and confusion.

c) **Treatment:** Move to shaded area, loosen clothing and pour water on the patient and fan him/her. Slowly drink one canteen of water or preferably an electrolyte solution. Elevate legs. Monitor casualty until symptoms are gone or medical assistance arrives. Check casualty for signs and symptoms of Heat Stroke.

d) **Prevention:** Follow the fluid replacement guidelines for warm weather training. Implement a work rest plan for any activity in a warm weather environment. Acclimatize.
11) **Heat Stroke:** The body's normal mechanisms for dealing with heat stress, such as sweating and temperature control are lost. This is a Medical Emergency. Some risk factors include:

<table>
<thead>
<tr>
<th>Heat Stroke Symptoms</th>
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<tbody>
<tr>
<td>• Flushed, warm skin</td>
</tr>
<tr>
<td>• Elevated temperature</td>
</tr>
<tr>
<td>• Change in Mental Status</td>
</tr>
<tr>
<td>• Absence of Sweating (Late Finding)</td>
</tr>
<tr>
<td>• Can begin as heat exhaustion and progress</td>
</tr>
<tr>
<td>• Organ Damage is related to the duration of the elevated temperature</td>
</tr>
</tbody>
</table>

**a) Dehydration**
- Respiratory and Gi illnesses
- Alcohol use
- Laxatives and diuretics

**b) Medications**
- Increase heat production and/or decrease heat loss (pseudoephedrine, thyroid hormone, cocaine)
- Decrease sweating (antihistamines (Benadryl), anti-nausea (meclazine, phenergan)

**c) Supplements**
- Ephedrine (MaHuang), caffeine

**d) Treatment**
- ABC: Unconscious patient may vomit and aspirate.
- IV: no more than 2L unless circulatory collapse.
- Lower the body temperature as fast as possible. All clothes off. Apply cool water with fanning to increase evaporation.
- Ice packs under groin or axilla.
- During EVAC, open doors/windows in helicopter/vehicle keep cooling to temp 101-102°F. Ice-water immersion if available.
Chapter 16. High Altitude Illness and Prevention

1) Introduction: Conducting combat operations in the mountains exposes Soldiers to unique conditions that can rapidly make unprepared units combat ineffective. Understanding the effects of altitude on Soldiers and the steps necessary to mitigate or prevent these effects will significantly increase a unit’s operational capability.

2) Acclimatization Considerations

a) Conditioning. Training in mountains of low or medium elevation 5,000 to 8,000 feet does not require acclimatization procedures. Poor physical condition will decrease performance even at low altitudes. All non-acclimated Soldiers display some altitude effects above 8,000 feet.

b) Acclimatization. When you can live and function physically and psychologically, you are acclimated to that elevation. The acclimatization process begins when you arrive at the higher elevation. If the change in elevation is large and abrupt, some Soldiers will suffer the symptoms of acute mountain sickness. Disappearance of symptoms (4-7 days) does not suggest complete acclimatization. The process continues for weeks or months. Attempts to acclimatize beyond 17,000 feet results in a degradation of the body greater than the benefits gained.

3) Acclimatization Methods

a) Deployment to High Elevations: There is no way to shorten the acclimatization process and the absence of acclimatization hampers operations. The following measures are important:

- **Ascend by Stages:** Spend 2 or 3 days at each stage, beginning at 8,000 feet and subsequent stages of 2,000 to 3,000 feet increments, will insure that the ultimate destination is reached. By this time, a considerable degree of acclimatization will have occurred, mountain sickness greatly reduced and the operational potential greatly increased.

- **Pre-treatment:** Pre-treating Soldiers with Acetazolamide (Diamox) will reduce the incidence and severity of acute mountain sickness.

- **Local Acclimatization:** Begin acclimatization in CONUS or another safe area before deployment to the operational area. Deploy to the operational areas by rapid transport once acclimatization is complete.

- **Rest Cycle:** If troops are moved directly to high altitudes, the first 3 to 5 days must be a period of relative inactivity.

- **Nutrition:** Plan for and ensure sufficient caloric intake at higher elevations to accommodate increased work output.
• **Water:** Danger from dehydration is as high in mountain regions as in hot dry areas. Plan on at least 4 quarts per day when in bivouac and 6 quarts per day when active. Boil water and snow from an unknown source for a minimum of 1 minute to kill bacteria and microorganisms.

4) **High Altitude Medical Problems:** Medical problems associated with high altitude include several uncomfortable and life threatening conditions. All are primarily the result of a decreased oxygen concentration in the blood caused by the lower atmospheric pressure at high altitude. Altitude illness does not occur on the highest mountains only. More people are more affected between 8,000 and 12,000 feet than at higher altitudes. Many examples confirm that not only altitude and rate of climb, but also the length of stay and the effort expended, decide whether an individual will or will not have some kind of altitude illness.

a) **Acute Mountain Sickness**

• **Definition:** Acute Mountain sickness is a temporary illness.
• **Cause:** Rapid ascent over 8,000 feet in elevation.
• **Signs and Symptoms:**
  o Headache plus one or more other symptom:
    ▪ Nausea/Vomiting
    ▪ Fatigue
    ▪ Lassitude
    ▪ Dizziness
    ▪ Difficulty sleeping

**Note:** The symptoms usually develop and increase to a peak intensity by the second day, then gradually subside over the next several days. The headache may last until the Soldier returns to lower elevations. Most Soldiers WILL experience some degree of Acute Mountain Sickness at elevations above 8,000 feet.

• **Treatment**
  o Consists of relieving the headache with non-aspirin substitutes.
  o The patient should wear sunglasses since bright sunlight seems to aggravate the headache.
  o Reassure the Soldier.
  o Encourage fluids and light foods in small frequent amounts.
  o Moving the Soldier lower 2,000 to 3,000 feet may alleviate the symptoms.

• **Prevention**
  o Acclimatization.
  o Moving at progressive staged ascent, slows assumption of physical activity.
  o Protection from cold.
• **Miscellaneous**
  
  o There are three levels of severity for AMS; Mild, Moderate, and Severe. The signs and symptoms will remain the same for each level. The increase in intensity or severity of those symptoms will result in a higher level of AMS.
  o We are subject to this sickness at altitudes as low as 8,000 feet.
  o Incidence and severity increase with altitude and when transport to high altitudes is rapid.
  o Indications are that substantial disability and ineffectiveness can occur in 50 to 80 percent of troops rapidly brought to altitudes in excess of 12,000 feet.
  o At lower altitudes or where ascent to altitudes is gradual, the lessened severity of the sickness will allow a majority to carry out assignments with moderate effectiveness, although with some discomfort.
  o Arrival at high elevations 8,000 to 14,000 feet commonly feels well for the first few hours. A feeling of exhilaration or wellbeing is not unusual. There may be an initial awareness of breathlessness upon exertion and a need for frequent pauses to rest.
  o Breathing irregularities can occur, particularly during sleep. Individuals who become aware of these changes may exhibit some apprehension.
  o The true onset of symptoms begins 4 to 12 hours after arrival at the higher altitude.

b) **Sleep Hypoxia**

  • **Definition:** A slight drop in arterial hemoglobin oxygen saturation occurs due to a decrease in the rate and depth of breathing.
  • **Cause:** Decrease in arterial oxygen during sleep.
  • **Signs and Symptoms:** Inability of many individuals to sleep well at high altitude. It may also explain why headache and other symptoms of acute mountain sickness are more severe during the night.
  • **Treatment:** Diamox can relieve the severity of sleep hypoxia.
  • **Prevention:** None.
  • **Miscellaneous:** During sleep at sea level, a slight drop in arterial hemoglobin oxygen saturation occurs due to a decrease in the rate and depth of breathing. During sleep at high altitude, the decrease in ventilation of the lungs is more marked, fluctuates widely and arterial oxygen saturation may reach very low levels.

c) **High Altitude Pulmonary Edema (HAPE)**

  • **Definition:** HAPE is a swelling and filling of the lungs with fluid caused by rapid ascent. It occurs at high altitudes and limits the oxygen supply to the body.
  
  • **Cause:** Rapid ascent to heights over 8,000 feet.
• **Signs and Symptoms**
  o Progressive dry cough that becomes productive with frothy white or pink sputum.
  o Cyanosis or the turning blue of the face, hands, and feet will occur and will become more intense.
  o Most victims have the symptoms of acute mountain sickness. The early pulmonary difficulties may not be primary or striking.
  o Closely observe personnel with acute mountain sickness for increasing ill feeling, labored breathing, repeated clearing of the throat, and development of the dry cough and an increase of difficult and labored breathing at night.
  o In rapidly progressive cases, the onset of respiratory difficulty may be quite sudden, associated with a choking feeling and rapid deterioration.
  o Oxygen Saturation < 80-85% (Determined with pulse oximeter).

• **Treatment**
  o Prompt treatment consisting of rest, warmth and oxygen.
  o Immediate evacuation to lower altitudes 3,000 feet by air if possible. The patient should not be allowed to descend on foot, as physical work accelerates HAPE.
  o If immediate descent is not possible, place patient in a hyperbaric chamber if available (Gamov bag) to increase atmospheric pressure.
  o If untreated, HAPE will become irreversible and lead to death. You can expect recovery in cases that are recognized early and treated promptly.
  o Individuals who have had a previous attack of HAPE are more prone to have subsequent attacks.

• **Prevention**
  o Acclimatization.
  o Moving at a progressively staged ascent slows assumption of physical activity.
  o Protection from cold.

**Note:** A program of acclimatization, as indicated under acute mountain sickness can largely prevent HAPE. Immediate descent is the BEST treatment for HAPE.

• **Miscellaneous**
  o High altitude pulmonary edema is the most dangerous of the common types of altitude illness.
  o HAPE is encountered exclusively at high elevations and characteristically occurs in individuals experiencing mountain sickness.
  o HAPE is characterized by high mortality.
  o Incidence and severity increase with altitude.
  o Except for acclimatization, there is no known resistance or immunity.
  o Cases are rare on the day of arrival and infrequent after the fourth day. There are few cases after more than ten days at altitude.
  o The incidence of HAPE is much less frequent than that of mountain sickness.
  o Factors contributing to HAPE include: a history of prior high altitude pulmonary edema, a rapid or abrupt transition to high altitude, strenuous physical exertion, exposure to cold and anxiety.
o A drop in the concentration of oxygen in the blood results, eventually causing cyanosis, impaired cerebral function and finally death by suffocation.

o Depending upon the ease versus hazards of evacuation, the use of rest, warmth and oxygen may be preferable to a hasty evacuation to lower elevations.

d) High Altitude Cerebral Edema (HACE)

- **Definition:** HACE is the accumulation of fluid in the brain, which results in swelling, and a depression of the brain function that will result in death.

- **Cause:** Rapid ascent to heights over 10,000 feet aggravated by overexertion.

- **Signs and Symptoms**
  - Rare below 10,000 feet.
  - A severe headache seen lower is an early form.
  - Takes several days to develop but rarely comes on swiftly.
  - Characterized by increasing headache, poor judgment, auditory or visual hallucinations, incoordination, stumbling walk (ataxia), drowsiness, coma and death.

- **Treatment:** Descent is mandatory, urgent and often the only effective treatment, as well as rest, warmth, and oxygen.

- **Prevention**
  - Acclimatization.
  - Moving at a progressively staged ascent slows assumption of physical activity.
  - Protection from cold.

- **Miscellaneous**
  - Cerebral edema develops over the course of a few days. It is quite unlikely to happen on Mount Rainier where altitude exposure is usually limited to two days and maximum sleeping altitude is 10,000 to 11,000 feet.
  - It is not uncommon in the Everest region where altitude exposure is at least seven days and maximum sleeping elevation varies from 16,000 to 18,000 feet (possibly even higher).

**Note:** Immediate descent is the ONLY treatment for HACE.

5) Fluid and Nutritional Requirements While Operating at Altitude

a) Energy requirements for Soldiers operating at elevations above 8,000 feet will increase 15-50% over that needed at sea level for comparable exertion, depending on the elevation and type of mission. Soldiers should expect to expend up to 6,000 calories per day depending upon the temperature, altitude and physical activity. Operations at altitude in rough terrain require mental toughness and physical stamina. Hydration and appropriate (adequate) calorie intake is essential for maintaining peak operating performance. Leadership and individual preparation for sustaining operations in a high-altitude environment is essential.
b) High Altitude Hydration Requirements

- **Factors That Cause Dehydration**
  - Increased urinary output due to cold diuresis.
  - Water loss from the lungs from increased ventilation of cold dry air.
  - Sweating from increased physical exertion.
  - Vomiting and diarrhea, especially in the first few days at altitude.
  - Water purification and water resources may be unavailable or limiting.

- **Considerations for Proper Hydration**
  - Maintain a sustainable water requirement of a minimum 5 quarts per Soldier per day.
  - Drink water consistently throughout the day as tolerated.
  - Maintain hydration especially when first arriving at altitude, this may decrease the effects of AMS.
  - Soldiers will not “feel” the urge to drink, although the water requirement has increased.
  - Water purification must be available. Boiling water may be limiting as the fuel requirement to boil water increases with altitude (longer boiling times).
  - Water will freeze as the temperatures decrease. Consider insulating containers for hydration systems.
  - Water gathered from local sources must be considered contaminated and appropriate purification methods should be used.
  - Cold Weather Rations (RCW) require water to rehydrate food contents. Water is also required for food absorption within the body, so adequate water should be ingested with a dehydrated meal.

**NOTE:** Proper hydration in a high-altitude environment is critical to Soldier sustainability and mission success. It is very easy to become dehydrated as the urge to drink decreases with altitude. Dehydration exacerbates the effects of altitude, environmental injuries, increases fatigue and impairs judgment.

c) High Altitude Calorie Requirements

- **Adequate Calorie Intake**
  - Soldiers can be expected to burn between 4,500 – 6,000 calories per day while operating in a high-altitude environment.
  - Suggested daily energy allowances (4,500 calories) for high-altitude operations can be consumed in 4 MREs’ or 1 Ration, Cold Weather (RCW). The RCW requires about 3 quarts of water to rehydrate all of the food contents. As a rule of thumb, it requires about 2 pounds of food per Soldier per day (excluding packaging) to sustain caloric intake for energy expenditure while at altitude. A high-carbohydrate diet is desired, as it will replace muscle energy stores and keep blood sugar levels balanced. A low blood sugar level combined with the effects of altitude can lead to disorientation, confusion and lack of coordination.
  - Calorie intake should be in the ratio of 60-65% carbohydrates, 20-25% fat, and 10-15% protein.
Drinking carbohydrate-loaded beverages can be easily tolerated and helps to ingest calories and remain hydrated. 400-600g of carbohydrates per day (60-70% of dietary energy) is suggested for optimal performance. This is difficult to achieve unless Soldiers consistently drink carbohydrate-loaded beverages or snack on easily digested high-carbohydrate foods. The first 24-72 hours after arriving at a higher elevation may produce nausea and vomiting. Warm, carbohydrate based fluids are well received and can help with energy and fluid requirements if solid food cannot be tolerated.

**EXAMPLES**

- Carbohydrate Beverages include Beverage Base Powders, Electrolyte Packets found in MRE and RCW, Gatorade, PowerAde, Cider, Cocoa, Sweet Tea etc…
- High-Carbohydrate foods include Cereals, Crackers, Fig Newtons, Breads, Dried Fruits, Granola Bars, Bagels, and Pastries etc…
- MREs’ and RCWs’ provide adequate protein requirements for operations at altitude. A high fat diet is discouraged as the energy requirements for metabolism are increased. If high fat foods are desired, consume them with high carbohydrate foods. MREs’ and RCWs’ provide enough vitamins and minerals that supplementation is not needed.

**Note:** Everything is harder at altitude. It will take discipline and constant monitoring to maintain proper food and fluid intake throughout the day. Meals should be eaten warmed if applicable and “snacking” should be encouraged throughout the day. Bring foods that you know you like to eat because your appetite will diminish as you gain altitude.
Chapter 17. Basic Mountain Casualty Evacuation

1) Introduction: Conducting casualty evacuation in a mountainous environment can pose significant challenges due to terrain, elevation, weather and available equipment. Leaders must assess environmental conditions and enemy capabilities and plan/rehearse to ensure they are prepared to evacuate Soldiers. Although air evacuation may be available, an injured Soldier may need to be moved to an area where air can pick up the casualty. A unit’s ability to quickly assess, treat and prepare to evacuate an injured Soldier may be the difference between that Soldier’s life and death.

2) Phases of Tactical Combat Casualty Care

a) Care Under Fire Phase
- Lasts only seconds (1-2 minutes max!)
- Scene safe/tactical situation. Don’t become a casualty yourself.
- Check airway and blood sweep.
- Oral/Nasal adjuncts and tourniquets only (30 sec - 1 min)
- Arterial bleeding is #1 concern.
- Get casualty behind cover fast.

b) Tactical Field Care Phase
- 5, 10, 20 minutes… You have what you have. Make the most of it.
- Reduced hostile threat or behind good cover.
- Rapid trauma assessment (3-5min)
- Head to toe, treat as you go. Patch him up quickly using the old ABCD.
- “Stay and play” or “load and go” decision

c) Combat Casualty Evacuation Phase
- No hostile threat
- Detailed trauma assessment (15 min)
- Head to toe, treat as you go, but in more detail. (Include neuro exams, etc…) 
- May be performed in place or on recovery asset.

3) Identify and Treat for Shock

a) Shock = not enough oxygen to the cells.

b) Oxygen Delivery Requirements: In order for the cardiovascular system to deliver oxygen to all cells of the body, there must be three functioning items:
- Pump (heart)
- Pipes (blood vessels)
- Oxygenated blood. If everything is functioning correctly, oxygenated blood is delivered to the cells. If anything interferes with this process, oxygen is not delivered to the cells where it is needed. The patient experiences this as "shock".
- **Types of Shock**
  - R respiratory: carbon monoxide poisoning, drowning, COPD, CHF, SIDS.
  - N neurogenic: spinal damage, drugs, anaphylaxis, infection.
  - C cardiogenic: heart attack, MI, angina pectoris.
  - H hypovolemic: hemophoge, burns, dehydration.
  - A anaphylactic: bee stings, food reactions.
  - M metabolic: diabetes.
  - P psychogenic: fainting.
  - S septic: systemic infection, TSS, toxemia of pregnancy.

- **Body's Compensation for Hypovolemic Shock**: The body will try to shunt blood to the vital organs (brain, heart and the lungs). Everything "non-essential" is shut down.

- **Signs and Symptoms of Shock**

<table>
<thead>
<tr>
<th>Class</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 1</td>
<td>Restlessness, anxiety, increased HR (heart rate)</td>
</tr>
<tr>
<td>Class 2</td>
<td>Cool clammy skin, increased R (respiration), increased systolic or decreased diastolic BP blood pressure, thirst, nause/vomiting</td>
</tr>
<tr>
<td>Class 3</td>
<td>Pallor, cyanosis, decreased LOC, decreased BP</td>
</tr>
<tr>
<td>Class 4</td>
<td>Very low BP, carotid pulse only (if any), pupils fixed &amp; dilated, comatose, death</td>
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</tbody>
</table>

- **The Golden Hour**: If a person is in severe shock (class 3) for one hour, they will die. After that “Golden Hour,” death may come soon or in a few days.

- **Treatment of Shock**
  - Treat the underlying condition
  - Lay the patient down
  - Elevate legs 18 inches (unless prevented by other injuries, i.e. hip fracture)
  - Maintain temperature
  - Reassure the patient
  - Oxygen
  - MAST
  - IV
  - Transport
4) Identify the Cause, Prevention and Treatment of Blisters

a) Causes: Blisters are caused by friction that pulls the skin back and forth over underlying tissue. Eventually, a space develops and collects fluid. The most common cause is new or ill-fitting boots. Boots that are too loose in the instep allow the foot to slide forward when going downhill, producing "downhill blisters" on the front part of the foot. "Uphill blisters" are common over the heel and Achilles tendon.

b) Prevention: Wearing properly fitting boots, breaking in new boots slowly, protecting blister prone areas (hot spots) with adhesive tape or moleskin and minimizing friction between the foot and the boot, can avoid blisters. Friction can be reduced by keeping the foot dry with powder (to reduce adhesion between the boot and the skin). Wearing a thick outer and a thin inner sock (made of nylon or a similar material) will allow most of the slippage to take place between the two socks.

c) Treatment

- If the blister will not receive any more pressure, protect the blister (pad around it) and allow the body to absorb the fluid.

Unbroken Blister-Not Likely to Break

- If the blister is likely to break (i.e. during a road march), drain the blister and wash the area. Swab with povidone-iodine (check for allergy to iodine). With a sterile needle, make a hole at the bottom of the blister. With sterile gauze pad or clean cloth, apply pressure to drain the fluid. Often the blister will require draining several times during the first twenty-four hour period to allow the blister roof to adhere to the base. Tincture of benzoin around the blister will help the moleskin stick well. Cover the blister with gauze (so the roof is not torn off later). Apply a moleskin "doughnut". More than one moleskin layer may be necessary. Too much moleskin will cause problems.

Draining the Blister
• "Hot Shots", the practice of injecting tincture of benzoin compound into a blister, creates a much greater chance of infection and tissue damage. This procedure is not recommended.

d) Follow-up Care: See a medic if the blister gets worse or if there are any signs of infection (pus, redness). DO NOT perform self-care for blisters that lie deep in the skin.

e) Apply the Treatment for Broken Blisters

• Treatment: Treat a broken blister as an open wound: clean, dress and protect. Healing is faster, pain is diminished and the risk of infection is greatly reduced when the blister roof is preserved. If the roof is torn away, apply antibiotic ointment, cover with a non-adherent layer and protect with a moleskin "doughnut".

• Follow-up Care: See a medic if the blister gets worse or if there are any signs of infection (pus, redness). DO NOT perform self-care for blisters that lie deep in the skin.

Padding a Broken Blister

5) Principles of Rescue Operations

a) First Rule: When faced with the necessity of rescuing a casualty threatened by hostile action, fire, water or any other immediate hazard, do not take action without first determining the extent of the hazard and your ability to handle the situation. The first rule of rescue is "DO NOT BECOME A CASUALTY".

b) Primary Mission: The primary mission is to get the casualty to appropriate medical care without causing further injury.

c) Three Major Steps: The rescuer must evaluate the situation and analyze the factors involved. This evaluation can be broken down into three major steps:

• Identify the Task: Decide if you really need a rescue attempt. It is a waste of time, equipment and personnel to rescue someone not in need of rescuing, to look for someone who is not lost or risk the lives of the rescuer(s) needlessly. In task identification, attempt to obtain the following information:
  o Who, what, where, when, why and how the situation happened?
  o How many casualties are involved and the nature of their injuries?
  o What is the location of the casualties?

• Evaluate the Circumstances of the Rescue: After identifying the task required, you must relate it to the circumstances under which you must work.
- Do you need additional people, security, medical or special rescue equipment / skills?
- What is the tactical situation?
- What are the weather conditions?
  - When considering weather, you should insure that blankets or rain gear are available. Even a mild rain can complicate a simple rescue. Available time diminishes with high altitude and/or in extreme cold and gusting winds.
  - High altitudes and gusting winds reduce the ability of aircraft to help in operations.
    Rotary wing aircraft may be available to remove casualties from cliffs or inaccessible sites and transport to medical treatment facilities in a comparatively short time.
- Is the terrain hazardous? With respect to terrain, you must consider altitude and visibility. Uses of secure/reliable trails or roads are essential.
- Aircraft are vital elements of search and rescue units. You cannot use aircraft in all rescue situations. Do not rely on their availability. Reliance on aircraft or specialized equipment is a poor substitute for careful planning.

- Plan the Action
  - The time available can cause rescuers to alter their rescue/treatment plans. Make a realistic estimate of time available as quickly as possible.
  - Timely gathering of accurate information, so that an effective assessment of the situation can be made, is essential. Once the initial investigation is complete, outline a list of options with backup contingencies for optimum flexibility. Establish goals and objectives for the first working periods of the mission. Apply basic principles of emergency response during this phase.

6) Considerations for Evacuating a Casualty

a) General Considerations for Evacuations
- Select the smoothest available route.
- Avoid unnecessary handling of the patient.
- Protect the patient from all environmental hazards (i.e. falling rock) by placing, his helmet over his head and pad him in the litter.
- When the evacuation route is long and difficult, a series of litter relay points or warming stations should be established. Staff these warming stations with the minimum medical personnel needed to allow proper emergency treatment. Hold any patient that develops signs of shock during evacuation at warming station/relay point. Treat and stabilize before continuing the evacuation.
- You can use skis to form expedient litters and as a substitute for the ahkio sled.
- Use helicopters or heated vehicles for evacuation whenever the situation, terrain and weather permit.
- Augment litter teams in rough terrain.
- Movement of a casualty over technical routes can be easier than movement through brush and rough terrain.
b) Special Training Requirements
   - Before receiving training in basic mountain evacuation, litter teams should receive instruction in military mountaineering.
   - Litter bearers and aid men must become thoroughly familiar with rope and mountaineering equipment.
   - The members of litter teams must become thoroughly proficient in the technique of belaying and in the selection of belay points so that proper support and protection can be given to patients and litter bearers when evacuating over difficult terrain.

c) Handling Wounded Soldiers: You may save a wounded Soldier's life through the application of the appropriate first aid measures only to lose him through careless or rough handling during transport. Before you attempt to move the wounded Soldier, you must evaluate the type and extent of his injury. Reinforce dressings over wounds. Immobilize and support fractured bones to prevent causing more damage.

   Note: It is important to establish proper safety measures for both the casualty and the rescue personnel.

7) Identify Patient Packaging Considerations

   a) Patient Packaging Considerations
      - Injury
      - Distance of travel
      - Terrain
      - Weather
      - Number of rescue personnel
      - Time
      - Equipment available

   b) Principles of Patient Packaging
      - Patient immobilization
      - Insulation or ventilation
      - Padding
      - Vapor barrier
      - BUFF (Big, Ugly, Fat, Fluffy)
      - Do no further harm

   c) Types and Characteristics of Manufactured Litters: Personnel involved with mountain evacuation will encounter several litter types. The most common are the following:

      - **Poleless, non-rigid litter:** The non-rigid, nylon litter is the least favored. It does not offer much protection for injuries. There is also a substantial amount of difficult rope and knot work involved.

      - **Standard collapsible litter:** The standard collapsible litter is the most common in the military system. It also involves substantial knot and rope work.

      - **Stokes/Mountain basket-type rigid litter:** The use of the rigid Stokes litter serves to eliminate much of the rope work used in the two previous litter types.

      - **SKED stretcher:** The SKED stretcher is quickly replacing all of the above litters in the military system.
d) Preparing the SKED for Low Angle Evacuation

- Tie a double figure eight in the middle of a 30-foot long 11mm rope. Pass each end of the rope through grommets at head of stretcher. Bring the double figure-8 snug and centered on the litter. Continue feeding rope through the grommets and handles all the way to the end. Tie the ends of the rope together with a square knot. Bring the ends of the rope up over the ends of the SKED and through the carrying handles. Tie another square knot with overhand safeties.

- A single attendant can be attached with a long tail bowline on the installation rope. Additional attendants can be attached by means of a short section of static rope (sling rope).

- If hypothermia is a threat, use a hypothermia wrap.
  
  o **Hypothermia Wrap**
    
    - Place a poncho in the bottom of the litter.
    - Place a sleeping mat and then a sleeping bag on top of the poncho.
    - Once the patient is in, place another sleeping bag and poncho on top.
    - This forms a warm, water-resistant cocoon for the patient.
    - Cervical padding should be placed around the head and neck using improvised items such as boots, rolled up shirts, rolled up blankets, etc.
8) Identify Techniques Used to Ascend and Descend Slopes and Cliffs

a) Ascending a Slope with a Litter

- **Main Force**
  - To ascend a moderately steep slope that can be walked, litter bearers take their places.
  - Any extra bearers take their positions along the extended rope that is in the hands of the belay man.
  - Exchange positions at each halt. Upon arrival at each belay point, place the litter on the ground and take a new position farther up the slope.

- **With a hauling system:** Upon encountering small steep obstacles, main force is sometimes not adequate for the task. In these situations, use a hauling system to assist the litter bearers.

b) Descending Slopes with a Litter

- One man acts as the belay man while another assists him. The litter bearers take their positions. Use a munter hitch or a super munter, depending on the slope.
- Other personnel may help with the litter or precede the team. If preceding the team, they can make reconnaissance, clear a trail or establish successive belay points.
- Take the most direct practical path. Use available trees and rocks as belay positions.
- Be sure to keep the casualty's head uphill with his helmet on.

c) Traversing Slopes with a Litter: If the evacuation route includes traverses, use directional anchors to prevent the litter team from taking a "pendulum" fall.

d) Belay Method

- The installation rope will be tied off to an appropriate anchor.
- A hot point tied into the installation rope; clip a locking carabiner and a locking parabiner into the hotpoint.
- Tie a munter hitch with the load rope into the parabiner.
- Tie a three wrap prusik on the load rope approximately 18 inches away from the munter hitch, tying the prusik off with a munter mule into the locking parabiner.
- This brake system is for lowering a load only.
- The rope must run over the solid portion of the parabiner, away from the gate. If the rope touches the gate, it could unlock and open the parabiner.
- To operate the brake pull the ropes back against the parabiner.
- The installation rope, the hot point of the Sked and the attendant line will be clipped into 2 opposite and opposed carabiners.
- The attendant can be secured to the attendant line with a locking carabiner into his harness, a figure 8 clipped into the locking carabiner with an autoblock tied onto the attendant line so he can go hands free if needed.
1) **Introduction:** How much weight a Soldier carries is a crucial concern for leaders during the planning process. Leaders must carefully consider how much to carry, how far, and in what configuration. Rigorous planning and inspection is the key to ensuring Soldiers are not overloaded and are capable of accomplishing missions in the mountains. Commanders and leaders balance the risk to their soldiers from the enemy against the risk of mission accomplishment due to excessive loads and soldier exhaustion or injury. **Commanders and leaders must accept prudent risks to reduce soldier load based on a thorough mission analysis.**

2) **Optimization of the Soldier’s Load**
   - Average fighting Load: 60-80 Pounds (about 30% of body weight)
   - Average total approach march-load: 80-100 pounds (about 45% body weight)
   - Average total emergency approach-march load: 100-125lbs

<table>
<thead>
<tr>
<th>Individual Body Weight (BW) in Pounds</th>
<th>Fighting Load (30% of BW)</th>
<th>Approach March Load (45% of BW)</th>
<th>Emergency Approach March Load (46 to 70% of BW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>120</td>
<td>36.00</td>
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a) The load Soldiers can carry is based not only on their body weight, as in the previous table, but also on the climate, terrain, altitude and prior or current stress. Therefore, the “Body Weight Percentage Table” should serve only as a guide for leaders to not overload Soldiers.

b) Economizing the individual combat load is essential for conducting dismounted operations in the mountains. In steep terrain at elevations above 1,524 meters (5,000 feet), individual loads may need to be reduced by 50 percent. For example, water purification and the amount of bulky ammunition, such as pyrotechnics, must be considered. Lightweight assault packs designed for mountaineering are vital. Leaders at all levels must continually review and modify existing unit packing lists and SOP’s. They do this by determining the level of mobility necessary for achieving mission success first, then determining the maximum loads to be carried before generating packing lists.

c) In the extreme cold weather environment, every effort should be made to keep the Soldier with his personal approach load (rucksack). The sleeping bags, extra clothing, rations, and other equipment, can mean the difference between life and death. Approach loads can be cached before an assault, but avoid leaving them behind altogether. Sustainment loads must be pushed forward as soon as practical.

3) Rucksack Fitting & Packing Considerations

a) Rucksack Fitting

- A poorly packed & fitted pack will make loads seem heavier than they are. It will reduce sure-footedness, balance and lead to higher fatigue. These effects will drastically increase the risk of a stumble or fall leading to serious injury.

- Packs should be sized so that the frame top is level with the shoulders allowing the Soldier to look upward with a helmet on while scrambling, climbing or shooting.

- The waist belt should sit above the hips in order to place weight on top of them. Sternum strap should sit across the center of the chest. Waist belt and sternum straps can be unbuckled while moving in ambush terrain & buckled in terrain where the risk of ambush is low. Using both straps over long movements will reduce fatigue as well as the risk of a stumble or fall in steep terrain.

b) Rucksack Packing

- In most cases, speed and endurance are enhanced if the load is carried more by the hips (using the waist belt) and less by the shoulders and back. This is preferred for movement over trails or less difficult terrain. By packing the lighter, more compressible items (sleeping bag, clothing) in the bottom of the rucksack and the heavier gear (stove, food, water, rope, climbing hardware, extra ammunition) on top, nearer the shoulder blades, the load is held high and close to the back, thus placing the most weight on the hips.
• In rougher terrain it pays to modify the pack plan. Heavy articles of gear are placed lower in the pack and close to the back, placing more weight on the shoulders and back. This lowers the climber’s center of gravity and helps him to better keep his balance. Heavy items should not be placed on the outside rear of the pack. This creates leverage and will drastically increase fatigue.

• Equipment that may be needed during movement should be arranged for quick access using either external pockets or placing immediately underneath the top flap of the pack. As much as possible, this placement should be standardized across the team so that necessary items can be quickly reached without unnecessary unpacking during emergencies.

• The pack and its contents should be soundly waterproofed. Clothing and sleeping bag are separately sealed and then placed in the larger wet weather bag that lines the rucksack. Zip-lock plastic bags can be used for small items. A few extra-large plastic garbage bags should be carried for a variety of uses—spare waterproofing, emergency bivouac shelter, and water procurement, among others.

• The ice axe, if not carried in hand, should be stowed on the outside of the pack, the adze facing forward or to the outside, and be securely fastened. Mountaineering packs have ice ax loops and buckle fastening systems for this. If not, the ice ax is placed behind one of the side pockets, as stated above, and then tied in place.

c) Load Carrying Equipment:

• Personal load carrying equipment (chest rig, plate carrier, FLC) should be adjusted or modified in order to be functional in mountain terrain. Essential Kit needs to be accessible while moving with pack on. Kit should be located above the belt line giving the Soldier room for an improvised harness and making room for his legs while climbing.

• Operational history & current enemy situation must be considered to determine the optimal amount of equipment required. All non-life preserving equipment should be stowed in the pack. Use a layered approach by distributing gear between kit, pack and on body. Ammunition, ordinance & water can be split between kit on body and in the pack during movements.

• An extremely basic example would be the following for a rifleman

<table>
<thead>
<tr>
<th>Kit</th>
<th>Pack</th>
<th>On body</th>
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</thead>
<tbody>
<tr>
<td>o 4 Magazines</td>
<td>o 3 Magazines</td>
<td>o Escape &amp; Evade / Survival Kit</td>
</tr>
<tr>
<td>o 1 Grenade</td>
<td>o 2 Qts. Water</td>
<td>o Small Signal Items</td>
</tr>
<tr>
<td>o 1 Smoke</td>
<td>o 2 Grenades</td>
<td>o Small Knife</td>
</tr>
<tr>
<td>o IFAK</td>
<td>o Spare Batteries</td>
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</tbody>
</table>
4) Essential Equipment & Contingency Gear

a) **Day Pack (Smaller 20-30 liters):** When a Soldier plans to be away from the bivouac site for the day on a patrol or mountaineering mission, he carries a light day pack. This Pack should contain:

- Extra insulating layer such as a polypropylene or waffle / pile top,
- Protective layer such as a waterproof jacket and pants, rain suit or poncho
- First Aid Kit
- Flashlight or Headlamp
- Water bottle (Capable of taking boiling liquids)
- Cold Weather Hat
- Rations for the time period away from base camp
- Survival kit
- Improvised harness material or harness
- Carabiners
- Gloves
- Climbing Rope, (One per climbing team)
- Climbing Rack, (One per climbing team)

b) **Squad or Team Safety Pack:** When a squad sized element leaves the bivouac site, squad safety gear should be carried in addition to the individual day packs. This can either be loaded into one rucksack or cross-loaded among the squad members. In the event of an injury, casualty evacuation, or unplanned bivouac, these items may make the difference between success and failure of the mission.

- Sleeping Bag
- Sleeping mat
- Squad Stove
- Fuel bottle

c) **The Ten Essentials:** Regardless of what equipment is carried, the individual military mountaineer should always carry the ten essentials when moving through the mountains.

1. Map
2. Navigation Equipment
3. Sunglasses and Sunscreen
4. Extra Clothing
5. Headlamp
6. First Aid Kit
7. Fire Starter (tinder or dryer lint ball)
8. Matches &/or lighter
9. Knife
10. Extra Food

d) **Repair Kit:** A repair kit should be on hand either individually or for the group. Groups need to be self-sustaining regarding zipper, goretex, boot repairs, etc. These items, when damaged can present serious problems when the weather turns bad. The kit should contain the following:

- Stove Tools and Spare Parts
- Duct Tape
- Patches
- Safety Pins
- Heavy Duty Thread (Dental Floss)
- Awl and or Needles w/ Cord or Wire
e) **Mountain Kit:** The type and amount of equipment a Soldier’s may need to operate in the mountains may change depending on many factors. The gear packing list should always be reviewed/re-evaluated prior to an operation. Below is a recommended starting point for unit S.O.P.’s. that would serve adequately as a contingency technical kit list for missions where the need for technical equipment is likely, but no specific technical problem has been identified.

- **Individual Soldier Mobility Kit**
  - 2 Non Locking Carabiners
  - 2 Locking Carabiners
  - 1 Rappel / Belay Device
  - 2 Sewn Runners or Joined 1” Tubular Webbing
  - 22’ Tubular Webbing for Field Expedient Harness or Manufactured Harness

- **Squad Mobility Kit**
  - 100’ Static Mountaineering Rope
  - 100’ 7mm Cord
  - 1 Locking Carabiner

**Note:** The above packing lists of items are often overlooked, forgotten or deemed unnecessary. This is a critical oversight which can present life threatening consequences as a result. A professional mountain soldier knows the value of these items and the cost of not having them in an emergency. These items add weight and use up space and that must be accounted for when creating the Soldier load plan.

5) **Planning Consideration**

a) Leaders must ask themselves the following questions when creating packing lists and load plans:
   - Is every item in your kit necessary?
   - Can you share anything with other members of your squad (stove, filter, etc.)?
   - Can you accomplish multiple tasks with a single item?
   - Can you live without a few creature comforts for a short duration?
   - Does the packing list have the least amount of gear that does the most?

b) It is not possible to carry all necessary equipment for all possible contingencies. The army risk assessment process provides an excellent framework for evaluating what equipment to bring or leave behind. Use the LIKELIHOOD VS. SEVERITY MODEL. Equipment falling into the moderate or low risk categories of residual risk should be considered for removal from the gear list.

c) **The following Acronym can help Leaders ensure an appropriate load plan is achieved:**

D – Determine level of mobility
R – Reduce redundant / non–essential equipment
O – Organize resupply
P – Police your Soldiers
6) Summary

a) Remember the enemy attacks where we are vulnerable. Our vulnerabilities lie in our fatigue
due to loads carried during combat patrols in austere environments. Every effort must be put
forth to reduce the load carried by the Soldier which will have a direct impact on the reduction
of our vulnerabilities.

b) Soldiers operating on foot in the mountains and in alpine terrain must pack light and smart to
maintain a good balance of mobility and lethality. Essentially each piece of equipment a
Soldier carries must perform multiple tasks and enhance the mission through lightening the
Soldiers overall load. Small team mountain warfare is all about mobility & the loads direct
negative impacts on mobility.

MOBILITY = LETHALITY, OUNCES = POUNDS, POUNDS = PAIN
Chapter 19. Vertical Danger Areas

1) **Introduction:** The ability to successfully negotiate vertical danger areas in a mountainous environment greatly enhances unit mobility and forces the enemy to defend multiple avenues of approach. Standard Operating Procedures for linear danger areas should be applied to Vertical areas with some additional considerations.

2) **Types of Vertical Areas:** As with any danger area, they can be identified during the mission planning process (Deliberate) or identified during the conduct of the mission (Hasty). When time is available, a leader should conduct a detailed METT-TC for patrol routes and determine the risk of difficult terrain. Conducting a map reconnaissance does not always allow leaders to identify difficult terrain due to map quality and size. Whenever possible, utilize satellite imagery, aerial photographs, local guides and 3D holographic maps to present a better picture of the terrain. Additionally, weather, seasonal conditions and visibility can greatly affect a unit’s ability to conduct a movement over difficult terrain. In most cases the terrain can be broken up into three categories: Easy, Moderate, and Hard.

   a) **Easy:** Easy Terrain is considered up to and including third class terrain. Movement in this terrain can be as simple as changing a movement formation to requiring a simple fixed rope to move up or down (knotted hand line or hasty rappel). Easy Terrain requires minimal additional equipment and training to overcome. Movement times are minimally effected but should be accounted for. Any Soldier sustaining a fall on Easy Terrain would not result in death but could result in injury requiring medical evacuation.

   b) **Moderate:** Moderate terrain is classified as exposed third to fourth class terrain. Movement in this terrain requires the use of a simple fixed rope or complex fixed ropes. Moderate terrain will require Level I or even Level II Mountaineering skills for the construction of suitable anchors and fixed rope routes. The number of trained mountaineers will depend on the size of the element being moved, amount of mission preparation, and the number/complexity of systems being installed. It is important for leaders to accurately assess their units’ ability and training as falls sustained under moderate terrain can result in death.

   c) **Hard:** Hard terrain is exposed fourth or fifth class terrain. Movement in hard terrain will require the use of complex fixed ropes and the potential usage of other systems (hauling, high lines, rappelling etc.). In order to safely negotiate hard terrain, trained Level I and Level II Soldiers are required. Leaders should use the knowledge and experience of the patrol members before making movement decisions. In many cases this terrain can be bypassed. The time it may take for installation, movement, and recovery is often underestimated and could adversely affect the mission. With proper training, equipment, and risk assessment this terrain can be your best option for movement. It is often lightly defended, but will also leave your element heavily exposed while under attack.
3) **Recon and Security Emplacement:** Depending on patrol size and situation, both recon and security emplacement can be accomplished together. Depending on the area and mission, a simple security halt can be conducted to push Soldiers out to recon and secure the high ground. Employment of a recon/security element should approach the same as any other danger area. It is critical that leaders use this time to task organize personnel and equipment.

a) **Recon:** Regardless of the type, a suitable recon should be conducted to ensure the area is safe to continue movement or to allow for the installation of systems. This should be completed in similar fashion to a stream crossing or danger area, with subtle differences. Similar to a stream crossing, the recon element will move to the vicinity of the vertical danger area, ensuring the element is not exposed to enemy small arms fire from above. METT-TC will determine how close the recon element to gain observation but maintaining the ability to break contact.

b) **Security Emplacement:** For easy terrain, the seamless transition from traveling over watch to bounding over watch may be in order. However, in when rope installations are necessary, Left/Right side security and Cliff Head Security will be necessary. Emplacement of security at the loading and unloading point is useful for controlling movement on the installation lines and to control massing of personnel at key locations. It may be advantageous to not expose more than a Fire Team at one time in either location.

- **Left and Right Side or Near Security:** Just like the security for linear danger areas, the left and right security should have an automatic weapon and an M203. METT-TC will dictate security placement, understanding not to be too close to the cliff head as this may expose Soldiers to enemy fire from above and below the vertical danger area. Alternate firing positions may need to be established to engage targets on the cliff head. When developing a Soldier load plan it may be advantageous to have these Soldiers carry ropes and drop them prior to taking security positions. In most cases, they will be the last personnel to move across the VDA and will be available to assist the installation team in rope recovery.

- **Cliff Head Security:** Cliff head security is an additional element compared to linear danger areas. Cliff Head security should be placed close enough to actively scan and engage the Cliff Head but provide enough standoff to break contact after providing cover fire. The use of Snipers/Squad Designated Marksman greatly enhances the effectiveness of cliff head security. Emplacement of over-watch personnel can be done prior to moving over the deliberate VDA.

- **Covering Dead Space:** If available, Forward Observers should be pre-planning targets on the area directly behind the Cliff Head and exposed cliff face areas. Pre-planned fires are a critical element for breaking contact.

- **Topside or Far Side Security:** Once the topside has been cleared, leaders may choose to use topside security. These positions should be close to the VDA to allow contact with the nearside security elements and to utilize the elevated position to their advantage.
4) Role of the Installation Teams

a) **Installation Team Responsibilities:** Depending on the type of system the installation team may vary from a level I-III. Regardless of their level the team that installs the system should maintain and monitor it during its use. This is important to the flow of personnel and the possible degradation of the installation. This will depend primarily on three factors Proficiency, Equipment, Complexity.

b) **Proficiency of the Team:** Trained military mountaineers are critical to effectively overcoming vertical danger areas. As with any specialty team assignment (Aid and Litter, Demolitions etc.), sustainment training and rehearsals should be conducted whenever possible. Installation team proficiency can affect mission timeline and safety. Leaders need to fully understand their Soldiers’ capabilities prior to conducting operations in a mountainous environment.

c) **Equipment Available:** To reduce the burden of additional equipment, installation teams should train to conduct VDA with minimal equipment. Equipment with multiple uses should be utilized while single purpose equipment should be avoided when possible. Mountaineers should stay current on available equipment as items are becoming lighter and stronger.

d) **Complexity of the System:** The system being installed should remain as simple as possible. The complexity of the system will be determined on METT-TC and installation team capabilities. Installation teams should not try to install systems beyond their capabilities and should remain as simple as possible. Overly complex systems are time consuming for setup and troop movement. The end state is to establish an appropriate system that is safe and leads to mission accomplishment.

e) **Actions during Installation:** It is the responsibility of the installation team to safely negotiate the obstacle and may be responsible for clearing the far side. TTP’s will change depending on the complexity of the system and the amount of additional equipment that has to be carried.

f) On Easy or Moderate terrain, installation teams will most likely be armed with M-4’s and clear the far side. On difficult terrain, installation teams may be required to switch out weapons and climb with just pistol. When clearing the far side ensure provisions are in place for actions on contact. Rappel lines (if applicable) are in place and Soldiers are prepped to move on them if breaking contact. The task organization of key weapons and leadership is critical to insure survivability in case enemy contact is made.

5) **Preparation of Personnel and Equipment to Cross a Vertical Danger**

a) **Duties in the Security Halt/ORP:** As the installation team begins to install the system, leaders at the security halt/ORP will begin to prep equipment (if necessary) for individual movement. A member of the installation team should be present during rigging of individuals to inspect Soldiers and advise on equipment requirements. For more information go to ‘Fixed Ropes, 071-FAFAC001 for details on movement on a fixed rope.
b) **Slinging/Packing Weapons:** Movement on fixed ropes may require the use of both hands depending on the terrain difficulty and complexity of the system. Leaders will need to determine if their Soldiers should sling their weapons or pack them in their rucksacks for the movement. Leaders need to weigh the chances of enemy contact with speed/safety of movement on the system. If the weapon is to be slung, ensure that Soldiers do so at their side. Weapons that are slung in the front will generally scrape the ground/clip and hit the Soldier's knees. It is unrealistic to think that Soldiers will be able to return effective fire while moving on a system. A Soldier who takes fire while moving on the system is to take immediate cover and/or hastily move up or down the system. Soldiers in over watch positions should increase fires until the system is clear to facilitate this action.

c) **Discrepancies of Follow-on Troops:** Soldiers’ must be inspected for proper equipment and rigging prior to moving to the base of the system to ensure exposure is limited and movement is uninterrupted. The installation team should radio back any additional hazards to the security halt/ORP leadership to disseminate information to Soldiers.

6) **Movement Techniques of Follow-On Troops at a Vertical Danger Area**

a) **Prior to movement:** The element should be briefed on any major requirements to negotiate the route. In most cases this will be done at the ORP. If changes have been made to the route, Leaders and Soldiers will need to be briefed. Accountability of personnel will be on the element being moved. In most cases this will be done at the loading site on the near side.

b) **Task Organization:** Unlike most linear dangers areas, breaking contact is considerably more difficult. Leaders must plan to task organize leadership and key weapons to ensure continuity on both sides of the VDA. Fire Team/Squad integrity should be maintained whenever possible to assist in accountability. If multiple routes are established, it may be feasible to move a team up multiple routes so all members arrive at the top around the same time, allowing better command and control. Leaders must understand how they will react if contact is made at the beginning, middle or end of the system routes.

c) **Establish a Release Point:** Soldiers will often bunch up at the nearside loading platform while waiting to hook up to this system. Leaders need to prevent this from occurring, calling individuals forward one at a time, to minimize exposure.

7) **Responsibilities of the Lead team During Movement:** Key areas should be manned by the installation team during movement. These positions will depend greatly on the size of the element, type of terrain and hazards to name a few. Positions may include:

a) **Nearside Loading Platform:** This is generally the most important position and should be manned by the unit’s most experienced military mountaineer. This Soldier will control the loading and movement on the system, briefing of any additional route information and provide a final inspection point.
b) **Far Side-unloading Platform:** The second key position to be manned is the far side unloading platform. This position can be occupied by a member of the installation team or key leader. This Soldier will provide guidance on stowing equipment/recovering packed gear and weapons, provide tactical guidance and orientation to continue the mission. Similar to the near side loading platform, Soldiers will have a tendency to congregate at this point. Soldiers should follow direction and immediately move away from the unloading platform to minimize exposure.

c) **Along the Installation:** Installations can range greatly in complexity. In some cases, installations may be very long in length, and require guidance or assistance through multiple sections. An installation team member might use an existing anchor point or establish separate positions to work from. This Soldier should be placed at key locations to assist Soldiers, help in communications, and provide advice on hazard areas and overall system flow. It is important this Soldier does not impede the movement of the follow-ons or overload a single anchor point.

8) **Conduct Installation Recovery Procedures**

a) **Recovering the System:** The final step is the recovery of the system and continuation of movement. In most cases, the team that installed the system will conduct recovery. Ropes should be kept neat and all equipment should be accounted for. Some installation team members may opt to back stack ropes inside of rucksacks (as opposed to coiling ropes) if other rope installations are expected on the mission (allowing ease of deployment of the rope).

b) **Responsibilities of the Installation Team**
   - Recover System.
   - Account for Equipment.
   - Return as a member of the Patrol.

c) **Responsibilities of the Element**
   - Aid in recovery of equipment (if needed).
   - Recover and stow personal gear used during movement.
   - Continue the patrol.

d) **Installation Stays in Place:** The majority of operations will require that the system be recovered, as it may be needed later. However, there are certain times when the equipment will stay in place. If the threat level is high enough that the risk of recovery outweighs the benefit of the equipment, it may be left behind. If equipment is left behind, it should be rendered inoperable. Under certain circumstances, if the objective is close enough, the systems may be left in place to better facilitate ex-filtration. If the system is left and planned to be used again, security should be left in place to secure the route to minimize a potential ambush point.
9) Example: Crossing a Vertical Danger Area Annex

1. SITUATION:
   a. Enemy Forces (Mountain Proficiency, Cold Weather Skills)
   b. Friendly Forces
   c. Environmental
      (1) Terrain
         (a) Ground Composition- (Rock, Talus, Scree, Snow-Ice)
         (b) Terrain Assessment- (Easy, Moderate, Hard)
         (c) Snow Depth and Avalanche Hazards- (Overlay)
         (d) Ground Slope and Vertical Obstacles
         (e) Friendly Forces-Assault Climbers Technical Skills, SQI-E, Mountain Training, Soldier Load & Mountain
      (2) Weather.
      (3) Equipment (Mountain Equipment / HAM Kit)
   d. Attachments and Detachments-(Assault Climber Teams, Sniper Team (over-watch), etc...)

2. MISSION: (Include Deliberate and Hasty VDA movement)

3. EXECUTION:
   a. Concept of Operation
      (1) Maneuver
         (a) Easy Terrain (Class I and II). Slow movement terrain. Consider ease of movement, night movements, weather, walking surface and Soldier load. Recommended systems and movement techniques:
            1- Simple Fixed Rope Installed (when needed)
            2- Hand Line (knotted) for ease of movement (for assistance)
            3- No system if terrain allows
            4- Descending techniques (hasty or body rappel)
            5- Harness not required
         (b) Moderate Terrain (Class III and IV). Slow moving technical terrain. Consider Soldier movement techniques and technical equipment. Recommended systems and movement techniques.
            1- Simple or complex fixed ropes
            2- Ascending methods:
            3- Double-headed safety line (safe and fast when viable)
            4- Mechanical ascenders (safe not fast)
            5- Hand over hand method (fast not safest)
            6- Prusik safety (simple fixed rope only)
            7- Descending techniques (hasty/body rappel, belayed rappel, rappel devices: figure 8, ATC) terrain dependent.
            8- Harness required (field expedient or manufactured)
         (c) Hard Terrain (Class V). Extremely slow movement. This terrain will require technically proficient installation teams and technical gear. Preparation to move over this vertical surface will take time. Recommended systems and movement techniques.
            1- Complex fixed ropes
            2- Installation team preparation (lead climber team)
            3- Ascending techniques
            4- Two -mechanical ascender method (safe but gear intensive)
5- Prusik ascent method (slow but not gear intensive)
6- Mechanical ascender with prusik back-up (safe not fast)
7- Mechanical ascender with single point attachment back-up (safe and easiest)
8- Hauling system for personal equipment and team gear (high-line)
9- Descending techniques (belayed rappel, rappel device)
10- Harness required (field expedient or manufactured)

(2) Fires- (FDC needs elevation of targets)
(3) CASEVAC PLAN
b. Tasks to Maneuver Units
   (1) Elements
   (2) Teams- (Installation, Recovery, Loading, Unloading)
   (3) Individual- (Lead Climbers, Installers, Anchoring)
c. Tasks to Combat Support Units
d. Coordinating Instructions
   (1) Task-Organize Installation Team
   (2) Security Emplacement-(Left-Right, Cliff-head, Sniper Tm Over-watch)
   (3) Type of Installation System- (Special Equipment, # of Lanes)
   (4) Method and Order of Movement- (Simple/Complex Fixed Rope, Haul System)
   (5) Alternate Plan- (Fixed Rope Hazards, Alternate Movement Techniques)
   (6) Actions on Enemy Contact- (During Movement over VDA)
      (a) Far Side
      (b) Near Side
      (c) Elements Moving on VDA
   (7) Marking Release Point and Cliff-head (Top and Bottom)
   (8) Near and Far Side Rally Points
   (9) Link-up Plan- (Follow on Units)
   (10) Consolidation Plan- (Near side and Far side)
   (11) Recovery Plan
   (12) Rehearsal Plan
   (13) Time Schedule

4. SERVICE AND SUPPORT:
   a. Classes of Supply
   b. Transportation

5. COMMAND AND SIGNAL:
   a. Command (Task Organize)
      (1) Location of Patrol Leader- (Far Side)
      (2) Location of Assistant Patrol Leader (Near Side)
      (3) Location of CP
   b. Signal-(FM, Tug-Lines, Runners, Commands for moving on ropes)

6. SAFETY
Chapter 20. Altimeter Land Navigation

1) **Introduction:** The altimeter/barometer is an extremely useful tool for mountain navigation. It provides the Soldier an ability to determine altitude, interpret the weather, pinpoint an exact location, check movement progress and identify terrain features. A Soldier’s proficiency with an altimeter greatly enhances a unit’s ability to navigate in the mountains.

2) **Define the Altimeter/Barometer**

   a) **Altimeter / Barometer.** The Altimeter/Barometer can provide readings of elevation above and below sea level and barometric air pressure in inches of mercury or millibars. The altimeter reads in feet or meters. Many versions exist.

3) **Uses of the Altimeter/Barometer**

   a) An altimeter will aid you in the following:

   - Locate your position
   - Route planning
   - Monitor your rate of ascent or descent.
   - Interpret the weather in your location and monitor changing weather fronts.

4) **Altimeter Specifications**

   a) The following list includes general specifications of an altimeter:

   - **Range:** The range is the lowest reading possible (usually below sea level) to the highest reading possible (usually up to 30,000 feet).
   - **Accuracy:** Different altimeters will sense elevation change at varying accuracy and from +/- 10 feet to +/- 30 feet.
   - **Scale Units:** Either the altitude scale can be in feet or meters or the barometric pressure scale can be in inches of mercury (Hg) or millibars (mB).
   - **Field Display:** The altitude will be displayed in either a digital or an analog format depending on the device.

**NOTE:** There are many different types of altimeters available. Check with the manufacturer for your device’s specifications.
5) Measure the Altitude Differences Using the Altimeter

a) Use the Altimeter to Measure Difference in Elevation During Movement

- Set your altimeter to a certain elevation.
- Climb or descend to another elevation.
- Re-check your altimeter.
- The difference between your first reading and the second reading is the number of feet gained or lost in elevation.
- Examples of using altitude differences;
  - At the start of a foot march, your altimeter indicates 2000 feet. Now you read 2480 feet. You have climbed 480 feet (2480 feet – 2000 feet = 480 feet).
  - If it has taken you 2 ½ hours to gain the first 1500 feet of a 3000-foot climb and you know that the trail will continue at the same roughness and grade, you will not be far off in estimating your arrival at the peak about five hours after you start. It is advised to add time for longer rest stops.

b) Rate of Ascent/Descent: Sometimes it helps to decide whether to continue to climb or to turn back, by checking the rate of ascent. For example, during a climb you have been keeping an hourly check on time and elevation. It has taken your team 4 hours to climb 3,000 feet, an average of 750 feet per hour, but the actual rate of ascent has been declining with each hour.

- In fact, the team gained only 500 feet in the past hour, compared with 1,000 feet the first hour. Your destination is at an elevation of 8,400 feet, and an altimeter reading shows the team is now at 6,400 feet. Therefore, you can predict that it will take at least four more hours to get to your destination. Take your rate of ascent and combine it with the weather, time of day, condition of the team. This will give you the data on which to base a sound decision on whether to proceed or turn back.

6) Measure the Elevation Readings Above Sea Level Using the Altimeter

a) Adjust your altimeter/barometer to show true height above sea level using supplied altimeter instructions.

b) Starting Point: Set the altimeter accurately at your start point. As you gain or lose elevation, the height indicated will be your elevation above sea level.
c) **Resetting:** This is an important technique for maintaining accurate altimeter readings. Regularly reset your altimeter at points of known elevation, because its accuracy depends on the weather.

- A change in weather is accompanied by a change in air pressure, which can cause an error in the altimeter reading. As one rises, the other drops and vice versa.

- A change in barometric pressure of 1 inch of mercury corresponds to a change in altitude reading of roughly 1,000 feet.

- **For example,** if overnight the air pressure decreased by 0.2 inch (7 millibars), the altimeter could show a reading of about 200 feet more than it did the previous night, even though the actual elevation has remained the same. Even during apparently stable conditions, an error in elevation reading of 100 feet per day is not uncommon.

- When you are following your progress on a topographic map, you can read the height of any point you can identify by looking at the contour lines and there should be many opportunities to reset your altimeter.

d) **Use:** Using the altimeter, you can relate readings to elevations of contour lines on the map to verify your progress on your planned route.

e) **Resection:** Many Soldiers rely on resection to fix their position. In the woods or at night it is often impossible to get two bearings on two identifiable points. With an altimeter recently reset, you can get the same results using modified resection.

- **Example:** You are moving through the woods or traveling on a trail shown on the map. Through the trees, you spot the fire tower on a nearby mountain. Your compass gives a bearing of 30 degrees. Your altimeter reads 4000 feet. You must be on the contour line that indicates 4000 feet elevation. Simultaneously you have the fire tower on the back azimuth of 30 degrees (210 degrees). Draw the back azimuth or place the compass on the map so one edge of its' base plate points at the fire tower. In this example, you crossed a contour line with another position line on the map. You can probably think of many such lines; trails, creeks, compass bearings, roadways, marked game management boundaries and power lines. One rule always applies; you fix your position most accurately with two position lines that cross at right angles.

f) **Route Planning:** The knowledge of your elevation above sea level, gained from your altimeter, can also help you in route planning. For example, a Soldier needs to return to a cache at the 3600-foot level. Instead of entering the woods at the foot of the mountain and walking uphill to reach 3600 ft. he can enter the woods at the 3600-foot level of the road that he is on and find a level route to his cache.
7) Interpret Weather Using the Altimeter/Barometer

a) Reading the Altimeter: You can make use of your altimeter/barometer as a highly accurate weather barometer by following these procedures.

   • **Stationary:** Check you are altitude reading. If the barometric pressure changes so, will your altitude reading.
     
     o **Example:** You initially have a reading of 2500 ft. Four hours later, you have a reading of 2000 ft. Since the reading is now 500 ft lower and you did not move, you can assume that fair weather is expected.
   
   • **Underway:** If you find it necessary to readjust the altitude at known point then you can assume that the barometric pressure is changing. Example: At known points you keep having to decrease your altimeter reading to match the altitude of your known point. Since the altitude continues to read high, you can assume that foul weather is expected.

b) Applying the altimeter reading to general weather forecasting

   • If you have a situation where the air pressure is rising, it suggests that fair weather is expected.
   
   • If you have a situation where the air pressure is falling, it suggests that foul weather is expected.

8) Identify the differences between an altimeter and a GPS

a) The altimeter determines elevation by measuring the weight of a column of air (air pressure) either electronically or mechanically. A GPS determines elevation through the triangulation of four or more satellites.

b) A GPS requires four satellites at a minimum for an accurate elevation reading. Mountainous terrain, poor weather, and thick overhead cover can mask satellite signals preventing a good reading.

c) The fact that GPS uses triangulation of satellites to measure elevation, not air pressure, means that they have no use as a weather prediction tool. Changing air pressure is the key for weather prediction.

**NOTE:** Care should be taken when using GPS to pinpoint exact elevations. Mathematical variations in the software of some types of GPS devises can produce variation of 100 to 200 foot discrepancy in elevation. The horizontal accuracy is not necessarily equal to the vertical (elevation) accuracy.
Chapter 21. Mountain Operations

1) Introduction: Operating in the mountains presents a unit with two particular sets of tactical problems: one, the significant affects that the weather and environment has on personnel, weapons and equipment and two, the significant affects the terrain has on mobility, both mounted and dismounted. Units who can successfully meet these challenges will be more successful in focusing their efforts on fighting the enemy rather than the mountain environment.

2) Assess the Mountain Situation Using METT-TC

a) Commanders and planners must clearly understand the effect the operational terrain levels have on maneuver and how they interact with each other. They must identify and control dominant terrain at each operational level to facilitate maneuver. To maintain freedom of maneuver, leaders must apply combat power so that the terrain at levels II and III can be exploited in the conduct of operations. Successful application of this concept requires leaders to think, plan and maneuver vertically as well as horizontally. METT-TC is the method for this to ensure this happens. Units who have the motivation and ability to operate in higher levels of terrain will take the initiative away from the enemy who is often accustomed to owning that terrain.

b) Mountain Specific METT-TC

- **Mission:** Identify mountain tasks and assets necessary to access each operational terrain level.

- **Enemy:** (Assess the enemy’s ability to do the following)
  - Utilize the environment
  - Conduct air operations
  - Conduct decentralized operations
  - Utilize the terrain in levels II & III
  - Employ barrier or obstacles to restrict maneuverability
  - Conduct limited visibility operations
  - Sustain his maneuver elements.

- **Terrain:** In the mountains, surprise is easier to achieve for the force that knows the terrain better, and has the skills and equipment necessary to achieve greater mobility. The APPROPRIATE use of terrain improves the element of surprise if the terrain has been ANALYZED PROPERLY. In general mountainous terrain impacts the following during operations:
  - Mobility
  - Movement Time
  - Effectiveness of Some Weapons
  - Complicates Supply Operations
  - Creates Additional Hazards and Risks
  - Complicates MEDEVAC Operations
  - Line of Site Communications
  - Synchronization
  - Command and Control
o Compartmented Terrain (terrain broken up into smaller areas by mountains and ridges) effects on operations:
   - Ability to switch axis of advances
   - Mutual support between axis
   - Restrictions in the commander’s mobility
   - Decreased mobility
   - Planning based on strict movement timetables
   - Unit boundaries
   - Line of sight communications
   - Increased demands on junior leaders

- **Troops:** Assess the operational & tactical implications of the restrictive environment on mobility, firepower, protection and logistics. Mountain operations can greatly increase the combat power of defending forces and drastically reduce the combat power of attacking forces. Continuously assess the effects of the rugged mountain environment on soldiers. Operations may need to take on a slower pace or include rotations and short defense periods.

- **Time:** Adaptability of plans to the terrain and varying weather conditions. Increased time needed to conduct recon, execute movements and synchronize events. Significant variance in the number of hours of visibility with season and elevation.

- **Civil Considerations**
  - Populations located primarily in level I Terrain
  - Refugee movements due to conflict cause strain on limited mountain resources & lines of travel.
  - Populations separated by terrain are often diverse with varying levels of support or opposition

3) Leadership Considerations for Mountainous Regions

“The leader who is selected to lead troops in the areas of the world where the extreme cold and the rugged trackless terrain make living and fighting more difficult will face one of the greatest challenges of his lifetime.”

FM 31-70 Basic Cold Weather Manual 1968

a) Superficial knowledge of mountain warfare and ignorance of mountain hazards and environmental effects may result in mission failure and the unnecessary loss of soldier’s lives.

b) Mission Command dictates that leaders must be able to accept some degree of uncertainty, delegate, and trust and encourage subordinate leaders at all levels to use initiative and act alone to achieve the desired results, particularly when the situation causes them to lose contact with higher headquarters.

c) Units that have mountain mobility skills can use the terrain to their advantage to achieve surprise and success.
d) Mountain Warfare is always a battle against ignorance of the terrain, inclement weather and effects of altitude.

e) Mountain Warfare is a battle led by lower-ranking leaders.

4) Mountain Weather

“Mountain weather can be extremely erratic. It varies from stormy winds to calm, and from extreme cold to warmth within a short time or with a minor shift in locality. The severity and variance of the weather causes it to have a major impact on military operations.”

TC 3-97.61 Military Mountaineering

a) Mountain Weather Hazards

- Wind
  - Mountain operations can be considerably slowed by wind.
  - Individual and unit mobility are drastically reduced.
  - Communications become extremely difficult.
  - Cold weather injuries become prominent due to the effects of wind chill.
    - Wind chill is the perceived temperature we feel from the effects of wind and cold on exposed skin.
    - The higher the wind speed the faster we lose heat.
  - High winds can reduce exposure times to seconds in certain conditions.
  - Learn to perform all functions with gloves on.
  - Use the Buddy system to check for signs of frost bite on the face.
  - Learn to use terrain as a barrier for troop protection

- Rain poses the following hazards to mountain operations:
  - Hypothermia: Units need to stop & ensure soldiers are properly protected from the effects of rain and dropping temperatures. Time to stop and layer up needs to be built into the mission timeline if the weather calls for rain. Soldiers who are soaking wet need to be warmed. This is imperative to cold weather injury prevention.

  - Flash flooding: Flashfloods pose a significant barrier to unit movement. Unit is fixed. Have a contingency plan. Units must ensure they do not position themselves within flashflood corridors especially during limited visibility. Units need to have the proper equipment and have rehearsed water crossings. Decision points need to be discussed. Criteria for safe crossing.
• **Freezing Rain (Veriglas)**
  o Mobility extremely reduced.
  o Weapons / Optics / Communications subject to damage.
  o Route plans become unrealistic.
  o Units must have alternate routes that will mitigate this risk if possible.
  o Crampons or Micro spikes may be needed if terrain does not support easier alternate routes.

• **Snow**
  o Mobility extremely reduced
  o Possibility for whiteout conditions
  o Increases Avalanche Hazards
  o Allows Unit to be tracked easily

• **Temperature**
  o The air temperature will drop an average of 4°F for every thousand feet of elevation gained (adiabatic lapse rate).
  o The thinner atmosphere at higher altitudes allows for more direct heat being received than at lower elevations.
  o Rapid day time heating and night time cooling in clear weather can mean temperature changes of 40 to 50 degrees.
  o Freeze-thaw cycles can contribute to rock fall, avoid moving through danger areas as it warms.
  o Snow conditions vary significantly with changes in temperature, may be passable without out crampons during the day, but not at night.

• **Lightning**
  o Thunderstorms usually occur in the afternoon.
  o Know the forecast, and watch the sky.
  o Lightning takes the path of least resistance to the ground, often striking along the tops of ridges and at high points.
  o If thunderstorms are forecasted, move high in the morning and get low in the afternoon.
  o If you can see the lightening flash, the storm is on average 15 miles away.
  o If you can hear thunder, the storm is 6-10 miles away.
  o Topography and humidity will affect sound travel.
  o If you find yourself exposed in these conditions seek shelter immediately flash to bang; See the strike, count, hear the bang, divide by 5, that's how far away the storm is approximately (miles).
b) **Mountain Weather Indicators**: Soldiers conducting mountain operations need to be familiar with the following indicators of impending weather hazards:

- **Pressure Systems**: If a high pressure system is on its way, often you can expect cooler temperatures and clear skies. If a low pressure system is coming, then look for warmer weather, storms and rain.

- **Cloud Formations / Types**: The height of a cloud and its shape in the sky can indicate incoming weather up to about 36 hours out. Clouds can form at ground level or up to a height of 6 miles.
  
  o **Low Level Clouds**: Cloud types include nimbostratus and stratocumulus 0-6500ft. Low level clouds usually indicate impending precipitation. Precipitation from higher clouds evaporates before hitting the ground.

  o **Mid-Level Clouds** - Cloud types include Altocumulus and Altostratus 6500-20,000ft. Mid- level clouds usually indicate fair weather, especially if they are rising over time. Lowering middle clouds indicate potential storms, though usually hours away.

  o **High Level Clouds** - Cloud types include Cirrus and Cirrostratus 20,000ft +. Cirrus clouds indicate moisture aloft and the approach of a traveling storm system. Precipitation is often 24 to 36 hours away. As the storm approaches, these clouds will thicken, lower, and eventually become low-level clouds.

  o **Lenticular Clouds** - Moist warm air rises and condenses at the summit. Moisture dissipates after passing down the lee side. Lenticular clouds come 12-24 hours in advance of low pressure system

- **Cold / Warm Fronts** - Fronts occur when two air masses of different moisture and temperature content meet. Understanding the differences between fronts will help your general planning and prediction.

  o **Warm Fronts** are associated with low-pressure systems. Cirrus clouds indicate that a warm front is approaching. These clouds can be as far as 650 miles out in front of any precipitation. Contrails that linger and spread out in the sky and lenticular clouds that seem stationary over mountaintops are indicators of a low pressure or warm front moving in with in the next 24-48 hours. When high in the mountains, pay close attention to the clouds. If you see them, building in height and getting lower to the ground you need to move to lower ground and off exposed ridges quickly. Move to the leeward side of a mountain to avoid the worst aspects of a storm. If possible, get to the highest points of your climb early in the day to avoid afternoon storms caused by the daily summer convection cycle found in many mountainous areas.
Cold Fronts are associated with high-pressure systems and tend to move much faster than warm fronts. Summer time can bring violent thunderstorms or tornadoes due to the fast moving cold front colliding with the slower moving warm front it’s replacing.

- **Valley Fog** is another indicator of high pressure.

- **Occluded Fronts** combine the precipitation of both warm and cold fronts. If it has rained for an extended period with occasional strong bursts of rain or snow, an occluded front is most likely the culprit. Occluded fronts for the most part are fast moving systems.

- **Stationary Fronts**, as the name implies, are not going anywhere fast. Terrain can create stationary fronts. The Los Angeles basin is a good example of how the mountains that surround L.A. trap smog during a stationary front, only moving out when the stationary front is pushed out.
c) Mountain Weather Considerations

- Weather significantly impacts all areas of operations, and it changes rapidly.

- Create flexible, dynamic plans that account for contingencies.
  - Routes PACE plan
  - Aerial insertion and resupply
  - Communications PACE plan
  - Turnaround times

- Packing
  - Is staying in place an option?
  - Keep it light, but not too light
  - Soldiers should pack wet weather gear and sufficient insulating layers for the conditions.
  - Emergency bivy gear
    - Soldiers should have what they need to survive a night in the mountains, but should not be carrying enough to be comfortable

- Mountain weather is harsh, and variable.
  - Makes an already difficult environment more challenging.
  - Pay attention to the forecasts, and watch the skies for any possible change.
  - Account for the weather in your plans.

5) Communications in Mountainous Terrain

a) Limitations of Communications in Mountainous Terrain

- 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 affects and the techniques to mitigate them such as field expedient antennas will greatly increase a leader’s ability to command and control his unit.

- Communicating in the mountains is a challenge since there are few ideal spots for communication. FM radios, which are line of sight systems, frequently cannot communicate because their signals are absorbed by terrain folds and features. If all the force is on the same side of the mountain and the mountain forms a bowl, FM communications are usually possible. However, radios located on the same side of the mountain at different altitudes have difficulty communicating because of intervening terrain and communications dead space. If the force is deployed on the same side of a mountain, which curves out, communications, are especially difficult. 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.

- 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 where it can communicate, set up a radio retransmission site or relay messages across the net.

b) Field Expedient Antenna 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
  - Used when it is necessary to communicate in several separate directions at once.
  - Also receives 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.
  - Creates nulls in the areas not receiving energy.
  - Have to be positioned correctly (by azimuth) in order for them to work.

c) Transmission Range

When unimpeded, the distance radio waves will travel is primarily affected by two factors:

- **Power**
- **Frequency**

**Antenna Orientation**: Greatly effects the pattern of transmission.

- Unfold Man pack antennas
- Stand up vehicle antennas
- Ensure directional antennas are on azimuth and that the takeoff angle is correct.

**Communications Obstacles**

- Terrain of Significant Relief
- Weather
- Vegetation
- Manmade Obstacles
d) Communications Planning

- Identify problem areas ahead of time
- Map Recon
  - Topo
  - Falconview
  - Google
  - Intelligence RFI
- Coordinate with adjacent units & aircraft
- Plan Retransmission / OP combo sites
- Consider effects of weather
- Plan for increased battery usage
- **Employ “P.A.C.E.” Plan**

e) Military Communications Types

- **Line of Sight (LOS)**
  - Operate in the VHF/UHF spectrum
  - Often referred to as “FM” commo
  - Encompass the majority of commo devices
  - Relatively short range systems that are greatly affected by obstacles.
  - The higher the frequency, the greater chance of obstruction by terrain obstacles.
  - The lower the frequency, the less likely it will be obstructed by terrain obstacles.
  - If multiple frequencies are available and terrain is an issue, go with the lowest frequency possible.

- **Relay transmission** can be moderately effective as a means of communication. This is very time consuming and often the message is not relayed accurately.

- **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. 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; however, through simple analysis, these locations are often predictable and make them more vulnerable to enemy interdiction.
• **Beyond Line of Sight (BLOS)**

  o Use communications infrastructure (e.g.: Satellites, repeater towers) to relay or the Ionosphere to bounce radio transmissions past line of sight limitations.

  o The two forms of BLOS Communications soldiers must be proficient with are:

    ▪ **Satellite / SATCOM / TACSAT**

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

      – Tactical satellite (TACSAT) radio is a reliable beyond line of sight communication system. TACSAT relies on satellites to relay communications to over 90% of the earth’s surface.

    ▪ **High Frequency (HF)**

      – Before SATCOM technology existed, HF communication was the only way to communicate beyond the horizon. Today HF is still used for long distance communications. It has the advantage of not requiring (or relying on) any infrastructure, but rather utilizing the Earth's atmosphere. HF Primarily transmits via sky wave which refracts off the Ionosphere and back down to the receiver. HF also transmits ground waves for communication over short distances. HF usually employs field antennas constructed by the communicator. Military HF radios transmit at higher power than UHF/VHF radios.

      – HF has immense range: short range = 500 KM, long range = **Theoretically Unlimited.** When using the proper antenna terrain obstacles become nearly irrelevant

      – HF communications have the following challenges:

        • Require extensive field antenna training to be reliable.
        • Antennas take some time to construct.
        • Skip Zones requires careful tracking of other unit’s positions.
        • Affected by atmospheric conditions.
f) **Considerations for Maintaining Communications / Antennas in the Mountain Environment**

- 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. Pitons are excellent anchors for antenna guy wires 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.

- **Weather Protection Practices**
  - Weatherproof all communications equipment subject to moisture that could freeze during temperature drops.
  - Keep batteries warm by using insulation sleeves or packing inside ruck, to maintain battery life during cold weather.
  - Keep electrical connections free of moisture and dust.
  - Take additional care handling equipment as extreme cold makes components brittle.
  - Bring backup components for field repair.
Chapter 22. Mountain Patrol Base and Bivouac Operations

1) **Introduction:** Before you can successfully fight in the mountains you must learn to live in them. Units that can sustain themselves in austere mountain patrol bases in all types of weather and temperatures can gain a significant advantage over an enemy who cannot. Soldiers who are well versed in field discipline, establishing shelters, and simple bivouac routines can focus on fighting the enemy and not the environment.

2) **Site Selection Factors**

   a) **Area of Operations:** Your mission dictates your area of operation. Enemy activity determines the likelihood of contact. Take both security and defensive posture into consideration. The AO site may be used for future operations. High ground is often preferred for defense but at times is disregarded in favor of cover and concealment or more suitable ground conditions.

   b) **Cover and Concealment:** Cover and concealment from air and ground observation is essential for the bivouac area. Forested areas pose few problems in comparison to areas above the tree line. Operations above tree line or at altitude may offer less cover and concealment. Bivouac may need to be established below tree line to support operations conducted above tree line.

   c) **Wind Protection:** Protection from the wind is a prime consideration. Depending on your area of operations bivouac site selections may vary due to the unpredictability of winds at elevation.

   d) **Ground Condition:** The condition of the ground is important. In warm conditions bivouac should be located on hard ground. In snow-covered terrain avoid digging to the ground, as this may collect water due to the thawing of the snow, or rain. A layer of snow should be left for ground insulation, comfort, and absorption of water. The depth that is dug in will vary depending on the site selection and snow depth.

   e) **Construction Materials:** Construction materials play an important part in the selection of a bivouac. When making a reconnaissance of the area, consider such things as the availability of firewood, water procurement, and snow for snow shelters.

3) **Identify Bivouac Locations**

   a) **Forests:** Most forests in cold regions provide excellent bivouac sites. Forests provide many natural materials such as boughs for insulation, firewood, and camouflage construction materials. They often provide excellent concealment against enemy air and ground observation. Coniferous (cone-bearing) trees provide better protection from wind and better insulation material than deciduous forests.

   b) ** Marshy Ground:** You may find good sites when the ground is frozen that would otherwise be unsuitable. Although surrounding areas may be frozen, swampy areas may not freeze due to warm water springs or gases. These usually provide poor facilities for the bivouac sites.
c) **Open Terrain and on Frozen Bodies of Water:** Carefully choose sites on open ground. Some of the problems of an open ground site are strong winds, drifting snow and poor concealment. When possible, pitch tents where they are sheltered by natural windbreaks. Windbreaks may consist of depressions in the ground or ridges on the ice. A visual inspection will indicate the degree of drifting, direction of the wind and suitable protected areas. Construct snow walls in areas where natural windbreaks do not exist. Snow walls provide protection from winds and small arms fire. In areas with high winds, snow gathers rapidly on the lee side. It is necessary to clear the sides and tops of the tents periodically to prevent the weight of the drifting snow from collapsing the tent. The entrance to the shelter should face downwind at a 45 degree angle. This prevents the snow from blocking the exit and cutting off the ventilation.

- When on frozen lakes be aware that water may rise above the ice as it expands and pressure cracks are formed. In some cases this may not be avoided as pressure cracks/ridges may provide the only cover and concealment available. When on rivers be aware that heavy currents may cause drastic changes in ice thickness in relatively close areas.

- Although the center may be stable, pay close attention to the outside edges where the current is usually heavier. Water levels may rise/drop throughout the year this may cause the ice to be unstable along the edges, and in shallow areas.

d) **Mountainous Terrain:** Mountainous regions often have strong turbulent winds, cold temperatures and general lack of concealment above the timberline. The wind overhead creates an extensive lee near the mountain. The overhead lee resembles the dry space behind waterfalls caused by water having such speed that it shoots over the edge of the cliff and descends in a curve. An inland wind blowing 50 miles an hour may not strike the ground for several kilometers after passing the edge of a cliff or a very steep slope. Such a lee is an attractive bivouac site from the standpoint of wind protection. Note that such a lee area is often an area of maximum snow deposit. The requirement to constantly dig out vehicles, walkways, and weapons positions may offset the wind free advantages of a lee site during snowfall or snow blowing weather. Avalanche hazard areas must be avoided. Cold air is heavier than warm air and frequently settles in valleys. If tactically feasible it is better to establish a bivouac up the hillside above the valley floor and below the timberline.

4) **Patrol Base Considerations:** In preparation of Patrol Base (PB) locations leaders must consider the terrain and environmental conditions closely. Leaders must have a well-rehearsed occupation plan and be able to modify perimeter security contingencies to suit the terrain. Establishment of key weapon systems on avenues of approach is essential in mountainous environment as they will be limited in number. Setting in Observation Posts (OP’s) should be done in such a manner as to have the best observation of key terrain without giving away your position. Consider occupying the PB below the crest of ridgelines and hills and maintaining OP’s at the military crest with concealed routes to and from these OP’s. Small unit leaders should consider, but are not limited to, these key areas when conducting PB operations: Command and Control, Communications, and Security.
5) Procedures for Establishing a Mountain Patrol Base Bivouac Operation

a) Establishing a Bivouac

- **General:** Setting up a bivouac is based on a SOP which enables the commander to control the bivouac area, keep it protected and camouflaged, and maintain personnel ready to fight. Devote minimal time to pitching and striking shelters. Bivouacking in a routine manner allows rest, more time for daily movement, establishing an effective security system, defense of the bivouac site and making preparations for the continuation of the operation.

- **Unit Leader Responsibilities:** When entering the bivouac site, the unit leader should:
  o Post security.
  o Check the bivouac site.
  o Determine exact locations providing the best natural shelter and camouflage.
  o Designate an area from which construction material and firewood will be obtained.
  o Select a water point, or marking off the snow area to be utilized for water.
  o Designate latrine and garbage disposal sites.
  o Designate a site for weapon and ski racks. Temporary placement for weapons and equipment must be arranged until the bivouac has been established.
  o Break a minimum number of trails between the tent site and area assigned for firewood and construction material, water point, and latrine.
  o Maintain camouflage and track discipline at all times.

- **Organization and Work Assignments**
  o Clear and level the shelter sites. In winter, dig the snow to ground level or pack it down with skis, snowshoes or tracked vehicles.
  o Pitch tents.
  o Cut, trim and haul trees and boughs for construction of improvised shelters and bough beds (when tents are not available).
  o Construct an improvised shelter best suited to the area concerned.
  o Construct a windbreak.
  o Build weapon and ski racks. Give special care to the protection of weapons from the elements.
  o Construction of field latrines and garbage disposal sites.
  o Prepare a water point.
  o Gather and cut firewood.
  o Start fires and prepare hot drinks for all individuals.
  o Upon completion of shelter construction, start a warm meal.
  o Maintain and emphasize cleanliness, tidiness, and teamwork.
  o Prepare defensive positions, break and mark a trail from the shelters to the positions.
  o Maintain a duty roster for exterior guards, fireguards and similar assignments.
  o Rotate individuals on all jobs on a daily basis.
  o Assign specific sleeping areas for all individuals in accordance with the duty roster.
  o Upon establishing the bivouac, removing the exterior guard when the parent unit has taken over the security of the area.
  o Inspect the area; examine the security, camouflage, cover, weapons, skis, sleds, vehicles and the condition of the men and their equipment.
  o Outline and rehearse battle drills in the event of attack.
• **Patrol Bases:** Deceptive actions are mandatory in a snow-covered mountainous environment. Make use of jump-off points, deceptive tracks, and hasty ambushes.

  o Jump-off point: Is made on slopes or in dense woods where it is possible to hide the real track and where enemy pursuit will have such a high speed of travel that it is difficult for him to discover where the real track is, as well as any booby traps. The deceptive track should be made as far away as time permits.

  o Button Hook: Is the preferred method of setting in a track plan to a patrol base. This technique allows the track to be observed and covered by fire during the occupation of the position.

  o Deceptive tracks: Used to mislead the enemy from your jump-off position. They should be located in an area where you can observe them and cover them with small arms fire from the patrol base.

  ![Example Patrol Base Plan](image)

  EXAMPLE PATROL BASE PLAN

  o During occupation of the patrol base minimal activity should occur. Therefore, it may not be advisable to dig communication trenches and defensive positions. All food preparation, water procurement, weapon maintenance, etc. should occur in a covered area.

  o Due to the possibility of patrol base becoming detected and engaged by a superior enemy force, a contingency plan for escape must be planned, practiced, and implemented. Impeccable bivouac routine and security are the best means of preventing this possibility from becoming a reality. Here are some of the guidelines to follow:
• All equipment when not in use will be in the pack, (i.e., sleeping bag, stove, fuel, extra clothing, etc.)

• Due to the importance of equipment to Soldiers in a cold weather environment, patrols operating out of a patrol base should take precautions prior to leaving, in case the patrol base becomes compromised and the patrol has to be self-sufficient.

6) Bivouac Site Activity

a) The reality of a mountain bivouac is that the majority of your time will be spent preparing your site. The key to keeping Soldiers focused once you have reached your destination is to keep them warm and keep everyone busy.

• Arrival Sequence
  o Designate a latrine area.
  o Begin setting up the tents. On windy nights you will want to construct walls. After all the tents are set up, dig out the vestibules.
  o Once the tents are up and the vestibules are dug, have everyone start unpacking. Unpack only what you need and put your sleeping pads, bags and anything else they will need for the night in their tent.
  o Start cooking and melting snow for water.

• Sleeping Sequence
  o After dinner, fill your water bottles for the next day with hot fluids and place them in your bag to pre warm it (make sure Soldiers are using Lexan bottles and remind them to tighten the lids to prevent spills).
  o Pre-warm yourself (do some jumping jacks and empty your bladder).
  o It is usually a good idea to get situated in the tent one at a time.
  o Take your boots off in the vestibule, brush off excess snow from the shells. Remove the liners and place the liners inside of your sleeping bag. Place the shells under your sleeping bag on top of your sleeping pad.
  o Place your Gore-Tex layer between your pad and bag, spread flat and even.
  o Ensure Soldiers to take any damp cloths, their boot liners, and anything they want warm in the morning into their bag with them and sleep with it against the trunk of their body.

• Departure Sequence
  o Wake up, dress, and pack all of your equipment inside the tent.
  o The first out of the tent starts boiling water for breakfast.
  o Shake out your sleeping bag and let it dry in the sun or place it into a stuff sack. If you are staying overnight, leave your sleeping bag in the tent.
  o Once the water is boiled, shut down the stove as soon as possible to let it cool before you pack it to leave.
  o Tear down the tent, shake out, and divide the components between the Soldiers.
  o Knock down snow walls and fill in positions.
7) Bivouac Discipline Procedures

a) Shelter Discipline

- The first man entering a finished shelter arranges all the equipment in its proper place. Place the stove, water can, firewood, tools and rations in the most convenient place by the door of the tent. In a snow shelter, a special storeroom may be dug for these items.

- In low temperatures, weapons should be left outside on improvised weapon racks in order to avoid condensation. Commanders MUST insure that weapons left outside are properly secured, (e.g., providing security guards or securing the weapons in an unheated shelter).

- Carefully supervise the use of fire and lights in the shelter. Security, fuel economy and the prevention of fire and asphyxiation are essential. When wood is available, burn it in the stoves in place of gasoline. Extinguish all sparks on the tent or lean-to at once. No smoking in the tent.

- Accomplish as many tasks as possible before retiring in order to conserve time in the morning. Clean all eating utensils, melt snow, fill canteens or thermos bottles, and check all weapons.

b) Heat Discipline and Fire Prevention

- Heat discipline presents a problem during periods of extreme cold. Avoid overheating the shelter. It causes individuals to sweat and increases the fire hazard.

- Combine cooking and heating. Melting snow and ice uses large amounts of fuel. Use water from other sources if available. Temporary shelters have very little insulation and allow a great deal of heat loss. Heating the shelter not only allows you to get a good night’s rest it allows the drying of clothing and gives you the means to provide warming liquids to those performing duties outside of the shelter throughout the night.

c) Drying Clothes: Keeping dry is important in low temperatures. At times it is impossible to avoid sweating. Drying clothes and footgear is a necessity. Use every opportunity to dry your clothing. When drying clothes outside at an open fire, place clothing/footgear upwind from the fire, to avoid the sparks and smoke. Check clothes frequently. Do not leave drying clothes unattended. Clothing should never be placed too close to the fire or stove in the shelter. Leather items are extremely vulnerable to extreme heat. Clothing being dried in the shelter should be hung on the drying lines. The Tent, 10-Man Arctic, is equipped with strong hooks at the inside peak for suspending lighter weight clothing for drying. Ensure the roof vents are open and clear of obstruction to allow for maximum airflow.
d) Sleeping Arrangements in Bivouac

- When arranging the sleeping layout for a tent or improvised shelter, the position of every man is planned. Each man must know where his relief is sleeping; therefore, the floor space is occupied by the individuals in accordance with the duty roster. The number one man sleeps next to the door; the relief is easily located without waking up all occupants. The systematic sleeping arrangement will also permit exit from the tent in an organized manner in case of alert.

- The tactical situation dictates whether or not to use sleeping bags. The amount of clothing you wear while sleeping on a bough bed or in a sleeping bag can be best judged by experience and will depend on temperature and the tactical situation. As a minimum, remove clothing (to include boots) when using a sleeping bag. Place clothing not being worn beneath you for additional insulation and instant availability. In an emergency it may be necessary to dress in the dark. In the morning remove all ice and frost from the bag and ventilate it before rolling. Thoroughly dry sleeping bags when time permits.

- If the situation permits, remove your boots when sleeping in a heated tent without a sleeping bag. Use your parka like a blanket, and loosen your clothing. Your rucksack doubles as a pillow.

- If the tactical situation does not permit the use of a complete sleep system one alternative is to use just the seven layer clothing system. Layer seven can be used as a substitute for the sleeping system under certain circumstances. If wet weather is a concern the bivy sack may be used as a protective outer layer. This lightens a Soldier's load, and provides the ability to stay clothed and ready to fight on short notice.

e) Ammunition and Fuel: Ammunition and fuel are stored separately outside. Ammunition boxes should be stacked off the ground in a dry place and covered with canvas or boughs. In order to locate stacks if snow-covered; a pole should be erected near them. Boughs or poles are placed under fuel containers to prevent them from freezing to the snow.

f) Field Sanitation

- **Waste Disposal:** Field sanitation in colder regions is based on the same principles as in temperate climates. The extremes in climate and weather, however, make the problem more acute. The wastes that present constant and real problems are human waste, garbage, and trash.

  - In bivouac areas, pit or "cross-tree" type latrines are used for the disposal of human waste. One latrine will usually serve the needs of individuals occupying 3 to 4 shelters, or a unit of platoon size. The latrine is placed downwind from the bivouac, but not so far from the shelters as to encourage individuals to break sanitary discipline. Ration boxes or similar material should be used to collect waste. A urinal, designated for each shelter, should be located within 4 to 5 meters (4 to 5 yards) of the shelter. A windbreak of boughs, tarpaulins, ponchos or snow wall should be constructed to protect the latrine from the wind.
When breaking bivouac, the human waste that has accumulated in the latrine will be burned or buried. All closed latrine sites, tactical situation permitting, will be clearly marked.

8) The Ahkio Sled

a) **Description:** The Ahkio is the light infantry squad's primary means of transporting tents and other sustainment equipment in a cold weather environment. In addition to its primary function of transporting the tent group equipment, the Ahkio is excellent for transporting weapons, rations, ammunition, casualty evacuation and provides a stable firing platform for crew-served weapons in deep snow.

b) **Characteristics**
   - Three-runner sled.
   - Maneuvered easily over a variety of snow and terrain because of its boat like shape.
   - It is 88" long, 24" wide and 8" deep.
   - Maximum load capacity of 200 lbs.

c) **Towing**
   - Pulled by the Squad arranged like a dog sled team. It is towed for short distances over prepared trails during an approach march or similar type movement.
     - The sled and equipment can be transported by tracked vehicles using tow bars and towed behind the vehicle.

d) **Safety Note:** The Ahkio/Tent/Stove Group contains many potential hazards. Pioneer tools and sharp metal on stove parts may cut personnel or their equipment. Liquid fuel can cause instant frostbite. Fuel vapors are highly explosive. Carbon monoxide is a deadly gas, even in low concentrations, and is particularly dangerous because it is odorless. Ensure Soldiers always fill and light stoves at least ten feet from their shelter. All stoves require ventilation when they use them in confined spaces. Ensure they avoid over pumping the fuel cell on the squad stove. If a leak develops in the stove, extinguish the flame and repair the stove immediately.

9) Ahkio Loading Procedures

a) **Loading the Ahkio**
   - You must load the Ahkio with one end heavier than the other. Proper weight distribution is essential when packing the Ahkio.
   - The light end becomes the front and the heavier end the rear. This weight distribution aids in maneuvering. Keep the load low and streamlined.
   - Heavy items should be placed in the bottom and slightly to the rear of center.
   - Loading lighter equipment toward the top will prevent the ahkio from becoming top-heavy.
   - The load should be packed in a manner, which results in the lowest possible profile to avoid a top-heavy condition.
b) **Equipment:** The amount of equipment carried in the Ahkio depends on the mission, weather and terrain. Carefully plan Ahkio loads to insure the best balance between sufficient equipment and ease of handling. Hauling an overloaded Ahkio tires troops rapidly. Unfortunately, combat situations often dictate overloading the Ahkio beyond its rated capacity.

10) **Move with the Ahkio**

a) **General:** Towing a loaded ahkio is arduous work; teams must be rotated frequently to prevent Soldiers from becoming exhausted and to prevent them from sweating through their clothing, which will expose them to a cold weather injury. Generally, snowshoes are preferred for Soldiers who will have to pull an ahkio over snow-covered terrain, especially if the snow depth exceeds one foot. Ski poles are recommended as an aid to balance.

b) **Trail Breaking:** The lead element will have the additional mission of breaking trail if snow and vegetation require.

c) **Movement Techniques:** Winter Arctic weather and snow covered terrain means movement using snowshoes and frequently pulling an ahkio. This requires a modification of normal movement techniques. Traveling overwatch or bounding overwatch may be more suitable.

**Note:** The ahkio never passes in front of the lead team. The squad leader rotates the team pulling the ahkio as necessary.

11) **The 10 Man Arctic Tent**

a) **General Characteristics**

- This six-sided pyramidal tent supported by a center pole accommodates ten Soldiers with their individual equipment. When necessary, it can accommodate additional personnel. It may also be utilized as a command post, aid station or storage shelter.

- A snow cloth is attached to the bottom of the tents’ sidewalls. It is used to seal the tent to the ground in order to conserve heat in exposed or wind swept areas. This is accomplished by placing insulating material such as spruce boughs, brush, cardboard or other suitable material between the ground and the snow cloth.

- Four drying lines are rigged inside the tent, on which personnel can hang wet clothing and equipment.

- **CAUTION:** IF THE SNOW CLOTH IS SPREAD INSIDE THE TENT, IT WILL PREVENT PERSONNEL FROM ROLLING OUT IN THE EVENT OF A TENT FIRE.

- **CAUTION:** NEVER ALLOW THE SNOW CLOTH TO FREEZE TO THE GROUND. IN THE EVENT OF A FIRE, PERSONNEL MUST BE ABLE TO ROLL OUT FROM UNDER THE WALLS OF THE TENT. THERE WILL NOT BE ENOUGH TIME FOR PERSONNEL IN THEIR SLEEPING BAGS TO GET UP AND FILE OUT OF THE TENT DOOR.
a) **Ventilation**
- Ventilators, near the peak of the tent, allow the tent to "breathe." Make sure you check these ventilators often and keep them open.
- Construct a draft channel under the tent wall behind the stove. The stove draws fresh air from outside the tent through the channel.
- Without proper ventilation a tent is a definite liability. Carbon monoxide and carbon dioxide produced from breathing and operating the stove will accumulate in the tent. Moisture will form inside the tent and the fire will not burn if the tent is airtight.

**WARNING:** Use of Carbon monoxide detectors is mandatory. Carbon monoxide is a deadly gas, even in low concentrations, and is particularly dangerous because it is odorless.

12) **The Space Heater Arctic**

a) Space Heater Arctic (SHA) NSN 4520-01-444-2375
- The SHA provides heat in a range 15,000 to 25,000 BTU’s per hour. It is designed to be used in small to medium size shelters in moderate to arctic conditions. The SHA operates with various types of liquid or solid fuel.

13) **Safety Procedures of the SHA Stove**

a) **Safety Considerations**
- Never leave a stove running unattended.
- Make sure all fittings on the stove fit tightly.
- Keep the stove level at all times to spread an even flame on the burner plate. This can be accomplished by placing a piece of wood under the stove.
- Protect the gas hose from being pulled on or coming into contact with the stove.
- Do not use excessive force on the drip valve or the hose fittings. Too much pressure at these points will damage the threads and the stove will be useless.
- If the stove goes out accidentally, close the drip valve and wait for the stove to cool down before relighting.
- Store all fuel supplies outside the tent to prevent an explosion.

b) **Emergency Procedures for the SHA**
- Wake up occupants of the tent and set fuel control to OFF.
- Use fire extinguisher as needed.
- Remove fuel can from tripod.

**Note:** When disassembled for transport, all of the components with the exception of the stove board will fit inside the stove body, reducing the space required to pack the stove in the ahkio.
14) Squad Stoves

a) Portable Cooking Stoves

- Canister-fuel stoves are simpler to operate than liquid fueled stoves. The gas, being already pressurized, flows from the fuel canister into the burner, where it ignites, in the same manner as a domestic kitchen stove. Canister stoves are generally accepted as being more efficient for weight carried than liquid fuel. Canister stoves are unreliable in cold temperatures.

- Liquid-fuel stoves are more complex because the liquid fuel must be vaporized prior to burning. In many stoves, the priming pressure is generated by a small hand pump that forces air into the fuel container. Liquid fuel stoves are the most popular for mountaineering. They generally operate well in cold weather and at high altitude. Liquid fuel costs less than canister fuel. Some forms of fuel, such as kerosene or diesel, are readily available worldwide.

b) Squad Cook Set: The squad cook set is used with the stove to make a one burner-cooking outfit. The cook set consists of two nested cooking pots and a frying pan. The cook set should only be used to melt snow and heat water. Do not heat food or other beverages in the cook set, which creates a mess and contaminates the cook set for drinking water. To melt snow for drinking water, always start with a small amount of water in the cook set.

15) Improvised Shelters

a) Environment and Equipment: Your environment and the equipment you carry will determine the type of shelter you can build. You can build shelters in any area. Wooded areas usually provide the best location, while barren areas have only snow as building material. Wooded areas provide timber for shelter construction, wood for fire, concealment from observation, and protection from the wind. Shelters made from ice or snow usually require tools such as ice axes or saws. Things to consider when building a shelter:

- You spend a lot of time and energy to build a shelter.
- Ventilate an enclosed shelter.
- Always block a shelter's entrance, to keep the heat in and the wind out. Use a rucksack or snow block.
- Construct a shelter no larger than needed. This will reduce the amount of space to heat. A fatal error in cold weather shelter construction is making the shelter so large that it steals body heat rather than saving it. Keep shelter space small.
- Never sleep directly on the ground. Lay down some pine boughs, grass, or other insulating material to keep the ground from absorbing your body heat.
• Never fall asleep without turning out your stove or lamp. Carbon monoxide is a great danger. It is colorless and odorless. Always check your ventilation. Even in a ventilated shelter, incomplete combustion can cause carbon monoxide poisoning. Usually, there are no symptoms. Unconsciousness and death can occur without warning. Sometimes, pressure at the temples, burning of the eyes, headache, pounding pulse, drowsiness, or nausea may occur. The one visible sign of carbon monoxide poisoning is a cherry red coloring in the tissues of the lips, mouth, and inside of the eyelids. Get into fresh air at once if you have any of these symptoms.

b) Snow Cave/Snow Mound Shelter

• Choosing a Site for the Snow Cave/Mound Shelter: Choosing the site for the snow cave, a site free of any avalanche danger should be selected. Look for a drift near ridges or trees. A depth of at least 4 or 5 feet is helpful to start with. Many areas do not have this depth of snow available. To overcome this problem, snow must be formed into a large pile. This pile should be designed large enough to accommodate the number of people that the shelter will house. To form the snow pile, begin moving snow onto a site that will provide a flat and stable base. Continue adding snow until a rounded pile is formed at least 4-5 deep and as long and wide as it needs to be for the number of people it will accommodate. It is better to start with more snow than you think you might need. The newly formed pile needs to be left undisturbed for at least an hour before any digging is attempted. This time allows the snow crystals to begin to bind together and gives the snow cave strength and stability. It is possible that in some conditions, such as granular or corn snow that the snow crystals will require a longer time to form this bond and in some cases not form a bond at all. In these situations other types of shelters need to be considered. When using this method, smaller shelters will be easier to build. If there is a large number in a group, it will be more effective to build several smaller caves. Heavy digging can be done with a large scoop shovel. Smaller avalanche shovels work well also. In an emergency situation where a shovel is not available, use whatever you can improvise, including your hands. A small cooking pot, a snowshoe or ski will also work. Try to arrange the entrance to the cave so that it is on the leeward side of a slope. This will offer additional protection from the wind.
- **Tunneling In:** In deep snow begin by digging a trench downward into the snow. As you dig place the snow that is being removed from the trench onto the roof area of the cave. In these conditions make the trench as deep as you are tall. The next step is to begin tunneling in. At a point at about knee level make the entrance. Make the tunnel slightly wider than your body. If the terrain and snow depths are adequate, tunnel at a slight upward angle. Ideally the cave end of the tunnel should be at least a foot above the entrance; this will help prevent warm air from escaping the shelter. If possible make the tunnel the length of your body. At the upward end of the tunnel hollow out a space as large as your body. Moving the snow becomes a major task at this point. Use the shovel in front of your body to dig in. As you move forward use your feet to move the snow into the tunnel and out of the entrance. Now you are ready to begin shaping the cave.

- **Shaping the Snow Cave:** The minimum thickness of the cave walls should be 12 inches. The thicker the walls the more stable the structure and the better it will insulate. The ceiling and the walls of the shelter should be dome shaped and smooth and should be large enough for you to sit upright. Try to eliminate any sharp edges or ridges on the walls and ceiling of the cave. Initial shaping can be done with a shovel to do the bulk of the work. Final shaping is best done with a gloved hand. This shaping will prevent water-dripping problems as the temperature in the cave rises.
• **Finishing Touches:** An elevated sleeping platform is the most important feature you can add to your shelter. This allows you to be nearer the warmer air in the upper part of the cave. Another necessary feature is the ventilation hole that can be made with a stick, ski pole or other object. This hole should be made in the top and be about 2 inches in diameter. This helps to eliminate carbon monoxide if stoves or candles are used and carbon dioxide build-up from your own breathing. Check the vent hole at regular intervals to prevent it from becoming clogged. Leaving a stick or ski pole in the hole is a good idea. To clear the vent holes just wiggle the inserted object. Make a shelf for a candle. Once lit, a candle can increase the air temperature in a small cave by as much as 20 degrees or more. The entrance to the cave can be blocked with a snow block, pack or other gear. This will help to reduce air movement and increase the temperature inside.

**Note:** On occasion during the construction of a snow cave, especially in granular snow, a collapse can occur. It is a good practice to build caves in teams of two. During the construction, one person should always remain on the outside. In case of a collapse the outside person can then rescue the person digging. It is uncommon for a snow cave to collapse after construction, especially after the temperatures drop at night. The cold temperatures tend to increase the overall strength of the shelter.

c) **Emergency Snow Caves:** In an emergency, snow caves can be created quickly by digging into a snow bank or drift. Eliminate the tunnel and dig a compartment so that it is large enough inside for you to sit upright. Place your pack in front of the entrance hole. Use evergreen bows or other natural materials to insulate yourself from the ground. Use your pack as an emergency bivy sack and light at least one candle. If you use a candle make sure you have a vent hole or adequate ventilation. If you think people will be out searching for you, make the site as visible as possible from the ground and the air by placing clothing, sticks or stomping an unusual pattern in the snow. Remember when you are inside the cave your ability to hear what is happening outside will be reduced to almost nothing.

d) **Snow Trench:** A snow trench can be built very quickly and will shelter two people. At least 3-4 feet of reasonably level snow is required.

• Start by digging a slot about shoulder width and a little shorter than a sleeping bag.
• While one person digs, another can build a wall around the windward end with the excavated snow.
• Dig straight down until the trench is 3-4 feet deep. There will now be room for two people to sit in the trench.
• Insulating mats can be used as the floor.

• If you have skis with you the roof can be made by lying two ski poles across the trench then sliding a pair of skis over a poncho and placing this across the poles. Use snow to hold the edges down. Get in and out of the trench by lifting one corner of the roof and sliding in.

• A small trench will be warmer than a big one and quicker to dig.

• Overall, if your need is to get out of the wind quickly, several trenches are better than one large one. If it looks like your stay will be prolonged, a more solid roof can be put on a snow grave by using snow blocks to make an A-frame-style roof.
- When you leave a snow trench, fill it in and stamp the snow down.

e) **Snow Block and Parachute Shelter:** Use snow blocks for the sides and parachute material for overhead cover. If snowfall is heavy, you will have to clear snow from the top at regular intervals to prevent the collapse of the parachute material.

f) **Lean-To Shelter:** Construct this shelter in the same manner as for other environments; however, pile snow around the sides for insulation.

g) **Tree-Pit Shelter:** Dig snow out from under a suitable large tree. It will not be as deep near the base of the tree. Use the cut branches to line the shelter. Use a ground sheet as overhead cover to prevent snow from falling off the tree into the shelter. If built properly, you can have 360-degree visibility.
Tree-Pit Shelter
Chapter 23. Environmental Effects on Weapons

1) **Introduction:** Everything is more difficult in a cold weather mountainous environment and weapons employment is no exception. Extended engagement ranges are severe. Environmental conditions are often more erratic. Simply aligning a weapon’s sights center-mass on a target and squeezing the trigger will not reliably result in target elimination. Soldiers that understand factors affecting the strike of their rounds, and how to compensate for them, will hit targets more consistently and increase the lethality of their unit.

2) **Factors Affecting Target Engagement in Mountainous Terrain**

   a) Mechanical Function
   b) Target Acquisition
   c) Ballistics (Bullet Flight)
   d) Employment

3) **Factors that Effect Weapons Functioning in Mountainous Terrain**

   a) **Temperature**
      
      • **Problem:** Colder temperatures cause weapon parts to shrink slightly and fit together tighter, leading to increased malfunctions. Initial operation of automatic weapons may be sluggish.
      
      • **Solution:** Keep weapons clean and use proper lubrications. CLP begins to thicken and loses its lubricating effectiveness below freezing (32° Fahrenheit). For operation in temperatures approaching 0° F or below, LAW (Lubricant, Arctic Weather, NSN: 9150-00-292-9689) must be used. Refer to each weapon’s TM for specific guidance. For operation in extreme cold temperatures in which LAW is not available and CLP is impeding function, weapons may be thoroughly cleaned and run dry.

   b) **Precipitation/Condensation**
      
      • **Problems:** Precipitation, such as snow or rain, inevitably finds its way into weapon receivers, magazines or ammo cans/drums during normal operation. Combined with freezing temperatures, it will freeze and can impede movement of the weapon’s internal parts, which leads to malfunction or even failure to fire. Additionally, snow can become packed into a weapon’s barrel causing a catastrophic event if fired, damaging the weapon or injuring the soldier. Even if weapons are kept free of precipitation, condensation can find its way into the weapon, freeze and cause the same types of malfunctions. This typically occurs when moving a weapon from a cold environment to a warm one, such as from the freezing outside into a heated tent, building or vehicle. Just like with a cold beverage on a hot day, surface moisture will appear. When that weapon is brought out into the cold again the condensation moisture will freeze.
• **Solutions:** Greater discipline is required to keep a weapon functioning properly in a cold weather environment. The operator must constantly check it and clear snow, ice and water from its internal parts whenever the tactical situation allows. Preparing the weapon for operation in this environment is also key. Muzzle caps should be used to keep snow out of the barrel and may be improvised out of 100 MPH tape when not available. 100 MPH tape should also be used to tape up gaps in the bottom of magazines or ammo drums to help keep out precipitation. Materials, such as cardboard and tape, may be used to cover most of the top (leaving enough space for the belt to feed out) of crew served ammo cans to the same effect. During patrols, weapon’s actions should be occasionally cycled manually to ensure that the bolt has not frozen in place, and trigger/hammer assemblies inspected for function. Weapons should be stored in an area that is the same temperature as it will operate in. If this is not possible, weapons brought into a warm environment from the cold should be allowed a minimum of one hour to warm up to room temperature and then thoroughly cleaned and properly lubricated prior to returning to cold weather operation. Strict attention to these techniques will keep weapons running properly in this environment.

4) **Factors that Effect Target Acquisition in Mountainous Terrain**

a) **Target Detection:** Mountainous terrain can provide soldiers with the ability to observe tremendous ranges. Optics such as binoculars, spotting scopes, riflescopes and other more sophisticated targeting devices should be used to achieve maximum target detection capability. Using night vision devices or thermal devices in combination with weapon sights provides an advantage over the enemy during the hours of darkness. Aircraft may also be used locate and identify targets long before they are a threat to the unit. Day and night optics may also be used to observe the effects of friendly fires on enemy targets, allowing leaders to control fires with greater effectiveness.

b) **Range Estimation:** Target engagement ranges in mountainous terrain are often longer than in other terrain types. Engagements beyond 300m are common, thus the standard technique of aiming center mass and squeezing the trigger is ineffective. Accurate range estimation is critical to successful target elimination. Incorrect range estimation is the primary reason Soldiers can’t hit targets beyond 300m. Range can be determined by the following methods:

- **Map study:** Range can be determined by plotting the location of the shooter and of a target on a map and measuring the straight line distance. This is effective in defense or from an observation/blocking position when a range card is used and distance to easily identifiable features can be determined ahead of time. The features can then be used as range reference points when engagements must be made.

- **Mil-relation formula:** An optic with a mil-radian reticle (e.g.: binoculars, riflescope, or spotting scope) can be used to determine range by using the following formula: 
  \[
  \frac{\text{Target Height in Inches} \times 25.4}{\text{Target Height in Mils}} = \text{Range in Meters.}
  \]

  EXAMPLE: The average human is approximately 40 inches from belt line to top of the head. M24 binoculars are used to determine that from the shooter's location the target measures 1.8 mils from belt to top of head. Apply the formula: 40 inches x 25.4 = 1016. 1016/1.8 mils = 565m. With practice, this technique is effective to +/- 10% of target range. This is sufficient for small arms engagements.
• **Laser Range Finder (LRF):** Laser range finders are the fastest and most accurate method of determining range when used properly. Several measurements should always be performed to ensure the laser is not hitting brush or other objects in between the shooter and the target. Rolling or masking terrain can also cause false readings (i.e.: too short). Note: Weather such as snow, rain and fog are common in mountainous terrain and may interfere with the LRF’s laser making it ineffective. Additional batteries should be carried in cold weather.

5) **Environmental Factors on Bullet Flight (ballistics) in Mountainous Terrain**

a) **Distance:** When engaging targets beyond 300m the soldier must adjust his sights or point of aim vertically to account for the effect of gravity on bullet flight (bullet drop) in order to hit center mass.

• Standard iron sights are equipped with an adjustment knob designed to compensate for bullet drop at a variety of ranges, which soldiers should be familiar with operating. This is the most accurate method. Another method is to “Hold Over” the target to compensate for increased bullet drop at ranges beyond 300m. The process is to align the sights at some point higher than center mass. The distance above center mass that soldiers must hold increases as the range beyond 300m increases. This method is faster, but requires more shooter experience to ensure the proper hold over distance is used.

• **Optics**
  
  o **M68 CCO:** The only method of engaging targets beyond 300m with a CCO is the “Hold Over” method. To hit a human target at 400m, hold the red dot approximately at the top of the head. To hit a human target at 500m, hold approximately 4 feet above center mass.

  o **The ACOG** is magnified (4x) and is equipped with a bullet drop compensating reticle making it the most effective sight for target identification and engagement beyond 300m that can be used with the M4 carbine or M16 rifle. The tip of the red chevron must be zeroed at 100m for it to work properly. The horizontal stadia lines can be used to determine approximate range by aligning them with the width of a human target at the shoulders. The cross at the stadia line that is the closest match to the target’s shoulder width should be aligned with the target for engagements beyond 300m. For in between engagements (e.g.: 350, 450, 550m) the practice of aiming at the head/shoulders with the closest lower stadia line in the reticle should be used.

  ▪ **Example:** If the target is at 550 meters, aim at the head/shoulders with the 500m stadia line.

  o A variety of optics are available in the Army inventory for use with crew served and special weapons that provide an advantage at ranges beyond 300m. Leaders should outfit and train the units with such equipment to gain maximum advantage over the enemy in mountainous terrain.
b) Temperature

- **Problem:** The colder the air temperature, the denser the air becomes. This means greater drag on the bullet as it flies, causing greater bullet drop. Therefore, whenever the temperature is LOWER than it was when the sights were zeroed to the weapon, the round will strike lower than expected. The greater the difference in temperature and the further the range of the shot, the greater the deviation in the strike of the round. The opposite holds true if the weapon is fired at a hotter temperature than when it was zeroed, with the round striking higher. Changes in temperature of 20° or more will produce noticeable changes in the strike of the round. Changes greater than 40° will significantly affect the strike of the round and must be corrected for to achieve hits on target.

- **Solution:** Units should correct for significant changes in average operating temperature by rezeroing weapons under the conditions they will be operating in. Precision marksmen should refer to TC 3-22.10, Sniper Tactics and Procedures for information on calculating shot solutions to compensate for temperature changes.

c) Atmospheric Pressure (i.e.: elevation, altitude)

- **Problem:** As atmospheric pressure changes it affects the flight of the bullet and changes the strike of the round. The lower the atmospheric pressure, the less dense the air is, which creates less drag on the bullet and causes the bullet to strike higher than expected. This problem usually occurs when soldiers have zeroed at a lower altitude and then take a shot at a significantly higher altitude. The greater the change in atmospheric pressure and the further the range of the shot, the greater the deviation in the strike of the round. The opposite holds true if a weapon is zeroed at a higher elevation and then a shot is taken at a lower altitude, leading to the round striking higher than expected.

- **Solution:** Units should correct for change in elevation by rezeroing their weapons at the average elevation they will operate in (i.e.: upon arrival to an area of operation). Precision marksmen should refer to TC 3-22.10, Sniper Tactics and Procedures for information on calculating shot solutions to compensate for temperature changes.

d) Shooter–Target Angle: Given that engagement ranges are greater in mountainous terrain, soldiers must compensate for angle when firing up or down or they may completely miss their target.

- **Problem:** Non-precision marksmen are not trained to calculate for gravitational effect on bullet flight when firing at an angle. If soldiers use the same point of aim or sight adjustment that they would on a flat range, their round will strike higher than expected. This is true whether firing at an upward or downward angle. As distance and/or the angle of the shot increases, this effect also increases potentially causing the soldier to miss the target.
- **Solution:** Soldiers must “Hold Under” to compensate for angle when firing at significant angle (either up or down). This means aiming lower than where they would normally hold to hit a target at a given range.

  - The following guidelines may be used to obtain body hits when firing at an angle of 30° or greater and the weapon is zeroed at 25m/300m (Note: this guide accounts for angle and bullet drop):
    - 0-350: No change. Aim center mass
    - 350-450: Aim high center mass (neck)
    - 450-550: Aim approximately 1 foot above the head

  - The following guidelines may be used to obtain body hits when firing at an angle of 30° or greater and a bullet drop compensating sight is used (e.g.: ACOG, dialed iron sights):
    - 0-350: Aim center mass with 300m stadia/sight setting
    - 350-450: Aim low center mass (belly button) with the 400m stadia/sight setting
    - 450-550: Aim low (belt level) with the 500m stadia/sight setting

- **Wind** is often more severe and less stable in mountainous terrain. Extreme wind gusts are a common occurrence. Terrain channels these winds in a more complex manner, making it difficult to determine wind effects on bullet flight. A Soldier may have to fire rounds through two or more different wind conditions simply by turning left or right a small amount from a stationary position.

- **Problem:** Crosswinds can have major effect on bullet flight causing shots to miss the target by pushing them right or left. Even a light wind may cause shots to miss at extended ranges. The effects of wind on shot placement cannot be overemphasized.

- **Solution:** Soldiers must be familiar with the process of holding “into the wind” to ensure hits on target. The simplified process is to determine which direction the wind is blowing from and move the sights away from center mass some amount in that direction. The stronger the wind, the more perpendicular it is blowing to the bullet’s flight path and the further the range of the shot, the further “into the wind” a Soldier must hold to hit his target. Wind direction and speed must be evaluated to correctly predict its effect on round strike. Significant experience is required to gain proficiency in this technique. Exactly how far to hold into a given wind to obtain center mass hits can be calculated. Charts are available in TC 3-22.10, Sniper Tactics and Procedures to help Soldiers identify wind conditions and determine how far to hold left or right to compensate for them at benchmark ranges (e.g.: 300m, 400m, 500m). In the absence of time to calculate or available references, soldiers can work in shooter – spotter teams to determine wind effects on the strike of their round. One soldier shoots and the other observes impact, noting the horizontal distance from center. An effective follow up shot can then be made by the shooter holding the same distance into the wind. A unit that can identify wind and adjust shots will more effectively eliminate their adversaries.
EVALUATING WIND EFFECT

WINDS FROM THE LEFT BLOW THE BULLET TO THE RIGHT

WINDS FROM THE RIGHT BLOW THE BULLET TO THE LEFT

CLOCK SYSTEM
WIND VELOCITY INDICATORS

<table>
<thead>
<tr>
<th>VELOCITY</th>
<th>INDICATOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 3 miles per hour</td>
<td>Felt lightly on the face</td>
</tr>
<tr>
<td>3 to 5 miles per hour</td>
<td>Causes smoke to drift</td>
</tr>
<tr>
<td>5 to 8 miles per hour</td>
<td>Leaves in trees move constantly.</td>
</tr>
<tr>
<td>8 to 12 miles per hour</td>
<td>Leaves and trash move.</td>
</tr>
<tr>
<td>12 to 15 miles per hour</td>
<td>Small trees sway.</td>
</tr>
</tbody>
</table>

f) Difficult Observation Conditions

- **Problem**: Terrain, surface conditions, fog and precipitation can all make it difficult to determine the strike of rounds in mountainous terrain.

- **Solution**: Whenever possible, soldiers should use whatever optics they have available to work in shooter–spotter teams therefore maximizing the possibility of seeing where rounds are impacting and allowing for sight corrections and effective follow up shots. This will save ammunition and result in more effective target elimination.

6) Factors that Effect Weapon Employment in Mountainous Terrain

a) Soft surface (deep snow):

- **Problem 1**: The prone firing position is ineffective in drifted snow because it will not support the weight of a prone soldier and/or crew served weapons. Soldiers and weapons will sink causing the snow to obscure the firer’s vision and degrade his ability to hit enemy targets.

- **Solution 1**: Soldiers in defensive positions can improvise firing bases out of packed snow, snow shoes, wood, or other materials. During patrols, alternate firing positions such as sitting, kneeling, and standing may have to be used to gain proper sight alignment. Ski poles may be used to create hasty support by holding them in an X shape in the non-firing hand, planting the points in the snow and resting a weapon in the V at the top of the crossed poles. This technique is effective from both the standing and kneeling position.

- **Problem 2**: Deep snow reduces the effectiveness of explosive munitions (e.g.: grenades, mortars, artillery) by padding impact and dampening the force of explosions. This results in reduced lethality.

- **Solution 2**: More munitions may be needed to achieve the same destructive effect. Observers should consider air detonations above targets to avoid dampening by snow.
b) **Hard Surface (rocks, ice, frozen ground, etc.):**

- **Problem:** Hard terrain makes it difficult to stabilize weapons during firing. Vibration caused by the firing process may cause weapons to slide around making follow up shots more difficult. Broken terrain, boulders and rocky debris may also make it difficult to fire from the prone position by obstructing the line of fire.

- **Solution:** The prone unsupported position or alternate firing positions may be required to fire over obstacles. These less stable firing positions must be well-practiced to reliably achieve hits on target.

c) **Snow Fortifications:** Snow can be used as effective cover from enemy fire. Snow fortifications can be constructed in areas where more desirable materials (e.g.: sand, rocks) are not available to improve defensive positions.

- **Construction:** They should be constructed out of packed snow (at a minimum) according to the dimensions outlined in the diagram below. Sand bags may be filled with packed snow to reinforce its structure. Other materials (e.g.: rocks, sticks, metal fragments) may be used to improve the fortification if available. Another means of improving the fortification is to make "sno-crete" by mixing snow and water in a container (e.g.: ammo can) and allowing it to freeze into blocks, which can be stacked. Sticks and other materials may be mixed into the blocks for improved structure. Ice blocks ("Ice-crete") can also be made and are an effective barrier against bullets, but tend to shatter and break apart quickly. All barrier materials should be buried in the rear portion of the structure (closest to the friendly side) as a final protection from projectiles. This allows the snow, which acts like sand, to settle in on itself as projectiles pass through it. Thus the snow absorbs most of the energy from projectiles, but retains its effectiveness under repeated strikes, preserving the harder more brittle materials to protect against less common deep penetrators. When it comes to small arms, typically it is the smaller faster moving bullets that penetrate deepest.
Snow material bullet stopping depth:
- Newly fallen snow...........400cm/13.1ft
- Packed snow...............200cm/6.6ft
- Sno-crete....................150cm/4.9ft
- Ice-crete......................50cm/1.6ft
Chapter 24. Animal Packing

1) **Introduction:** From horse drawn chariots 3800 years ago, to Special Forces teams on horseback in Afghanistan, the use of animals in war has always been a force multiplier. The usage of Pack Animals allows Soldiers to reduce combat loads and increase sustainability during long operations. Understanding the basics of how to select, pack and care for pack animals can mean the difference between mission success and failure in the mountains.

2) **Pack Animal Use Considerations**

   a) **Infrastructure Considerations:** In many developing countries, road systems are generally in poor condition. Spring runoff, landslides and the lack of money and equipment to maintain road systems can bring wheeled and tracked vehicles to a complete stop. Resupply by air is often hampered by weather, PZ and LZ limitations and lack of air asset availability. This can create the need to use an assortment of pack animals when it comes to transportation requests. Being prepared to use locally obtained pack animals to bring materials through otherwise impassable roads and terrain. This will allow you to continue to bring the fight to the enemy.

   b) **Animals in Theater:** The last pack animal unit in the U.S. Army was disbanded in 1953. Units will not bring pack animals into theater. Another option is to acquire animals from the local population. Knowing how to choose animals that will perform the job for the task required is important to ensure mission success.

3) **Parts of Pack Animals**

   a) **Nomenclature:** There are five main parts to the animal. They are the following: head, neck, back/barrel, front quarters, hindquarters.

   b) **Conformation:** Conformation describes what goes into the selection process for determining what a good pack animal should look, with regard to size, shape, height, weight and dimensions. Good conformation is marked by a steady intelligent mind, short strong neck, well-defined withers, large muscular chest, and a short, straight, well-muscled back and loins. Knowing what to look for in an animal will allow you to avoid sick or weak animals that would otherwise compromise your mission.

   c) **Selection:** Avoid any animal that looks weak or frail. Be aware that drugs may have been administered before your arrival to improve the animal's looks or condition. Old scars and open wounds are a sign of hard use and poor treatment. Protruding rib and hipbones are signs of an undernourished animal. If the animal looks questionable at first glance, do not use it.
4) Acquiring Pack Animals

a) Bargaining: Avoid going into a village and choosing the first animals you come across. Talk with the elder and let him know your needs. Closely inspect the animals. Take pictures of the animals for further study later. Haggling is often part of local culture. The price you agree on will affect the price for others trying to acquire animals in the future. Do not accept the animals that day if possible. Some may have been drugged to hide an injury. One technique is to arrange to pick them up the following day, but wait two days before coming unannounced. Have the same animals gathered up, then compare. Any drugs given the first time will have worn off by the time you come back.

b) Interpreters: Insure that the interpreter is telling the elder what you are saying and not any more.

5) Characteristics of Horses, Mules, and Donkeys

a) Horses: Almost any horse used for riding can be used for packing. Horses carry about 65% of their weight on their front legs. This makes them less suitable for rough terrain or downhill movement. Horses are more skittish to loud noise and sudden movements. They are also more prone to foot problems than other pack animals.

b) Mules: Mules are the hybrid product of a male donkey and a female horse. Mules are sterile and cannot be bred. Mules carry about 55% of their weight on their front legs giving them better balance and footing than horses in rugged terrain. The term “stubborn as a mule” stems from the mules strong sense of self-preservation. If a mule thinks it will be injured it will refuse to go any further no matter how much persuasion is used. Mules form very close bonds with horses, especially mares. It is good practice to have at least one mare with a mule pack. The mules will willingly follow a bell mare. Even while grazing at night, mules will not venture far from the mare. Harsh treatment of these animals will lead to control problems later on. Mules will respond to an untrained handler better than a horse. Pound for pound, you will get more work out of a mule than a horse. An adult healthy mule will be able to carry a two hundred pound load all day.

c) Donkeys: Donkeys evolved in the desert. Their bodies are very efficient at conserving water, even pulling excess moisture from their dung before voiding it. Their tough compact hoofs handle sand and rock well. They do not sweat as much as horses due to having a smaller muscle mass. Large ears help to dissipate heat and can locate sound direction very well, alerting you to unseen danger. Like mules, they will instinctively attack any canines deemed a threat. They have a digestive system that is able to break down and get nutrients from almost anything. Donkeys also have a strong sense of self-preservation. Donkeys range in size from 36” to 56” high at the shoulder.
6) Animal Feeding Considerations

a) **Feeding:** Feeding pack animals in theater will create logistical problems if there is not enough natural forage to be found. Animal field rations are determined by their weight. A 1000 lb. mule will require 14 lbs. of forage and 10 lbs. of grain each day. A 400 lb. donkey will need 12 lbs. of forage and 2 lbs. of grain. These amounts will increase with a heavy workload. Half of the amount is usually given in the morning and the other half at the end of the workday.

b) **Free-range Food:** To meet the animal’s daily requirements, a pack animal left to feed on its’ own will need a grazing area large enough to feed for six hours without having to lift its’ head to look for and move to more food. Flakes of hay should be in some kind of manger to keep it off the ground to prevent mold and debris from contaminating the feed.

c) **Water Needs:** Water is critical to the animal’s ability to digest its’ food and maintain its’ health. A mule will require between 4-8 gallons per day (gpd), a donkey 2.5 – 5 gpd and a horse 8-12 gpd. These amounts are a daily total; the animals should be allowed a portion of this amount several times a day. A fast pace or hard exertion should be delayed for about a half hour after watering on the march to avoid digestive disturbances, which could kill the animal.

7) Animal Health Considerations

a) **Animal Health:** Animals acquired in theater will more than likely be tired and beat down already. Your job will be to select the best animals available to accomplish your mission. In general, injuries above the animal’s knees are treatable because of more muscle tissue and blood supply. Suture kits and medicated salve (Bag Balm) for cuts and abrasions are likely all you need. Wounds below the knees are more problematic. Poor blood supply, difficulty keeping the wound clean, and the constant motion prevent easy wound care.

b) **Medicine:** In general, anything used to treat a wounded Soldier can be used for animal wounds. Medics should carry heavy weight sutures, medicated salve and several rolls of 4” vet wrap/coban.

c) **Destroying Stock:** There are four main ways to destroy stock.

- Striking between the ears with a heavy blunt object. Make an imaginary x between the animals’ ears and eyes. Strike where they meet. Having the animal secured will greatly increase your chances of success.
- Cutting the throat on the lower 1/3 of the neck to sever the jugular vein.
- Shooting, make an imaginary x between the animals’ ears and eyes. Shoot from close range.
- Turn the animal loose. Let nature take its’ course. This is the least preferred option due to prolonged animal suffering and the animal may follow the herd.
8) Load Planning Factors and Considerations

a) **Planning:** Check within the unit to see if anyone has experience working with horses. These individuals can assist the local animal owner with handling the animals throughout the movement. It is recommended that no less than two people be assigned for every ten animals for control purposes. Cross load equipment in case of attack. For security reasons, if packing ammo or other sensitive items, those animals should be handled by U.S. personnel only.

b) **Packing:** All items to be loaded should be planned out so that each pair of bundles are balanced to within 5 lbs. of each other and placed on the animal at the same time. This will ensure that the load rides evenly on the animal. Placing loads should be done as quickly as possible. The goal should be to take no longer than 30 minutes to load all the animals. Begin the movement immediately after the last animal is packed.

c) **Leading:** Never coil the rope around your hand. Hold loose bights to prevent you from being caught in a loop if the animal runs. Be aware of your surroundings at all times to prevent injuries. Maintain firm control if leading an individual animal. Stand at or just in front of the animal’s head.

d) **Loads:** In general, the total load place on an animal should not exceed 25% of the weight of the animal. For small horses and donkeys, the average load is about 80 - 100 pounds. Consideration for the condition of the animal, durability of native pack equipment, terrain, and distance to be covered should be factored into the load plan weight.
e) **Building a Load:** Loads should be constructed so the load does not injure the animal or spill out the contents. The basic items needed for building a load can be varied. Blankets, canvas tarps, ponchos (light loads), sleeping bags, rucksacks and duffel bags all can be used to haul equipment.

f) **Mantee Bundle:** The mantee is an 8’ x 7’ piece of 12 to 18oz canvas or similar sized material. Laid flat on the ground, the load is placed in the center so that the corners of the mantee bisect it. The sides are tucked in and folded over the load followed by the ends. Tension must be maintained while folding to ensure a tight final product.

g) **Tying Off:** A 3/8” diameter rope 36 feet long with a small fixed loop at one end is needed to tie up the mantee. Bring the rope around the long axis of the load and bring the running end of the rope through the fixed loop. Pull this back on its self as tightly as possible. Make a series of half hitches around and down the load roughly 1/3 the distance at a time. Secure the end of the rope with a tightly dressed down overhand slip knot secured with two half hitches. Place any remaining rope under the wraps to hold it secure.
h) Commercially Manufactured Saddles

- Sawbuck saddle
- Decker Saddle

i) More than likely you will not be deployed with animals and tack, but you may be able to purchase some tack prior to your deployment.

j) Tack can be made from sling ropes, LBE/LCE, and Canvas with initiative and imagination.
Chapter 25. Water Procurement

1) Introduction: 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 in order 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.

2) Biological Contaminants

   a) Virtually all surface waters are microbiologically contaminated. There are three types of disease-causing microorganisms: protozoa, bacteria, and viruses. Since microorganisms are impossible to see, you are taking a chance of getting sick every time you sip straight from a stream or lake.

   b) 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 require long dwell times to do the job.

   c) 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.

   d) 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 people are becoming active outdoors, more rivers, lakes and streams are at risk of viral contamination.

3) Chemical Contaminants

   a) Filters and purifiers provide microbiologically safe drinking water. The carbon in the filters and disinfectant of the purifiers will adsorb or react with chemical contaminates such as herbicides, pesticides, and volatile organic compounds (VOCs). 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.
4) Filtration Treatment

a) 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). How well filters work depends largely on the physical size of the pores in the filter medium.

b) Filters have the advantage of providing immediate access to drinking water without adding an unpleasant taste. However, they suffer from several disadvantages: micro cracks and eroded channels within the filter are just a couple.

c) In addition, they are expensive and bulky compared to iodine. Alas, many travel filters are inadequate even to reliably remove E. coli and other medium sized pathogens.

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

5) Water Chemical Treatments

a) 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. Chemical water treatment allows you to treat water away from the source.

- 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.

- Chlorine Dioxide – is an effective chemical against most organisms including bacteria, protozoa, viruses, molds, spores and mildew. The most common forms are found in a 2 part liquid system or tablet form. It does not leave a residual chlorine flavor and most manufacturers claim it improves taste and smell.

- 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 issued iodine treatment tablets are not available, 10% Povidone-Iodine (Betadine®) can be used in the concentration 4 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 pre-filter water to remove the large cyclospora (about the size of Giardia cysts), and then treating with iodine.

6) Use Heat to Treat Contaminated Water

a) 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.

7) Field Expedient Water Sources from Moving Water

a) 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 run off this can contain very fine silt that will clog filters. Sediment in high concentrations can cause you to become sick, even when treated.

8) Field Expedient Water Sources from Standing Water

a) 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.

9) Field Expedient Water Sources from Snow and Ice

a) Look for clean white snow. When setting up camp mark off a place that 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 microorganisms can survive in a frozen state. Avoid discolored snow that has obvious contaminants.

10) Avoid Cross Contamination

a) 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.

11) Proper Container Selection

a) 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.
Chapter 26. Aerial Resupply

1) Introduction: AAR notes from the 10th Mountain Division’s Operation Anaconda (Mar 02) noted the lack of preplanned aerial resupply and the difficulties in resupplying units in contact. Aerial resupply techniques give units options that do not rely on ground convoys or increased Soldier loads. Smart SOPs, pre-configured loads and leaders who understand the pros and cons of the various types of aerial resupply are key to effective aerial resupply.

2) Considerations for Aerial Resupply
a) In remote, austere locations that are hard to reach by ground transportation.
b) With limited or no material handling equipment (MHE) to conduct recovery or retrograde operations.
c) In locations with no usable airfields or airstrips to conduct air-land operations.

3) Methods of Aerial Resupply
a) Speedball: Constructed simply by filling a duffel bag or similar sized container with resupply items and securing the contents inside. When over the DZ the bag is kicked out the door. Speedballs have a high rate of failure for delivering resupply items undamaged. Speedballs tend to burst upon impact with the ground and scatter the contents over a large area.

b) Poncho Parachute: The poncho expedient parachute can be used to drop up to 65 pounds of non to mildly sensitive equipment and lessens the need for more expensive parachutes. The load requires a buffer to protect load. Constructed by attaching lengths of 550 cord to a poncho at the grommet points. The individual lines are then brought together and secured to a light bundle. Poncho parachutes have an average 70% success rate in delivering the resupply items on target and undamaged. Tests should be conducted to determine the correct maximum weight that the poncho will support to increase the chances of success.

c) Low Cost Low Altitude (LCLA): The LCLA family of parachute systems for aerial resupply consists of five aerodynamic decelerator configurations capable of handling payloads weighing 30-500 lbs, delivering payloads from 100-2000ft of altitude, and costing no more than $375. The LCLA only requires a 50M drop zone. The system is flexible and simple enough to be quickly rigged with no specialized rigger or loadmaster training; can be airdropped from commercial or military fixed-wing aircraft, helicopters or unmanned aerial vehicles.

4) Quick Guide for Weights
a) Duffel Bag capacity; Each Duffel bag can hold one of the following:
   - 36 MREs (approximate weight 66lbs)
   - 3 cases of 5.56, linked ammo in plastic drums (approximate weight 225lbs)
   - 3 cases of 7.62, (8) 100round boxes per sandbag (approximate weight 225lbs)
   - 3 cases of 5.56 packed by bandoleer (approximate weight 200lbs)
   - 70 (1) liter water bottles (approximate weight 152lbs)

Summary: Aerial resupply provides the commander with ability to decrease the need for vehicle based LOGPACs in an austere environment. Thus reducing 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
Chapter 27. Confined Space Exploration and Clearing

1) **Introduction:** Confined spaces are found on the current battlefield in the form of wells, caves, collapsed buildings, and water and waste systems. Learning the skills needed to safely operate in and properly clear these danger areas will enhance your ability to deny the enemy use of these areas.

2) **Characteristics of a Confined Space**
   a) Confined spaces can be technically challenging due to the environment in which they occur. Confined spaces are often narrow and constricting preventing easy access. They are usually either unlit or poorly lit so Soldiers must provide their own light source. Finally, confined spaces often contain hazardous materials in liquid or gas form, which can be harmful or fatal to Soldiers.
   b) Vertical confined spaces are usually found in the form of abandoned wells or cave entrances. These spaces are often used to cache weapons or other hostile material. Wells must be checked for booby traps as well as poisonous gasses prior to sending in a Soldier.
   c) Horizontal confined spaces are found in cave systems and structure collapses. These spaces must be thoroughly checked for stability prior to entering.

3) **Tactical Considerations of a Confined Space**
   a) Enemy situation
   b) Mines, Booby Traps, IED’s
   c) Depth
   d) Water
   e) Actions at the Well
   f) Clearing Techniques
   g) Special Equipment Considerations

4) **Confined Space Anchoring Consideration**
   a) Vehicles provide easy anchoring possibilities for a hauling or lowering system. Ensure the vehicle wheels are chocked securely, and sharp edges are padded.
   b) Use additional height to create a high directional to safely lower and raise a Soldier into the space. This can be a tripod, and existing tree/structure, or a vehicle parked closely.
   c) Natural anchors such as trees, rocks, and earth anchors may be used if available.
5) Confined Space Belay Techniques

   a) Body Belays are a quick method to assist a Soldier entering a less than vertical space when solid anchors are unavailable. Realize that body belays only prevent a slip from becoming a fall – stopping an accelerating Soldier with LCE and weapon will be very difficult.

   b) Mechanical Belays such as the Munter Hitch are used when there is a good anchor and the Soldier can climb down and up the space unassisted.

   c) High friction lowering systems, such as the munter hitch, can be used for vertical to overhanging wells or when the entering Soldier is carrying extra heavy equipment, such as air monitoring equipment or demolition equipment.

   d) Hauling Systems complement lowering systems – the support team must be able to construct a mechanical advantage system to quickly raise the Soldier out of harm’s way.

6) Individual Movement Techniques in a Confined Space

   a) Single Line Rappelling can be used if the Soldier wants to control his own descent. Give extra care padding edges as there is no redundancy with a single rope. Either a top belay with a second rope or a self-belay must be used to have hands free capability.

   b) There are various ascending methods available. Prusik ascent is a simple method, although slow and fatiguing. Pre-tie your stirrups to speed the process. Another choice is using two mechanical ascenders if available. This method is much faster and less tiring.
Additional Resources

Manuals:
TC 3-97.61     Military Mountaineering, 2012
ATP 3-90.97    Mountain Warfare and Cold Weather Operations, 2016
ATTP 3-21.50   Infantry Small Unit Mountain Operations, 2011
ATP 3-21.18    Foot Marches, 2017

Civilian Publication:

Appendix A – Long distance holds for current issue M4 optics (ACOG)

The untrained mountain Soldier has two foes- the enemy and the mountain.
But he can make a friend and ally of the mountain by learning to know it.
The mountain can give him cover and concealment, points of vantage and control, even, at times, food, water, and shelter.

"Proposed Manual for Mountain Troops."
MOUNTAIN TRAINING CENTER, OCTOBER 1943