MCRP 12-10A.1

Small-Unit Leader's Guide to Mountain Warfare

U.S. Marine Corps

PCN 144 000125 01

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6 August 2025

FOREWORD

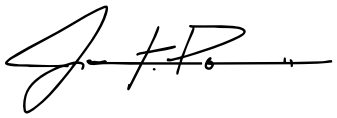
Marine Corps Reference Publication (MCRP) 12-10A.1, *Small-Unit Leader's Guide to Mountain Warfare*, is a reference for Marine leaders (team through company) to use when conducting operations in mountainous terrain, snow, cold weather, and at high altitudes. This publication is to be used in conjunction with the Marine Corps Tactical Publication 12-10A, *Mountain Warfare*; MCRP 12-10A.2, *Mountain Leader's Guide to Winter Operations*; and MCRP 12-10A.3, *Mountain Leader's Guide to Mountain Warfare Operations*.

The series covers individual and small unit tactics, techniques, and procedures across applicable warfighting functions. Topics include the environment, specialized clothing and equipment, weapons considerations, patrolling considerations, route selection and navigation, basic avalanche hazard assessment and mitigation, crossing streams and ice, snowshoeing, winter camouflage, logistics, fire support, helicopter operations, and casualty evacuation.

Because of the rapid turnover in personnel, operational tempo, and the multitude of training commitments, the Marine Corps Mountain Warfare Training Center cannot train all Marines or units. In combat, Marines may need to learn through doctrinal references that are augmented with instruction from their unit's qualified summer and winter mountain leaders and basic cold-weather advisors. This MCRP gives them that capability.

This publication supersedes MCRP 12-10A.1, *Small Unit Leader's Guide to Cold Weather Operations*, dated 21 May 2013; erratum dated 2 May 2016; and change 1 dated 4 April 2018.

Reviewed and approved this date.



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Publication Control Number: 144 000125 01

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CHAPTER 1.
MOUNTAIN WEATHER

Understanding weather forecasts and reports is aided by understanding the forces that create weather: the sun, air movement, the Earth's rotation, and cold and warm fronts. Weather affects a Marine's ability to see the enemy, terrain, and troops around them. Having access to weather information can help Marines be prepared; therefore, whether traveling or in the patrol base, Marines should constantly evaluate the following questions:

- What is the current weather?
- What was the weather recently and when did it change last?
- When is the next forecasted change coming?
- What is the historical data relative to current conditions and timeframe?

WINDS

Some types of winds that are peculiar to mountainous environments—but might not necessarily affect the weather—are anabatic and katabatic winds (Figure 1-1). Anabatic winds blow up mountain valleys to replace warm rising air and are usually light winds. Katabatic winds blow down mountain valley slopes caused by the cooling of air and can cause strong winds.

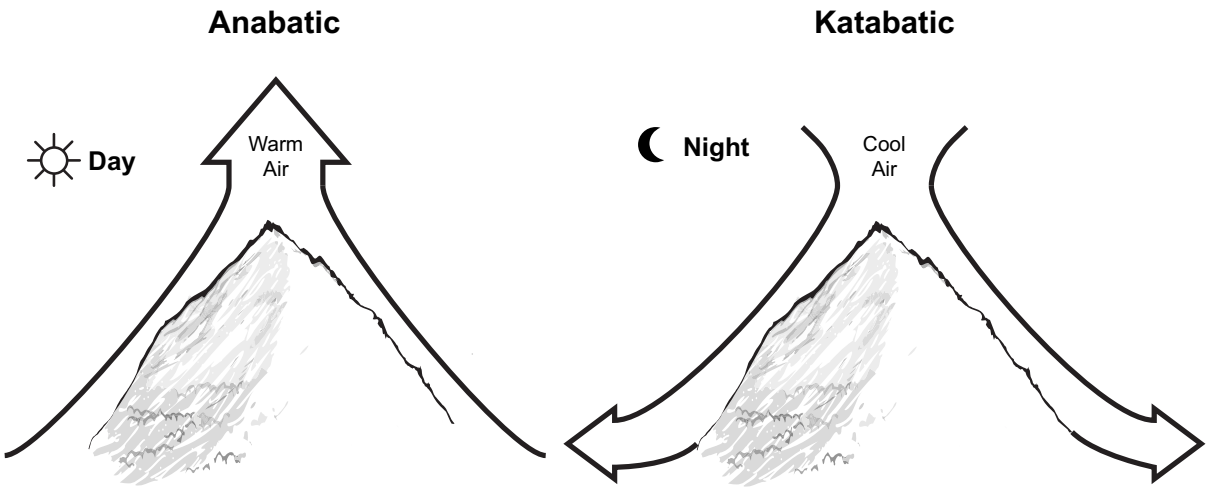


Figure 1-1. Anabatic and Katabatic Winds.

Wind Speed

Jet Stream. A jet stream is a long, meandering current of high-speed winds near the tropopause (transition zone between the troposphere and the stratosphere) that generally blows from the west and often exceeds 250 miles per hour. The path of the jet stream comes from the west, dips south, picks up air masses from the tropical regions, goes north, and brings down air masses from the polar regions. The jet stream results from circulation of air around the poles and equator and the direction of airflow above the mid latitudes.

The wind speed affects projectile trajectory, equipment, antennas, and personnel (see Table 1-1). Marines can determine wind speed by observing the environment. When wind speed is combined with the air temperature, it produces a windchill index (see Table 1-2). Windchill is the apparent temperature of air on exposed skin.

Table 1-1. Effects of Wind Speed.

The Beaufort Wind Scale		
Wind Speed (mph)	**Description**	**Observable Wind Characteristics**
0-1	Calm	Smoke rises straight up; calm
1-3	Light Air	Smoke drifts
4-7	Light Breeze	Wind felt on face; leaves rustle
8-12	Gentle Breeze	Leaves and Twigs constantly rustle; wind extends small flags
13-18	Moderate Breeze	Dust and small paper raise; small branches move
19-24	Fresh Breeze	Crested wavelets form on inland waters; small trees sway
25-31	Strong Breeze	Large branches move in trees
32-38	Near Gale	Large trees sway; must lean to walk
39-46	Gale	Twigs broken from trees; difficult to walk
47-54	Severe Gale	Limbs break fro trees; extremely difficult to walk; slight structural damage occurs
55-63	Storm	Tree limbs and branches break; trees uprooted
64-72	Violent Storm	Widespread damage
73 and higher	Hurricane	Sever and extensive damage
LEGEND mph miles per hour		

Table 1-2. National Weather Service Windchill Index.

Wind Speed (mph) \ Temperature (°F)	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45	-50
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	40	-46	-52	-57	-63	-69
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72	-78
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77	-83
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81	-88
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84	-91
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87	-94
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89	-96
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91	-98
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93	-100
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95	-102
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97	-104
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98	-105
65	24	17	10	2	-5	-12	-19	-27	-34	-41	-49	-56	-63	-70	-78	-85	-92	-99	-107
70	24	16	9	2	-6	-13	-20	-27	-35	-42	-49	-57	-64	-71	-79	-86	-93	-101	-108
75	23	16	9	1	-6	-13	-21	-28	-36	-43	-50	-58	-65	-72	-80	-87	-95	-102	-109

NOTE
Frostbite occurs in 15 minutes or less.

Wind chill (°F) = $35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$
T = *Temperature (°F)*
V = *Wind Speed (miles per hour)*

HUMIDITY

Humidity is the amount of moisture in the air. All air holds water vapor—the warmer the air, the more moisture it can hold. When the air has all the water vapor that it can hold, the air is saturated (i.e., 100 percent relative humidity). If the air is then cooled, the water molecules join to create water droplets that can be seen; the temperature at which this happens is called the saturation point or dew point. This point varies depending on the amount of water vapor and the temperature of the air.

Adiabatic Lapse Rate

The adiabatic lapse rate is the rate that air cools (-) on ascent and warms (+) on descent. The rate also varies depending on the air's moisture content (see Figure 1-2). Saturated air cools at 3.2 °F per 1,000 feet; dry air cools at 5.5 °F per 1,000 feet.

> NOTE: Small-unit leaders should use 4 °F as the basic combat planning factor for the adiabatic lapse rate. This is because condensation and moisture causes the air to cool at a slower rate and then warms the air at a slower rate until the moisture evaporates, illustrating adiabatic cooling and warming.

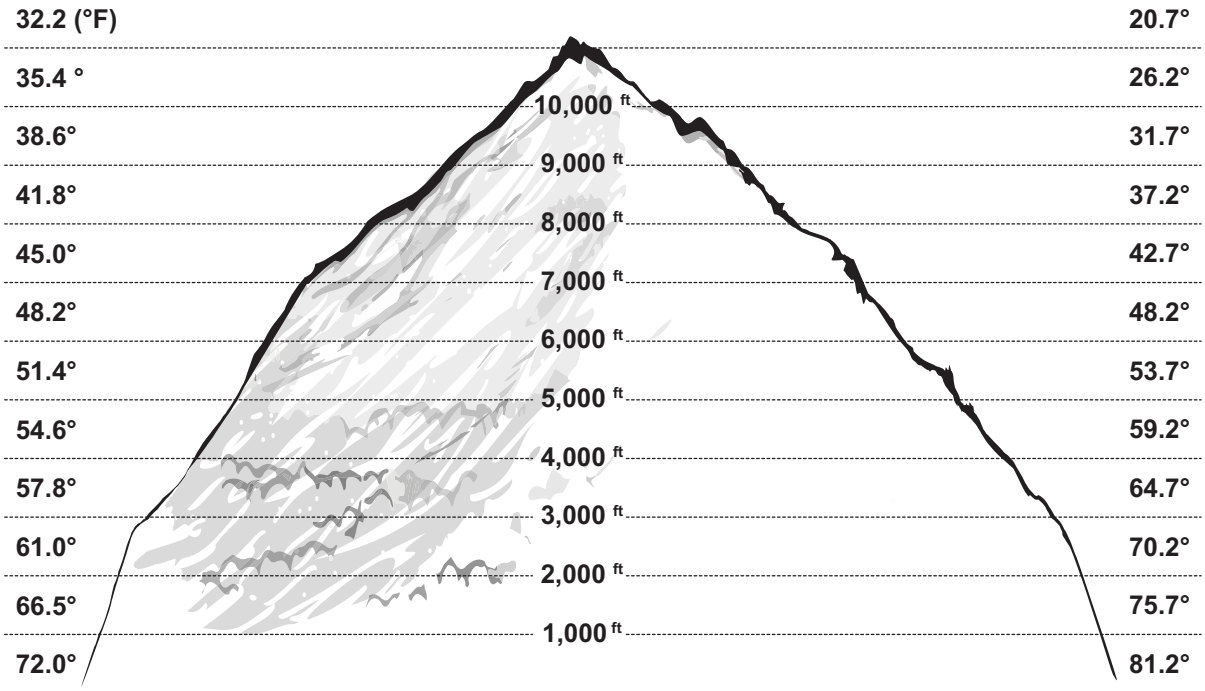


Figure 1-2. Adiabatic Lapse Rate.

VARIABLES OF DRY AND MOIST AIR LAPSE RATES

The key variable affecting both dry and moist air lapse rates is temperature, specifically the rate at which temperature decreases with increasing altitude. The main difference being that moist air cools at a slower rate because of the release of latent heat during condensation, making the moist adiabatic lapse rate significantly lower than the dry adiabatic lapse rate; other contributing factors include pressure and humidity levels within the air parcel.

Pressure

Air pressure is the atmosphere's weight at any given place. High pressure generally indicates fair weather and low pressure generally indicates inclement weather.

Air in the atmosphere acts like a liquid. Areas with a high level of this "liquid" exert more pressure on the earth; hence, they are called high-pressure areas. Areas with a lower level are be called low-pressure areas. To equalize, the areas of high pressure push out to the areas of low pressure; high pressure area flows out to equalize pressure, low pressure area flows in to equalize pressure.

The air from the high-pressure area gradually flows out to equalize its pressure with the surrounding air, while the low pressure builds vertically. Once the low has achieved equal pressure, it cannot stop and continues to build vertically, causing turbulence and inclement weather.

> NOTE: Weather maps indicate these differences in pressure with contour lines. These contour lines are called isobars and are translated to mean "equal pressure area." Areas of high pressure are called ridges and areas of low pressure are called troughs or depressions.

Pressure is measured in millibars or inches-mercury. The air pressure decreases as the altitude increases. For example, at 18,000 feet, the pressure would be 500 millibars vice 1,013 millibars at 5,000 feet.

Lifting and Cooling

The amount of moisture in the air depends on the temperature. If air is cooled beyond its saturation point, it must release this moisture in one form or another, such as through rain, snow, fog, or dew. There are three ways that air can be lifted and cooled beyond its saturation point:

- Orographic Uplift. This uplift happens when an air mass is pushed up and over a mass of higher ground, such as a mountain (see Figure 1-3). Due to the adiabatic lapse rate, the air cools as altitude increases and, when it reaches its saturation point, produces precipitation.
- Convection Effects. Convection effects typically occur in the summer because the sun heats the Earth's surface, causing the air currents to push straight up and lift air to a point of saturation (see Figure 1-4).
- Frontal lifting. Frontal lifting occurs when two air masses with different moisture levels and temperatures collide. Since the air masses do not mix, the warmer air is forced upward (see Figure 1-5). Once there, it is cooled and then reaches its saturation point.

Most precipitation comes from frontal lifting. However, a combination of the lifting types is normal.

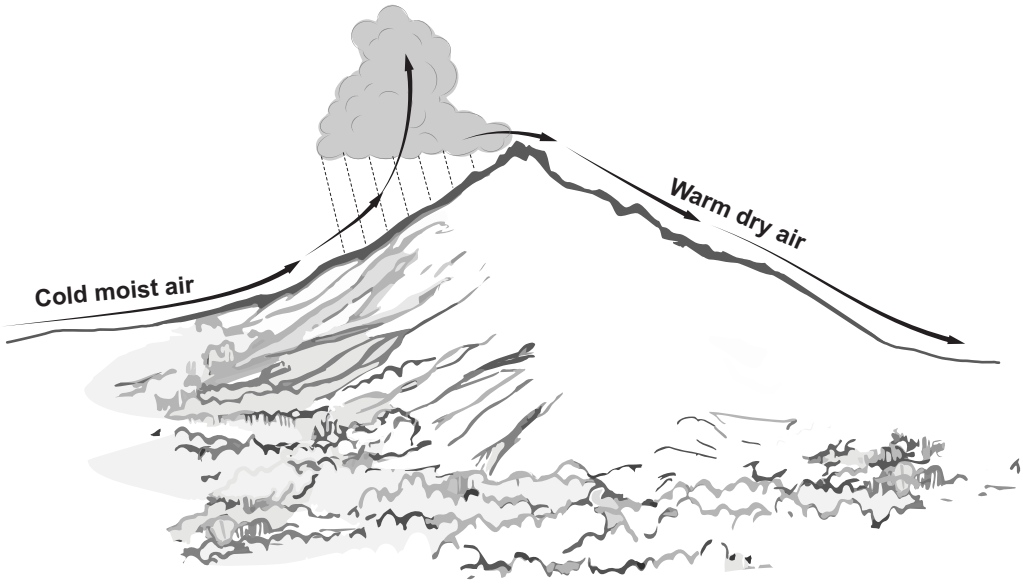


Figure 1-3. Orographic Uplift.

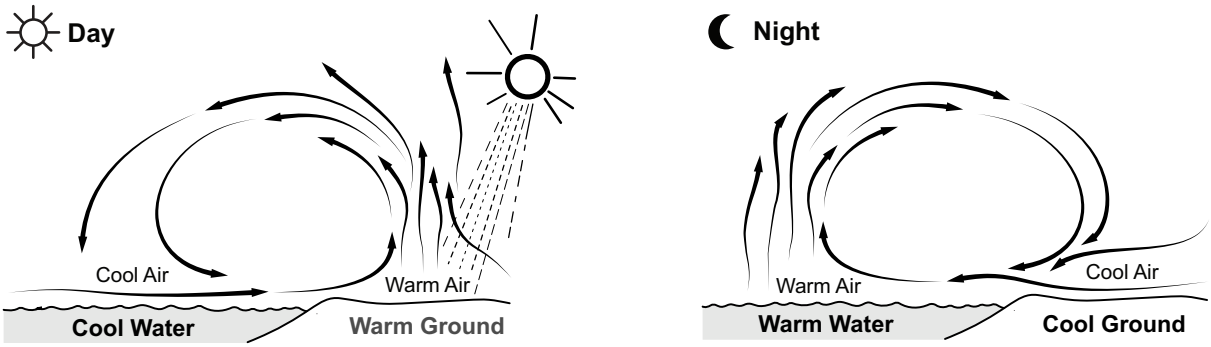


Figure 1-4. Convection Effects.

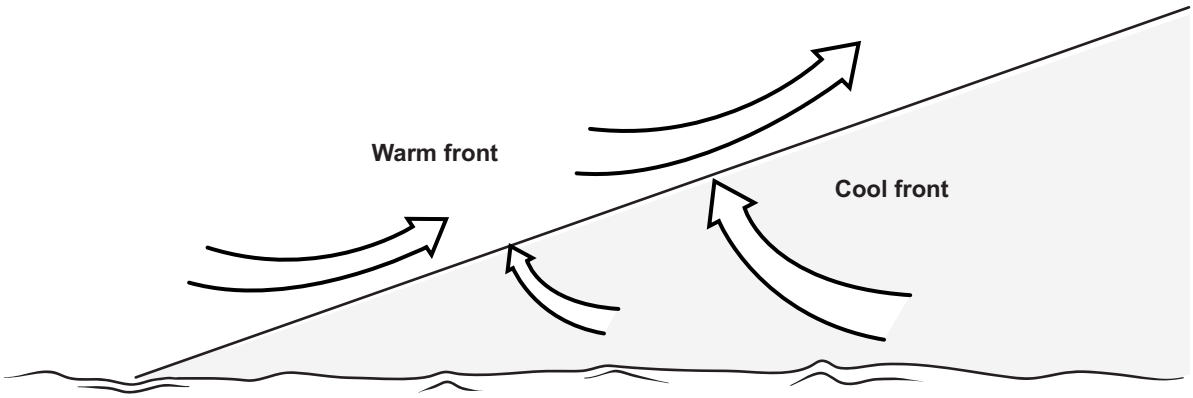


Figure 1-5. Frontal Lifting.

CLOUDS

When air is lifted or cooled beyond its saturation point (100 percent relative humidity), clouds are formed. They are classified by height, appearance, or the amount of vertical or horizontal area covered. In general, clouds are named using Latin roots: cirrus (ringlet) is used to designate wispy clouds; cumulus (heap) refers to puffy clouds; and sheet-like clouds are referred to as stratus (layer). Rain clouds contain the prefix or suffix nimbus, which means rainstorm.

Cirrus

Cirrus clouds are formed of ice crystals at high altitudes (usually 20,000 to 35,000 feet) but are thin, feathery looking clouds at the mid-altitudes. Because cirrus clouds can build hundreds of miles in advance of a front (cold, warm, or occluded), they can indicate approaching inclement weather up to 24 hours in advance.

Cirrus clouds look thin, frail, and feathery (see Figure 1-6). Types of cirrus clouds include sculpted (such as mare-tails and lenticulars), which show high winds in the upper atmosphere, and dense cirrus layers or scattered tufts, which are signs of fair weather.

Figure 1-6. Cirrus Clouds.

Cumulus

Cumulus clouds are formed by rising air currents and are prevalent in unstable air that favors vertical development. Cumulus clouds look piled or bunched up like cotton balls (see Figure 1-7). There are three types of cumulus clouds that help to forecast the weather:

- Fair Weather Cumulus. Fair weather cumulus clouds are scattered puffs of cotton in a blue sky.
- Towering Cumulus. Towering cumulus clouds are characterized by thick, vertical development like cauliflower.
- Cumulonimbus. Cumulonimbus clouds are heavy, dark, towering, and anvil-shaped clouds that produce precipitation. These clouds are characterized by violent updrafts, which carry the tops of the clouds to extreme elevations. They are associated with short, heavy precipitation; strong winds; lightning; tornadoes; and hail.

Figure 1-7. Cumulus Clouds.

Stratus

Stratus clouds are formed when a layer of moist air is cooled below its saturation point. Stratiform clouds form mostly in horizontal layers or sheets, resisting vertical development. Stratus clouds are associated with long, light precipitation, such as drizzle or snow flurries. Stratus clouds look uniform or flat, with a dull, gray appearance that resembles fog (see Figure 1-8).

Figure 1-8. Stratus Clouds.

FRONTS

Fronts happen when two air masses that have different moisture and temperature content interact. Marines can identify a frontal lift by observing the clouds' progressions.

Warm Front

A warm front occurs when warm air moves into and over a slower (or stationary) cool air mass. Since warm air is less dense, it rises above the cool air (see Figure 1-9), producing a cirrus cloud. When it starts rising, the cloud becomes stratus. As the warm air mass moves over the cooler air, it is forced to rise, which cools it down and increases the relative humidity, leading to condensation and cloud formation. As the moisture level increases, it darkens and becomes nimbostratus, which means rain from thunder clouds. The cloud progression for a warm front is cirrus to stratus to nimbostratus.

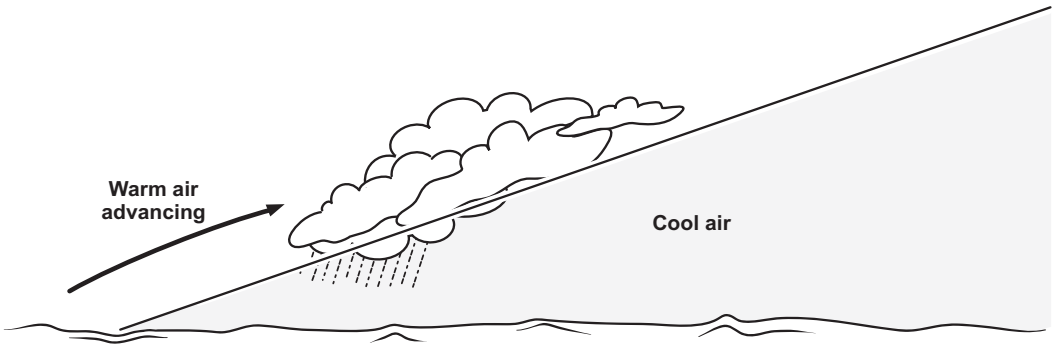


Figure 1-9. Warm Front.

Cold Front

A cold front occurs when a cold air mass (colder than the ground over which it is traveling) over-takes a warm air mass that is stationary or moving slowly. This denser cold air moves under the warm air (pushing the warm air higher) creating clouds of vertical extent compared to the elongated clouds from a warm front (see Figure 1-10). The cloud progression for a cold front is cirrus to cirrocumulus to cumulus to cumulonimbus.

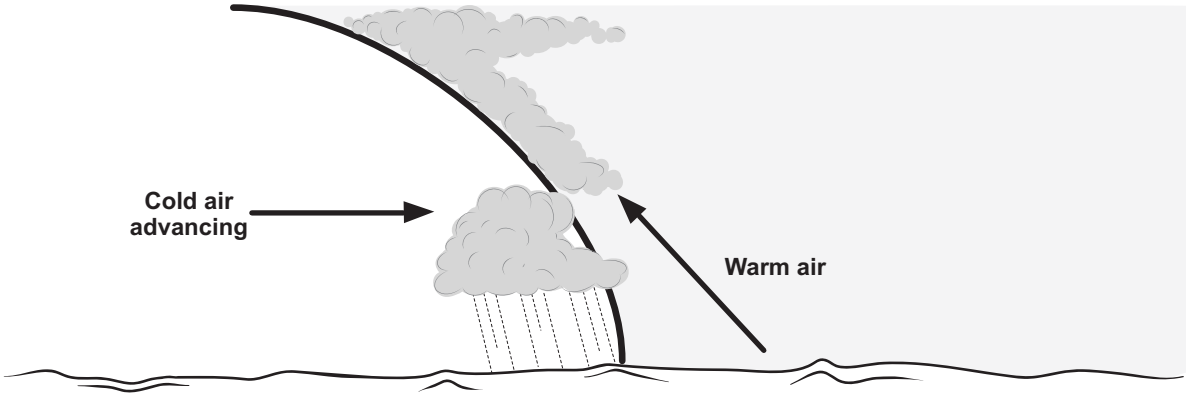


Figure 1-10. Cold Front.

Occluded Fronts

Cold fronts move faster than warm ones; eventually, a cold front overtakes a warm front, and the warm air becomes progressively lifted from the surface. The divide between cold air ahead and cold air behind is called a cold occlusion. If the air behind the front is warmer than ahead, it is a warm occlusion. The cloud progression for an occluded front is a combination of both progressions from a warm and cold front. The cloud progression for a cold front is cirrus to cirrocumulus to cumulus to cumulonimbus and the cloud progression for a warm front is cirrus to stratus to nimbostratus.

In an occluded front, cloud progression typically starts with high cirrus clouds ahead of the front, gradually thickening into cirrostratus and altostratus, eventually lowering to form a widespread layer of nimbostratus clouds. An occluded front often brings steady precipitation as it progresses, with potential for more convective clouds like cumulonimbus depending on atmospheric conditions. The warm air mass being lifted by the advancing cold front produces a broad layer of stratiform clouds with potential for heavier precipitation depending on the stability of the lifted air. However, orographic uplift can deceive the observer about the type of front as it can combine the progression of clouds leading to a warm front with orographic cumulus clouds.

WEATHER INDICATORS

Air Pressure

A change in the air pressure typically indicates a weather change. Low pressure or dropping pressure usually indicates deteriorating weather, whereas high pressure usually indicates good weather or clearing of bad weather.

Marines can monitor air pressure using the following methods:

- Barometer. A barometer is an instrument that measures atmospheric pressure. It is typically used for forecasting the weather and determining altitude. If the barometric pressure rises above normal, it would be considered a high-pressure reading.
- Altimeter. An altimeter is an instrument that measures altitude by measuring barometric pressure. It works by comparing the pressure of the air outside to the standard pressure of air at sea level. Mountaineers commonly use an altimeter; as the Marine climbs and rises in elevation, the pressure lessens, causing the altimeter's needle to rise. When the needle rises while the Marine is stationary, it indicates a lower pressure area.
- Observing Contrail Lines. A basic way for identifying a low-pressure area is to note the contrail lines from jet aircraft. If they do not dissipate within two hours, there is low pressure in the area. On days where the contrails disappear quickly or do not even form, Marines can expect continuing good weather; on days where they persist, a change in the weather pattern might be expected.
- Watching for Progressively Invading Cirrus. Progressively invading cirrus clouds are another indicator of low pressure and indicate a large area of moist air at high levels. Thick cirrus clouds are often associated with spreading from the tops of large storm complexes.

  NOTE: Both contrail lines and progressively invading cirrus clouds usually occur about 24 hours before an oncoming front.

Nature

Nature generally indicates the incoming weather conditions. Using as many signs together as possible improves the prediction. However, Marines should always try to obtain an official weather forecast. Marines should gather as much information as possible and compile it along with their own experience of the area to help form a prediction of incoming weather. Signs of changing weather might include the following:

- A spider's habits can indicate what weather conditions will be within the next few hours. When the day will be fair and relatively windless, they spin long filaments over which they scout persistently. When precipitation is imminent, they shorten and tighten their snares and remain in their centers.
- Insects typically begin swarming two to four hours before a storm.
- Wild game, such as deer, elk, or coyotes, feed heavily four to six hours before a storm.
- When the smoke from a campfire, after lifting a short distance with the heated air, beats downward, a storm is approaching. Steadily rising smoke indicates fair weather.
- When the sun rises in the morning and there is moisture present, the sky is red. If the wind is moving west to east, that moisture has already passed. However, this does not indicate it will not rain. When the sun sets in the west and there is moisture in the sky, the sunset is red. If the winds are moving west to east, it means that the moisture in the west making the sky red will move east and possibly form as clouds later.
- A gray, overcast evening sky indicates that moisture-carrying dust particles in the atmosphere have become overloaded with water, which indicates rain.
- A gray morning sky indicates dry air above the haze caused by the collecting of moisture on the dust in the lower atmosphere; one can reasonably assume a fair day.

- When the setting sun shows a green tint at the top as it sinks behind a clear horizon, fair weather is probable for most of the next 24 hours.
- A rainbow in the late afternoon indicates fair weather ahead; however, a rainbow in the morning is a sign of prolonged bad weather.
- A corona is the circle that appears around the sun or the moon. When this circle grows larger and larger, it indicates that the drops of water in the atmosphere are evaporating, and that weather will probably be clear. When this circle shrinks by the hour, it will most likely rain.
- In fair weather, air currents flow down streams and hillsides in the early morning and start drifting back up near sunset. Any reversal of these directions indicates an oncoming storm.
- When the breeze is such that the leaves show their undersides, it is likely to storm.
- It is so quiet before a storm that distant noises can be heard more clearly. This phenomenon is due to the inactivity of wildlife a couple of hours before a storm.
- The sight of morning mist rising from ravines is a sign of clear weather the rest of the day.
- When there is a heavy dew or frost, there likely won't be rain or snow because the moisture in the air has already settled (in the form of dew or frost).

CHAPTER 2.
LEADERSHIP IN A MOUNTAINOUS COLD-WEATHER ENVIRONMENT

LEADERSHIP CONSIDERATIONS

In addition to the Marine Corps' leadership traits and principles, there are four prevailing points essential to good leadership in a mountainous cold-weather environment:

- Pre-environmental training.
- Preparing for increased casualties.
- Understanding the unit's capabilities and limitations.
- Enhancing leadership awareness.

Pre-Environmental Training

Many of the casualties sustained in mountainous and cold weather environments result from Marines and Sailors not being physically and mentally prepared for the environment. Therefore, training for these environments should begin as soon as possible. Leaders should start the process by identifying the terrain and climatic conditions that the unit expects to encounter. Based on this information, leaders can identify specialized procedures and equipment needs specific to the environments and develop an appropriate training plan. Units can accomplish pre-environmental training using school-trained mountain leaders throughout the fleet, attending formal schools learning programs at the Marine Corps Mountain Warfare Training Center (MCMWTC), or by conducting unit-level training at the MCMWTC.

> NOTE: Master Lesson Files for mountain leaders and basic cold weather advisors to assist in pre-environmental training are available on the MCMWTC Formal Schools Sharepoint.

Learning Program Overview. Pre-environmental training is a seasonally specific curriculum (i.e., common across both individual and collective training at the MCMWTC) designed to provide students at formal schools and units conducting Service-level training exercises the minimum required knowledge and skills to succeed in mountainous, compartmentalized, high-altitude, and cold-weather environments.

The pre-environmental training curriculum consists of classes that focus on individual and small-unit leadership, environmental safety considerations, principles of use and design of issued clothing and equipment (see Chapter 13), environmentally specific gear requirements, weather effects, common injuries, and other health considerations.

The pre-environmental training curriculum is seasonally specific, covering core topics designed to enhance the students' understanding of the following:

- Mountain Leadership. Students are given a clear understanding of good and bad leadership attributes in a mountainous cold-weather environment. Additionally, they learn about various mountain leadership challenges.
- Mountain Safety. Students implement the 12 principles of mountain safety (see Chapter 12).
- Personal Cold-Weather Clothing and Equipment. Students use personal cold-weather clothing and equipment to prevent environmental injuries. See Chapter 13 for more information on personal clothing and equipment.
- Mountain Warfighting Load Requirements. Students become familiar with the six pocket items (i.e., knife, lip balm and sunscreen, sunglasses, notebook with pen or pencil, emergency ration, flashlight or headlamp), a survival kit, assault loads, combat loads and existence loads.
- Mountain Weather. Students learn to identify and recognize weather patterns that occur in a mountainous environment.
- Mountain Health Awareness. Students learn about how the human body generates and loses heat and high-altitude considerations and associated injuries. Students also learn the proper way to dispose of waste in a mountainous environment.
- Life-Sustaining Environmental Factors. Students become familiar with the life-sustaining environmental factors (i.e., fire, water, and shelter) in an emergency situation. See Marine Corps Reference Publication (MCRP) 3-05.1, *Multi-Service Tactics, Techniques, and Procedures for Survival, Evasion, and Recovery,* for more information on building fires, procuring water, and constructing shelter.

Individuals take an additional three classes for cold weather and snow-covered environments:

- Tents and Stoves. The tents and stoves course provides familiarization with the issued 4-person extreme cold weather tent and 15-person arctic shelter along with the issued small-unit expeditionary stove (SUES) and space heater, arctic (SHA) (see Chapter 13 for more information).
- Marine Corps Cold Weather Infantry Kit. Students can identify and inspect for serviceability the 14 components of the Marine Corps Cold Weather Infantry Kit (MCCWIK) and successfully employ them in a cold weather mountainous environment.
- Military Snowshoes. Students can explain the advantages and disadvantages of the military snowshoe and effectively employ them when needed.

NOTE: For information on equipment, links to product information sheets are available on the MCMWTC Sharepoint, Formal Schools page. Pre-environment training master lesson files are also available by course within the Marine Corps Management Information System training resource module or located on the MCMWTC Sharepoint, Formal Schools Page.

All together, these classes provide the foundational understanding of characteristics and concepts of the mountainous and cold weather operating environment.

Physical Conditioning. Physical fitness is also a primary consideration in pre-environmental training. Although the human body's adjustment to altitude is a lengthy process that cannot be accomplished at lower elevations, a high level of overall fitness significantly increases the body's ability to acclimate once in theater. Training should focus on developing lower body and core strength. Marines can train on circuit courses, combining cardiovascular and strength exercises, and conducting conditioning hikes over hilly terrain to train. Marching with heavy loads provides more productive conditioning than running.

Equipment Familiarization. Individual training should focus on familiarizing Marines with mountain or cold-weather clothing and equipment. Significant weather injuries result from the improper use and care of cold weather clothing. Commanders should establish standing operating procedures (SOPs) for their units prior to deployment and then refine them once the unit is in a mountainous or cold weather environment. Particular attention should be devoted to tactics and procedures for employing specialized equipment, such as tents and sleds. Additionally, Marines must consider how using specialized equipment might affect certain SOPs, such as immediate action drills. Training exercises should typically last at least 10 days to enable the unit to learn self sustainment in this environment.

Preparing for Increased Casualties

A standard Marine Corps infantry battalion suffers 15 or more injuries during summer operations and 30 or more injuries during winter operations while training at the MCMWTC.

Leaders must ensure that their units can accomplish the mission; cross-training personnel can help reduce the effect of casualties on the unit. For example, it takes three Marines to transport and operate a 60 mm mortar system. If the unit loses one or two Marines from that section, it can only employ two systems, cutting the indirect fires by one-third at the company level.

Detailed casualty evacuation (CASEVAC) and medical evacuation planning enables the unit to accomplish the mission. However, depending on the injury, environment, and terrain, moving a casualty from the point of injury to the collection point could require the Marine's entire squad and take significant time. Such movement not only endangers the mission but can be deadly for the patient. Units should include pre-planned collection points and movement routes, extraction points, alternate transportation options, and availability of litters (equipment) in their planning processes. Leaders should understand how the terrain will affect movement and ensure all levels can support the CASEVAC plan.

Individual medical training is essential because corpsmen are not always with dispersed units. Most Marines have never been exposed to many of the injuries that they might face in mountainous, cold weather environments. Marines must be trained to prevent, recognize, and provide initial treatment for high altitude and cold weather injuries.

Understanding the Unit's Capabilities and Limitations

Based on the estimate of the situation (mission, enemy, terrain and weather, troops and fire support available, time available [METT-T], as well as space and logistics considerations), Marines predict the enemy's capabilities, limitations, and most probable and most dangerous

courses of action. Leaders must spend extra time or take extra precautions to estimate and understand their unit's capabilities and limitations in a mountainous or cold-weather environment. Additionally, to accurately plan operations, they should understand the unique challenges of rugged terrain and cold conditions.

From crossing the line of departure to consolidation, Marines must strive to account for the effects of the environment on all aspects of the operation. In mountainous, cold-weather environments, leaders must consider the terrain, weather, equipment, level of training and fitness of their personnel, and exaggerated movement times. Incorporating these factors helps to accurately estimate the friendly and enemy situation and plan accordingly.

Documenting past performance can assist with future planning. Every time the unit conducts a movement, a route card should be created that predicts the movement time through specific terrain and environmental conditions. The actual performance can then be compared to the estimated time to form a database. To accurately plan operations, units should rehearse and document the results; the more variables leaders use, the more accurately they can assess the unit's abilities.

Enhancing Leadership Awareness

Rugged, mountainous terrain; high altitude; and cold weather increase the stress imposed on Marines. This stress is further complicated by the additional continuing actions and self-discipline required to survive. To avoid injuries and accomplish the mission, leaders should provide firm and proactive leadership and continuing actions.

Individual and unit discipline can be a challenge. As environmental stresses increase, individuals naturally begin to focus internally and revert to a survival mentality. Marines can become complacent and fail to execute proper continuing actions, which can lead to unserviceable equipment, increasing health problems, and loss of mission focus. Leaders maintain discipline by strictly enforcing individual and unit continuing actions.

Leadership presence is critical to troop morale. Leadership presence through inspections and supervision is required at all levels. Marines must understand that their leaders place a high priority on individual discipline and continuing actions and hold them accountable for violations of orders and SOPs. If Marines do not see their commanders personally checking the small, but important, details, they could underestimate the significance of these details.

Marines need to be kept informed. Operating in a mountainous and cold-weather environment can cause Marines to feel more disconnected from the command faster than in other environments. Marines who do not feel informed can become complacent, disgruntled, and detached from the mission. Good information flow allows subordinates to prepare and keeps leaders informed about the condition of their units.

COMMON LEADERSHIP PROBLEMS

Four negative trends associated with the highly stressful, extreme conditions in mountainous and cold weather environments are cocooning, loss of personal contact and communication, inaccurate time and space planning, and failure to adequately sustain the unit.

Cocooning

Cocooning occurs when individuals or groups begin to focus internally, being more concerned about their own comfort than achieving the mission. The monotony of the daily living routine and general inactivity are significant contributing factors. Cocooning can result in diminished situational awareness, failure to properly execute continuing actions, and a loss of mission focus. Although cocooning can occur in any environment, the unique stresses induced by the mountains and cold weather can trigger an epidemic of cocooning. To prevent cocooning leaders should pay particular attention to environmental training and physical activity. Environmental training is necessary in theater because most Marines have not been exposed to mountainous and cold weather environments and may not know how to cope with the conditions. Well-understood and rehearsed bivouac routines can make daily living less stressful and contribute to sustainable operations. Participating in physical activity, shortening watch rotations, and increasing the number of security patrols can reduce the effects of long periods of inactivity.

Loss of Personal Contact and Communication

A byproduct of cocooning is the loss of personal contact and communication. When people find temporary relief inside their shelters, they are reluctant to go back to unpleasant conditions. Leaders in this situation might not keep in touch with the condition of their unit and subordinates can become isolated. This loss of human contact and information flow degrades morale and the unit's ability to accomplish basic tasks. Therefore, leaders should keep their Marines informed, talk to their Marines at all levels, and inspect them more often than usual in adverse conditions.

Inaccurate Time and Space Planning

Inaccurate planning can skew timelines and cause Marines to suffer needlessly in the cold. Therefore, leaders must conduct realistic and detailed planning, understanding that all tasks are more difficult and time consuming in mountainous and cold weather environments than in others. Planning should be derived from past experiences to avoid repeating mistakes. Generally, if a unit lacks experience in a particular set of mountainous, cold-weather conditions, the planners should allow twice the amount of time it typically takes to complete the task when conducted on flat terrain and in warm conditions. With these factors in mind, leaders should employ back planning and timely warning orders to help subordinates to accomplish their missions.

Failure to Adequately Sustain the Unit

Well-led units and individuals are often capable of overcoming obstacles by sheer willpower; however, leaders must be aware of the potential for Marines to push themselves to the mental and physical breaking point. If leaders fail to recognize such situations and plan accordingly, they risk their unit ultimately becoming combat ineffective. Preventive care is key. Once an individual has reached the physical breaking point, rehydration takes a minimum of 6 hours, and it takes almost 24 hours for the body to recover energy from food. Mental recuperation may take significantly longer. Sustainable operations depend on the following factors:

- Mission Planning. In addition to the planning factors already discussed, selecting proper routes relative to the terrain and reducing unnecessary weight from the combat load lessens the burden on Marines.
- Logistical Support. Detailed logistical planning and coordination are essential to sustainable operations. The logistical requirements for an operation can be significantly reduced if the units are properly trained and can efficiently use the available resources (see Chapter 11 for additional logistics considerations).

COMMUNICATIONS CONSIDERATIONS

To execute command and control during mountain and cold weather operations, battalion and company leadership must address the following planning considerations:

- Communication equipment.
- Communication maintenance and supplies.
- Safety.
- The equipment load that communications personnel must carry in addition to their required personal equipment.
- Communication plans.
- Additional personnel and equipment needed to staff retransmission sites and to conduct mountain-picketing operations.
- Command group communication system configurations.

Additional planning and communications information is discussed in Marine Corps Tactical Publication (MCTP) 12-10A, *Mountain Warfare*.

Radio

Radios are the most common means of communicating; however, they are subject to many problems in the cold. Two major problems are reduced battery power and increased equipment failure.

Nonlithium Batteries. Nonlithium batteries, typically alkaline, lose capacity and produce less power if not protected from extreme cold weather (ECW).

Spare batteries should be stored inside heated shelters at a temperature above 10 °F and warmed before use. One spare set of batteries should be carried in a parka or trouser pocket between the body and outside layer of protective clothing. They should never be placed in the snow or unprotected against the shell of a sled. If snow covers the pressure release cover on the radio battery box, ice might form over it, which can restrict air exchange.

The batteries should be rotated every 4 hours and labeled with the amount of time used. Log entries should be made when batteries are changed.

Lithium Batteries. Lithium batteries are superior to nonlithium in the cold. They are lighter, last longer, and perform best when kept cool (but not cold or freezing). Lithium batteries are a hazardous material and could explode because of physical or electrical abuse, such as crushing, puncturing, short circuiting, overcharging, or over discharging.

Batteries can be stored at a temperature between -40 °F and 160 °F and should be serialized and accounted for during and after each use. Radio operators should keep batteries in a plastic bag and repack the battery for turn-in once it is depleted. Repacking protects the battery from moisture.

Rechargeable batteries should be kept warm, even when depleted. The cold can crack an internal gas tube, rendering them non-chargeable.

A lithium battery's performance starts to degrade (as much as 50 percent capacity) at temperatures below -4 °F. If high power is needed below -4 °F, then batteries might need to be warmed.

Material Failures. To maximize materials in cold-weather environments, Marines should consider the following:

- Radio equipment becomes brittle and susceptible to breakage at temperatures below 10 °F.
- Antennae (10-foot whip) can break during movement in thick vegetation.
- Coaxial cables, connectors, and antenna elements must have a thin coat of silicone lubricant.
- The handset cable and connector must have a thin coat of silicone lubricant.
- Press-to-talk buttons are subject to sticking in freezing weather. Radio operators should carry a spare handset.
- Microphones need to be protected from moisture. Covers for handsets should be used to prevent moisture from freezing in the microphone, or a plastic bag can be wrapped around the handset.
- Radios, remote sets, telephones, and cryptographic equipment should be kept off ice and snow.
- Radio remote antenna stations should use an ECW tent at the antenna station to keep the radio equipment warm.
- Insulated cold weather bags should be fabricated for radios and equipment if a tent cannot be used.
- Radio equipment should not be transferred from 0 °F into warm tents above 40 °F because the equipment condenses, causing moisture to short the radio circuitry.
- Frost should be removed from the equipment before bringing it into the tent.
- Operators must gradually warm equipment and batteries.
- Radio equipment should not be turned off at night if on-line and if needed for operation in the morning unless equipment is in temperatures above 10 °F.

Polar regions are subject to electromagnetic disturbances that affect radio reception. Therefore, operators should be familiar with their radio equipment and should keep it clean, dry, and as warm as possible to get the best performance from radio sets. Operators should ensure that—

- Plugs and jacks are clean.
- Antenna connections are tight.
- Insulators are dry and clean.
- Snow and ice are removed.
- Power connections are tight.
- Motors and fans turn freely.
- Knobs and controls operate easily.
- Batteries are fresh and warm, and there are spares on hand.
- Breath shields are installed on all handsets.
- Cables and wires are coated with silicone.

Messenger

Messengers provide the most secure means of communication; however, messengers can be limited by adverse terrain and weather. Every Marine is a messenger, particularly commanders who attend regular meetings. Using messengers should be preplanned, and messengers should consider the following factors when in mountainous, cold weather environments:

- The Enemy. What are the enemy's capabilities, equipment limitations, and numbers?
- Weather Effects. How might weather hinder or assist the messenger?
- Personal Survival. Messengers must have the proper equipment. An estimated time of arrival and return must be determined, and contingency plans made for delays.
- Transportation Over the Snow. Over-the-snow-capable transportation should be used, if possible. The messenger must be properly trained in the use of snowshoes or skis and familiar with the terrain and with mountain and arctic navigation.
- Wild Animals. Is there a threat from predators or other wildlife?

Visual Communication

In a cold weather environment, visual communications can be rendered ineffective by blowing snow, such as whiteouts. Visual signals should be prearranged and stated in the operations order. Some visual communications include—

- Panel Markers. Panel markers are fluorescent orange and pink and are excellent for ground-to-air signals by the air control party teams.
- Pyrotechnics. Red and green colors can be most easily seen against a snow-covered background. A red signal is the international signal for distress or emergency.

Employment varies based on the tactical situation and availability; leaders should consider visual indicators that unmanned aerial systems, aircraft, and Marines can easily identify.

Audio

Sound signals can be used in a cold weather environment; however, they must be kept brief and simple to prevent misunderstanding. Examples of audio signaling devices include—

- Whistles. Whistles have a limited range, but they are small and lightweight for use while on the move.
- Sirens. Sirens are suitable for use in forward operating bases.
- Loudspeakers. Can be used for deception efforts.

Maintenance

Preventive maintenance is essential to ensure communications equipment can operate in cold weather. Maintenance considerations include the following:

- Limited Technical Inspection. Marines must conduct a second-level, limited technical inspection on equipment before using it in the field.
- Daily Preventive Maintenance. Personnel operating communication equipment in the field must perform daily preventive maintenance.

- Communication Contact Team. The communication contact team should attach to the logistic train to provide maintenance support for the infantry companies and attachments.
- Maintenance Personnel. The communication contact team and headquarters groups must have maintenance personnel attached and enough pre-expended bin items and supplies. Such supplies include handsets, coaxial cable, connectors, whip and base antennas, silicone lubricant, plastic bags, duct tape, dry cloth, erasers, pencils, special cold weather electrical tape, and batteries.

Safety

There are four primary safety precautions when operating communications equipment in cold weather:

- Do not touch metal parts on communications equipment with bare hands when temperatures are below freezing.
- Construct antennas to be windproof.
- Ensure that the high frequency equipment is properly grounded.
- Check the exhaust system to ensure proper ventilation when the AN/MRC (a vehicle-mounted, integrated, multichannel system that provides two-way, secure, digital wideband transmission with two radios per system) communications equipment vehicle is operating constantly.

Equipment Load

During foot-mobile operations, the battalion and company communication personnel might carry additional communications equipment (Table 2-1) along with the required cold weather pack.

Table 2-1. Additional Communications Equipment.

Quantity	Equipment	Weight (Pounds)
1	AN/PRC-160 with battery	9.1
1	AN/PRC-150 with batteries	17.2
1	AN/PRC-117G with battery	12
1	AN/PRC-117F with batteries	15.9
1	AN/PRC-163 with battery	2.75
1	AN/PRC-152 with battery	2.5
1	BB-2590/U	3.3

The following methods can reduce the communications equipment load on the individual Marine:

- Use logistic trains to resupply batteries, wire, preventive maintenance material, and maintenance support for the exchange of inoperable equipment.
- Spread the load among Marines of each command group tent team.

CONFIGURATIONS

Infantry battalions primarily use very high frequency (VHF) radio assets; however, when operating in a mountainous environment, the terrain greatly reduces its effectiveness. Although retransmission sites can extend the VHF assets' coverage area, the requirement for security teams at those retransmission sites often exceeds what a unit is able to provide. Therefore, units must rely on other radio assets, such as high frequency and satellite communications (SATCOM), to communicate in a mountainous environment. Unlike VHF, both high frequency and SATCOM can communicate over long distances and over terrain features.

Though SATCOM is typically easier to establish than high frequency, units generally receive a limited number of SATCOM channels, which often results in numerous individuals simultaneously trying to use a SATCOM network. To prevent the network from becoming cluttered with traffic, it is important to establish and abide by SOPs, which dictate who can talk on the network, at what time, and for what reason.

Mechanized Communications Systems

Mechanized and motorized vehicles (organic or from attached units) may provide additional equipment to what is listed on the recommended table of equipment, as well as provide transport for additional equipment. They also provide heated spaces and additional mobility capability. All vehicles must be winterized in accordance with the vehicle Technical Manual (TM) 4-33.31, *Cold Weather Maintenance Operations*.

Communications Equipment Vehicles. When communications vehicle engines remain off in temperatures below 0 °F for more than 4 or 5 hours, operators must allow 10 to 15 minutes at a constant idle for the vehicles to warm. Once the vehicles are operating, operators should allow 5 to 10 minutes for the high frequency, VHF, or ultra-high frequency (UHF) mobile radios to warm up. If the radio does not transmit ("key out"), the problem may be that the radio set is not warm enough. Operators should start the vehicles every 1 to 2 hours for 5 to 10 minutes to prevent vehicle and radio components from freezing. All high-frequency communications vehicles contain pioneer gear—a pick, sledgehammer, two 4- to 6-foot grounding stakes, and salt.

Light Armored Vehicle. The light armored vehicle (LAV) is equipped with chains and is mobile both on and off the roads in shallow snow (less than one foot). Self-recovery capabilities of LAVs make them ideal for quick displacement. In snow deeper than one foot, they can become road bound. These same characteristics are applicable to the amphibious combat vehicle (ACV) in these environments.

Small-Unit Support Vehicle. The small-unit support vehicle (SUSV) provides exceptional combat operations center capabilities, command post displacement capabilities, and off-road capabilities. These vehicles are used by the Marine Corps with host-nation support and are prepositioned in Norway. Radios used in the SUSV for command and control must be provided from the unit's table of equipment. Mechanized infantry operations in mountainous terrain should be supported by SUSVs or a similar type of over-the-snow vehicle.

CHAPTER 3.
MOVEMENT AND NAVIGATION

Individual movement in the mountains is considerably more strenuous than movement on flat terrain. Marines can use certain techniques to conserve energy and prevent injuries during mountain movements.

FUNDAMENTALS OF INDIVIDUAL MOVEMENT IN MOUNTAINOUS TERRAIN

The following principles apply while walking in mountainous terrain:

- Always maintain body weight over the feet. This technique places the body's weight on the skeletal system and avoids unnecessary strain on muscles. Leaning forward or backward places the weight on the muscular system and expends additional energy.
- Avoid walking up and down microterrain (small projections, such as fallen trees or boulders, that a Marine could step over or go around). Although these steps up and down are small, the excess expenditure of energy compounds over long movements.
- Step over, rather than on top of, obstacles, such as large rocks and fallen trees, to avoid excess energy expenditure.
- Make use of the rest step; lock the rear leg out with each step allowing the leg muscles to relax. The aim of the rest step is to rest the body weight onto the skeletal frame. The use of the rest step can reduce energy expenditure.

WALKING TECHNIQUES

The herringbone, half-herringbone, and plunge steps are walking techniques that Marines can use in mountainous terrain.

Herringbone

A herringbone step pattern helps Marines maintain balance and keep their feet flat while ascending a slope. Toes are pointed outward to allow the heel to rest and avoid walking on the toes. Walking on the toes can tire the calf muscles.

Half-Herringbone

The half-herringbone step pattern helps Marines maintain balance and keep their feet flat while traversing a slope. Ankles turned away from the hill with the uphill foot pointed in the direction of travel while the downhill foot stays at a comfortable downhill angle to maintain good sole to ground contact.

Plunge Step

Marines should use the plunge step when moving down loose slopes. Facing downhill, the traveler should step assertively away from the slope and land on the heel, transferring weight to the new position. The lower leg takes all the weight while the upper leg is used for balance only. Leaning back into the slope should be avoided because it can result in slipping or falling. When using the plunge step, the knees should be kept bent to help maintain balance.

SKI POLES

Marines can use ski poles to help maintain balance when moving with a heavy pack over slippery, rough, and loose ground or when crossing a stream. They provide hikers a boost while moving up a slope and take some of the weight off the lower body while descending. If used properly, they can significantly decrease energy expenditure and reduce lower body injuries. They should only be used during situations when enemy contact is not likely. The following are additional considerations and best practices:

- Gripping the Ski Pole. Slide the hand up through the wrist strap and grab the handgrip and the upper portion of the strap together. The bottom of the palm should rest on top of the middle portion of the strap. The bottom of the wrist strap should feel snug around the wrist.
- Uphill and Flat Ground Use. Gripping the pole, extend the arms forward with a slight bend at the elbow. While walking, maintain natural arm swing and plant the pole next to the feet. When stepping forward, pull down on the planted pole while keeping the arms close to the sides to aid movement forward or up the slope.
- Downhill Use. Lean at the waist and plant the poles to the front to aid with balance and to transfer part of the weight from the lower body to the poles themselves.
- Traversing Use. On a traverse, the uphill ski pole should be held along the shaft versus the handgrip to accommodate for the slope angle.
- Negotiating Obstacles. When negotiating small obstacles, the wrists can be left in the wrist straps while the hands are used for balance. When moving through thick vegetation, ski poles should not be used.
- Weapons Use. When employing rifles, ski poles can be crossed to provide a stable bipod for supported firing.

MOVEMENT IN MOUNTAINOUS TERRAIN

While conducting movement in mountainous terrain, Marine leaders should select the appropriate uniform, set the pace, ensure the unit takes breaks, and select the appropriate formation.

Uniform

Individuals should begin a movement dressed in light layers, as they generate body heat while moving. A vapor transmission layer should be worn next to the skin. A warming and protective layer should also be readily available to wear during breaks. The amount of personal protective equipment to be worn must be considered. Often, in mountainous terrain, it is advisable to lighten the personal protective equipment load to enable effective movement and maneuver.

Mountain Pace

Mountain pace is the rate at which all members within the group can travel together for the duration of the movement. This pace can vary but is generally much slower than on flat terrain.

Breaks

Factors that may affect the frequency and length of rest stops include the Marines' physical condition, load weights, terrain, and weather conditions. The following recommendations apply to breaks while conducting movement on rugged terrain:

- The members of the movement should be given a chance to adjust their layering after 10 to 15 minutes of movement with a 2-minute break. Breaks also provide troops the opportunity to make any gear adjustment.
- After the initial break, a 5-minute rest stop should be taken after every 30 minutes of movement, or as required.
- A longer break of 10 to 20 minutes should be taken after every two or three short breaks, or as required.
- When possible, halts should be planned to coincide with water resupply at streams or at positions where Marines can observe key areas along the route.

Formations

See MCRP 3-10A.3, *Marine Infantry Platoon*, for detailed information on tactical formations.

TYPES OF SLOPES

The following are the basic types of slopes commonly encountered in a mountainous environment, whether above or below the tree line:

- Hard Ground. Hard ground is a slope of firmly packed dirt with vegetation that does not give way underfoot.
- Grassy. A grassy slope is covered with scattered clumps of grass known as tussocks.
- Scree. A scree slope consists of small rocks and gravel, which have collected below a rock ridge or cliff. The size of the rocks varies from sand size to rocks about the size of a fist.
- Talus. A talus slope is like a scree slope, but the rocks are fist size or larger.

Hard Ground

Ascending. Marines should maximum use of the rest steps by locking out the knee to relieve the muscle and use bone support to support the body. If the slope is gentle, Marines may be able to walk straight up the slope; however, as the slope becomes steeper, they should employ the herringbone technique.

Unless restricted by terrain, steep slopes should be traversed (i.e., zigzagging) rather than climbed straight up. While moving horizontally across the slope, the traveler steps up with the uphill foot and, when turning at the end of a traverse, steps off in the new direction with the uphill foot. This pattern prevents crossing the feet and losing balance. When traversing uphill, travelers should not exceed an angle of 15 degrees. Traversing is intended to allow alternate legs to rest.

Descending. The rate of descent should be controllable. It is usually easiest to come straight down a hard ground slope without traversing; however, if the slope becomes too steep, traversing may be safer to avoid descending uncontrollably. Marines should keep their backs straight and their knees bent so their legs act as shock absorbers for each step.

Grassy Slopes

Ascending. When ascending a grassy slope, the techniques described for hard ground slopes should be used (i.e., stepping on the uphill side of each clump or mound of grass where the ground tends to be more level and firm).

Descending. Because grassy slopes are typically uneven, individuals can quickly gain speed and lose control while descending. The plunge step should be used to traverse the descending slope.

Scree Slopes

Ascending. Marines should avoid ascending scree slopes because they do not provide stable footing. When it is necessary to cross a scree slope, Marines should traverse the area to reduce energy expenditure. Hard ground principles apply with the addition that each step must be chosen carefully and placed slowly so that the foot does not slide down when weight is placed on it. To do this, the Marine kicks in the toe of the upper foot so that a step is formed in the scree. After determining that the step is stable, the Marine carefully transfers weight from the lower foot to the upper foot and repeats the process. On a traverse, step kicking with an edged sole is more effective than flat footing. Marines should stay close together so that rocks—should they become dislodged—can be halted (depending on the size) or directed away from the group before they can gain speed and momentum. When traversing, the unit should stay close together with all personnel completing a switchback before starting another traverse leg. However, if this not possible, then one person traverses a leg at a time and then that person should warn others below about any dislodged rocks by yelling "ROCK!".

Descending. Scree fields often make a good descent route. Marines should not run down a scree slope because they can lose control, which can result in injury. Instead, Marines should use the plunge step to come straight down a scree slope. Screeing is a technique that is both timesaving and energy efficient. To conduct screeing, the slope must be sufficiently steep and the run-out zone visible and hazard-free. This technique resembles skiing. The feet are shuffled along, allowing the small rocks to break away and pile up underfoot. Momentum must be maintained to "ride" the descending rock pile in a standing position. The small rockslides created should not present a significant hazard as long as personnel stay close together.

NOTE: If a rock fall hazard is present, Marine should wear helmets.

Talus Slopes

Ascending. Marines should always step on the top of the uphill side of the rocks to prevent them from tilting and rolling downhill. Marines should stay close together so that rocks—should they become dislodged—can be halted or directed away from the group (depending on the size) before they can gain speed and momentum. When traversing, the unit should stay close together with all personnel completing a switchback before starting another traverse leg. If this not possible, then one person traverses a leg at a time and then that person should warn others below about any dislodged rocks by yelling "ROCK!".

Descending. Marines should descend with caution. The likelihood of rock fall increases in a descent since the force placed on rocks is greater. Descent should be slow, with each step taken carefully. Just like the ascent, Marines should step on the top and uphill side of the rocks. The interval between Marines is the same as during the ascent.

NOTE: If a rock fall hazard is present, helmets should be worn.

NAVIGATION

Navigation in a cold weather environment poses unique challenges. For example, heavy snowfall can alter or hide terrain features, severe weather conditions can cause periods of limited visibility, compass reaction may be slower, and handling maps becomes increasingly difficult. The use of an altimeter in mountainous terrain is beneficial.

For Marines operating in a cold, snow-covered environment, each task becomes more difficult, and land navigation is no exception. Long nights, fog, snowfall, blizzards, and drifting snow all limit a Marine's visibility. Snow-covered ground creates a condition that makes it difficult to recognize ground features. Before beginning a movement, Marines should consider the following factors that can affect their ability to navigate:

- In cold-weather regions, visibility may be drastically reduced by long periods of darkness, snowfall, fog, and wind-driven snow. At times, overcast skies above open, snow-covered ground can produce a condition known as whiteout, where the surrounding terrain appears to blend into the sky, terrain features disappear, and depth perception becomes impossible.
- Deep snow may completely cover tracks, trails, streams, and improved roads, making them indistinguishable from one another or completely concealing their presence.
- When lakes and ponds are snow-covered, individuals might think they are solid ground. Although a body of water might have an easily recognizable and distinct shape on the map, it might not be recognizable when it is blanketed with snow.
- Drifting snow can hide small depressions or may change the appearance of small hills by collecting on the leeward side, making the hill appear to be larger or shaped differently than the map indicates.
- Imagery taken during the winter may lack detail and discernible relief or contrasts.
- Excluding population centers, maps of cold regions are generally inaccurate and outdated. In general, the cold regions of the world are sparsely populated and are characterized by limited road networks and few manufactured structures.
- Handling maps, compasses, and other navigational instruments in extreme cold temperatures is difficult because of the bulky handwear necessary to protect against cold weather injuries. Additionally, battery-operated global positioning systems (GPSs) may become unreliable or inoperable in the cold weather.
- In polar regions, there are often wide, open coastal plains or dense boreal forests. The lack of terrain features, or their total concealment by dense forest, may make terrain association difficult or impossible.

- The Earth's magnetic poles cause increased compass deflection (expressed as the grid-magnetic angle). The further north or south Marines move, the more their ability to accurately determine direction is affected. At either of the magnetic poles, the needle of a compass will continually rotate.
- Cold regions are characterized by many magnetic ore deposits that, if encountered, can cause large deviations from the grid-magnetic angle listed on maps for that area.

Marines can use the following best practices to aid navigation:

- Keep the compass warm to speed up the process of taking bearings.
- March on the back azimuth when no aiming marks exist to the front. The aiming mark may be a natural feature to the rear or an artificial aiming mark left behind by one.
- Check the compass frequently to ensure the correct bearing is maintained when visibility is limited. Only close-aiming marks can be seen. Under these conditions, the navigator should try to pick up farther-aiming marks, which can only be done accurately when the route to each mark follows a straight line. The compass should also be set for night marching.
- Measure accurately. When measuring distance, pace counting is useful only if the pacers know the length of their pace and how to convert their paces to meters. Measuring distance by a known cord length is more accurate than pacing.

Navigation Techniques

Direction method and distance measuring are two navigation techniques that have proven most successful in terrain and weather conditions characteristic of cold, mountainous regions.

Direction Method. The direction method is navigation with a compass and map. Compasses, steering marks, dead reckoning, and altimeters are tools Marines use when employing the direction method.

Compasses. Dry filled compasses are more useful in the arctic terrain because standard, liquid filled compasses can become sluggish.

> NOTE: Metal objects, such as ski poles or weapons, affect the direction the compass needle indicates.

Steering Marks. In a barren region, Marines can be sent forward as steering marks. It is easier to take a bearing on a steering mark with a compass and then march to it than it is to continually refer to the compass.

Dead Reckoning. Dead reckoning is a term to describe navigating by using a known initial position, speed and direction, and duration of movement to determine the new position. Two elements required for dead reckoning are direction and distance. Marines can locate their own positions with the formula "distance = speed x time" or by using an accurate pace count. The following equipment is needed to accomplish this technique:

- Map(s) or imagery of a known scale.
- Compass.
- Protractor.

- Route card.
- Pace counter.
- Known distance measuring cord.

Dead reckoning includes—

- Selecting the route to the objective.
- Plotting it on a map or imagery.
- Completing a route card.
- Determining an accurate pace count for the chosen method of movement, whether foot, snowshoe, or ski.

While navigating by dead reckoning, the navigator must—

- Trust the compass.
- Maintain an accurate pace count.
- Adjust the plotted route as required to negotiate obstacles.
- Record azimuths, distances, times, adjustments to the route, and any pertinent notes in the log.
- Update the log constantly during movement.
- Verify the location by terrain association or resection when possible.
- Keep route legs to under 400 meters if possible to minimize error from drift.

Altimeter and Contouring. By monitoring elevation and checking it against a topographic map, Marines can keep track of their progress, pinpoint their location, and locate intersections in their route. Marines should consider the following when using an altimeter:

- The altimeter should be calibrated at a known position before and during the march, keeping the altimeter current and accurate.
- Barometric air pressures affect the accuracy of the altimeter's reading. As air pressure rises, the altimeter reading lowers and vice versa.
- The altimeter should stay at a relatively constant temperature by carrying it next to the body, which helps prevent false readings.

Contouring in mountain navigation refers to the practice of following a specific contour line on a map to maintain a consistent elevation while traversing a slope. This enables Marines to walk along a path of equal height, thereby avoiding steep ascents and descents, making it easier to navigate and manage terrain in mountainous areas. Contouring is primarily used to prevent unnecessary elevation gain or loss. See Chapter 4 for more information about route planning and selection.

Distance Measuring. Distance measuring uses the pacing, cord, or tick-off feature method.

Pacing. When the pacing method is used, the pace must be checked against a measured distance over terrain similar to the terrain that will be encountered during movement. The pace count can be affected by the following:

- Slopes.
- Surface composition and snow density.
- Head and tail winds.
- Weight of clothing and equipment.
- Stamina.
- Proficiency level (usually only applies if wearing skis).

Cord Method. Although skis are the fastest, most energy efficient, and least tiring method of dismounted movement in snow-covered terrain, they make it difficult to maintain an accurate pace count. The most accurate method for measuring ground movement distance is the cord method.

Marines can conduct the cord method using the following steps:

- One Marine measures a piece of cord or salvaged field wire to 50 meters (approximately 164 feet).
- Two Marines run a dual point where Marine A walks forward while holding the cord as it trails behind that individual; Marine B remains in place holding the cord as an anchor.
- Once the cord is fully extended, Marine B pulls on the cord to signal that Marine A should stop and remain in place.
- Marine B walks up to the position of the fore Marine bringing the cord up with them.

> NOTE: The Marines should have moved 50 meters from their original position with the main unit body following behind them.

This cycle then repeats until the unit has reached their intended destination. The Marines may switch positions as desired, or a unit leader can assign additional members of the movement to replace the individuals.

Although the cord method might be more time consuming, it is more accurate than other methods, particularly flat open tundra areas. It is also the most effective method to maintain an accurate pace count when using over-the-snow mobility equipment.

Tick-Off Features. Tick-off features are terrain features that Marines "tick off" on the route card as they pass by them. Poor visibility may hamper this method.

CHAPTER 4.
ROUTE PLANNING AND SELECTION

Route selection is the logical or systematic approach to determining one course over another. A small-unit leader or planner is responsible for ensuring that the best route is chosen.

ROUTE CONSIDERATIONS

The eight factors to consider when selecting a route are terrain, weather, avalanche or rockslide potential, snow and melt-off conditions, unit ability, tactical situation and mission, equipment, and time.

Terrain

Planners must consider terrain contours, natural lines of drift, altitude and elevation, and vegetation and rock type when selecting a route.

Contour. In a mountainous, cold-weather environment, the lay of the land greatly affects how Marines negotiate each piece of terrain. Severe cross-compartment movement can expend energy and time and may jeopardize mission success; moreover, moving directly up or down a slope without regard for gradient could be disastrous. Although routes that follow a contour line may not be as direct as following an azimuth, they conserve valuable energy and time. Contouring also reduces the slope angle of the movement.

Natural Lines of Drift. A natural line of drift is a terrain feature that allows ease of movement. Although a natural line of drift may save time and energy, it also presents an opportunity for the enemy to establish an ambush. The decision to follow a natural line of drift should be made only after weighing the probability of ambush against the time and energy the unit might save.

Altitude and Elevation. Knowing the maximum and minimum altitude and elevation that Marines might encounter on a route can help Marines predict the weather they might encounter, likely speed of movement, necessary clothing and equipment, and the likelihood of rotary-wing assets being available to assist in emergency extracts and CASEVACs.

Vegetation and Rock Type. Planners should determine the predominant vegetation and rock type within the microterrain. The microterrain can affect the movement timeline, equipment and previous training required, fire support plan, camouflage pattern, and route selection (macro and micro).

Weather

Weather is perhaps the greatest hazard in a mountainous environment. Temperature, visibility, precipitation, and wind velocity can hamper movement and cause even the simplest tasks to become a burden, particularly security awareness. At elevations above 5,000 feet, it is not uncommon for winter-like conditions, such as snow, to suddenly occur in the middle of summer.

Avalanche and Rockslide Potential

Route planners must identify and avoid any avalanche and rockslide hazards in the area of operations. The adversary might initiate an avalanche or rockslide in an attempt to destroy friendly forces. All movement on or near critical slopes must be carefully planned. Vital information that can assist a unit leader in making an appropriate hazards analysis includes local avalanche maps; local knowledge; current weather patterns; weather patterns from the past two weeks; historical trends and forecast; and areas of loose, near-vertical rock (identified from imagery and reconnaissance). Considerations should include advance initiation by supporting arms. See Chapter 6 for more information about avalanches.

Snow and Melt-Off Conditions

Snow conditions can enhance or deteriorate a unit's ability to navigate a particular route or route segment. Unpredictable changes in the snow conditions make it difficult for combat-laden Marines to use a particular route, particularly in areas that are windswept or crusted because of temperature changes. The depth, melt-freeze cycle, slope aspect and angle, direction a slope faces, and amount of sunlight and shadow a slope receives are factors that can determine whether over-the-snow mobility is required and, if so, what type should be used.

Unit Ability

When planning a unit movement, leaders should consider the degree of slope, snow and vegetation cover, temperature, and weight of combat load and mission-essential gear (see Appendix B for equipment weights).

Tactical Situation and Mission

Speed and security measures must be balanced to match the threat condition. Leaders should consider whether to use mountain pickets, possible cross-compartment movements, and the size and type of unit using the route.

Equipment

The equipment available (assault climber's kit [mountain and glacier], sleds, ropes, skis, snowshoes, pack animals, crampons, ice axes, etc.) and the degree of training that Marines have received in using that equipment directly influence route selection.

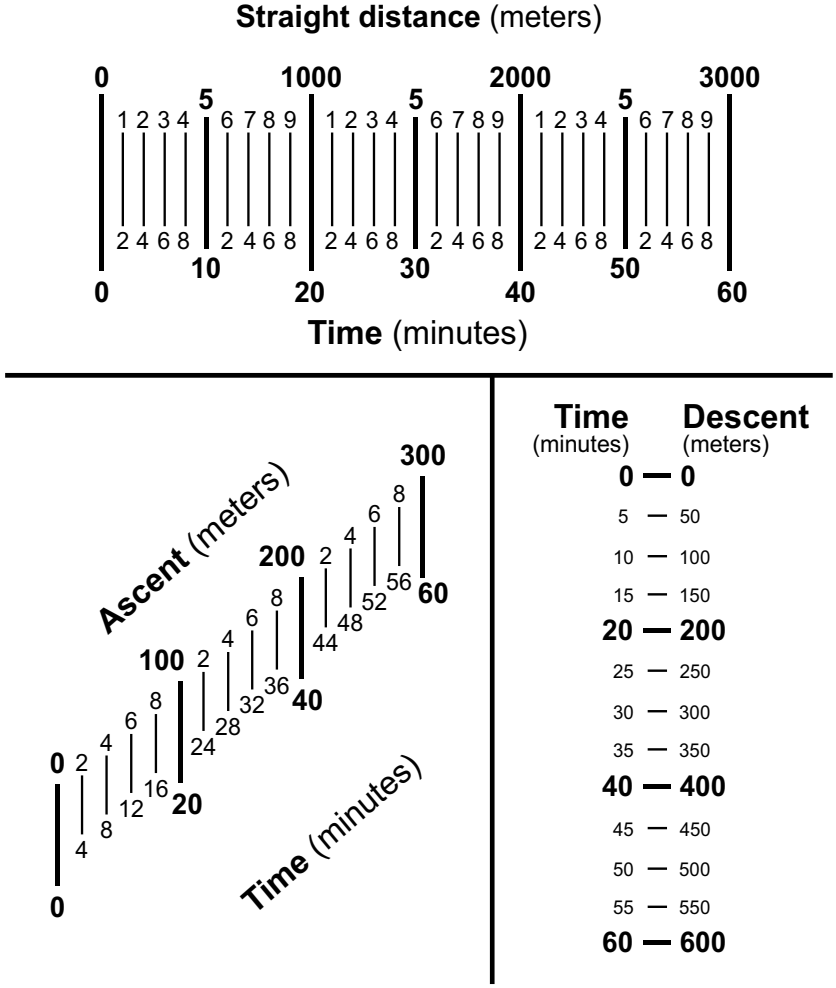
Time

Selecting a route might call for a deviation from a direct march to the objective to save time and energy, as it expends effort in distance traveled rather than overcoming obstacles. Because of the difficulty of movement in mountainous terrain, time-precedent missions are usually unrealistic in the mountains. If it is deemed necessary to conduct a time-precedent mission, a mountain leader should be placed in charge and three times the suggested personnel needed should be allocated; if additional personnel are not available, the mountain leader should task-organize a group of Marines with a high state of physical fitness and acclimatization to accomplish a time-precedent mission.

ROUTE PLANNING

When planning for unit movement in mountainous terrain, route planners must consider weather conditions and track discipline. During route planning, Marines can use the following tools:

- Map, photo, and imagery reconnaissance.
- Orders and overlays.
- Time-distance formula (TDF). See Figure 4-1 for the TDF.
- Elevation gain and loss graph.
- Track discipline (if on snow).



NOTE: Time-distance factor displayed for all scales is 3 kilometers per hour. For ascent, planners add 1 hour of travel time for every 300 meter increase in elevation. For descent, planners add 1 hour of travel time for every 400 to 600 meter decrease in elevation. The descent scale on the lower right depicts a planning factor of 1 additional hour per 600 meters of descent.

Figure 4-1. Time-Distance Formula.

Map, Photo, and Imagery Reconnaissance

Before Marines establish route description or overlays, they must conduct a thorough map, photo, and imagery study. This study should concentrate on those items peculiar to a mountainous, cold weather environment. Determining the prevailing weather patterns of the area of operations can assist in determining correlations between the snowpack and terrain. For instance, knowing that the weather generally comes from the west and southwest, Marines can conclude that most north and east facing slopes will receive the greatest deposit of snow and subsequent cornice formations.

Leaders should also consider cross-compartment movement when conducting map reconnaissance. The tactical situation and the mission may dictate establishing cross-compartment movement to contact, so attention should be directed toward skirting or avoiding avalanche-prone slopes, scree, talus, or rockslide areas and staying in the tree line. Photos and imagery are useful in identifying these types of terrain. From standard 1:50,000 or 1:25,000 maps, Marines can determine critical slopes by looking for a key indicator, such as type of slope (either convex or concave), gradient of the slope, and vegetation on that slope (obvious cuts in the tree line).

When establishing routes using a map or imagery, Marines should establish wide boundaries so the unit leader has flexibility when selecting a route. The large contour interval in mountains can hide many obstacles. Aerial photos and satellite imagery show vegetation type and coverage as well as the hidden obstacles between contour lines, such as cliffs; however, snow can obscure or completely cover linear terrain features. A flyover can give planners an understanding of the difficulty of the terrain.

Orders and Overlays

The order should include movement based on the TDF. The overlay must include critical slopes, cliffs, avalanche paths, and other natural hazards because these terrain features may be part of the adversary's barrier plan.

Time-Distance Formula

Each route should show a completed TDF; however, time to cross the route may increase because of hidden difficulties, such as streams, roads, or cross-compartments. The rate of march for individual movement (see Table 4-1) and TDF are made for acclimatized troops. Route cards should include space to write in the actual and planned time for each leg. Using these rates can enhance the ability to estimate the actual time it takes the unit to cover a certain distance.

Table 4-1. Rates of March for Individual Movement.

Movement Mode	Unbroken Trail	Broken Trail
On foot, no ski or snowshoe, less than 1 foot of snow	1–2 mph (1.5–3 kph)	1.25–3 mph (2–3 kph)
On foot, no ski or snowshoe, more than 1 foot of snow	.3–.6 mph (.5–1 kph)	1.25–3 mph (2–3 kph)
Snowshoe	1–2 mph (1.5–3 kph)	2–2.5 mph (3–4 kph)
Skiing	1–3 mph (1.5–5 kph)	1–3.75 mph (5–6 kph)
Skijoring	Not applicable	5–15 mph (8–24 kph) (for safety, 9.3 mph, or 15 kph is the highest recommended speed)
NOTE Add 1 hour for every 1000 feet (300 meters) of ascent and 1 hour for every 2000 feet (600 meters) of descent.		
LEGEND kph kilometers per hour mph miles per hour		

Elevation Gain and Loss Graph

The elevation gain and loss graph is made using graph paper or a ruler to plot out elevation from a map in a profile. It gives the Marine a "side" view of the terrain on the route, instead of the typical top-down map view. This perspective is helpful in recognizing how much up and down movement is on a route.

Track Discipline (When on Snow)

Not all tracks can be hidden in the snow. Therefore, units should consider taking routes below the tree line or on the windward side above the tree line. Selecting either the British technique of a single track on which all stay in line or the Finnish technique of taking multiple tracks in all directions affects time estimates for the route.

GENERAL CONSIDERATIONS

Leaders should consider the following during route planning:

- Terrain Negotiation. By traversing slopes early, Marines eliminate the necessity for sudden gains or losses in elevation, which ultimately adds several minutes or hours to a previously short move. It may be more efficient to contour around an object, such as a slope, draw, or finger, than to travel in a straight line and may prevent unnecessary loss or gain in elevation. When descending slopes of scree or snow, the plunge step should be used.
- Narrow Depressions. Marines should contour in and out of narrow depressions.
- Waterways and Lakes. A frozen body of water makes an ideal avenue of approach; otherwise, it is a large obstacle. See Chapter 5 for guidelines about crossing water obstacles.
- Commander's Log and Route Card. A commander's log (see Figure 4-2) and a route card (see Figure 4-3) are tools to develop understanding of the unit's ability and available capabilities. A copy should be completed for every route done by the entire unit or any subordinate unit to create a more accurate the time-distance estimation.

FOR TIME-DISTANCE ESTIMATION IN MOUNTAINOUS AND SNOW-COVERED TERRAIN:
(Attach route overlay/route card, if possible) UNIT:
DISTANCE (map):
ELEVATION GAIN, TOTAL:
ELEVATION LOSS, TOTAL:
WEATHER CONDITIONS (winds, precipitation, humidity, day/night):
TEMPERATURE (high and low):
ALTITUDE (high and low):
SNOW CONDITIONS (depth, hardness/flotation, dry/wet):
OVER-THE-SNOW MOBILITY EQUIPMENT (skis, snowshoes, sleds, combat boots, vapor barrier boots, skiboots, skins, wax):
REMARKS:

Figure 4-2. Commander's Log Example.

ROUTE CARD								
UNIT ID		UNIT CDR		# OF PERS		DTG		MAP REF
CHECK POINT	AZIMUTH	DIST	GRID LOCATION	ELEV GAIN	ELEV LOSS	ET	AT	DESCRIPTION

TOTALS:
DIST_____ ELEV GAIN_____ ELEV LOSS_____ ET _____AT_____

LEGEND

AT	actual time	**ET**	estimated time
CDR	commander	**ID**	identification
DIST	distance	**PERS**	personnel
DTG	date-time group	**REF**	reference
ELEV	elevation		

Figure 4-3. Route Card Template.

CHAPTER 5.
CROSSING WATER OBSTACLES

CROSSING STREAMS AND RIVERS

Mountain streams and rivers are obstacles and danger areas for units crossing them. To reduce the time a unit spends in a danger area, a reconnaissance team should precede the main body to select the best crossing site. When selecting a site for water crossings, Marines should—

- Look for logjams, rocks, or fallen trees that can provide a dry crossing.
- Select a wide, shallow crossing point where the current is slower when a dry crossing is not possible.
- Avoid sharp bends. They can be deep with a strong current on the outside of the bend. Cross at a straight section.

  NOTE: In cases where the bends of a river form the letter "S," the safest place to cross is generally the straight section in the middle of the "S" between the bends, where, should an individual lose footing, the current is likely to carry the individual to the bank on the outside of the bend.
- Look for a firm, smooth bottom. Large rocks provide poor footing and cause turbulence in the water.
- Understand it may be easier to cross several small channels of water rather than one large one.
- Not cross just above rapids, falls, or logjams because there is an increased hazard due to slipping or falling.
- Cross in the early morning during snowy conditions. The water level tends to be lower in the morning because there has been less daylight for the snow to melt and, on sunny days, this leaves more time to dry clothing and equipment.
- Ensure there is a suitable spot downstream for safety swimmers to preposition.

In a training environment, extra safety precautions are required to minimize the injury hazard. There must be strong swimmers positioned downstream to serve as safety swimmers. Using a throw bag, the safety swimmers are positioned to rescue anyone who is swept downstream. As a last resort, safety swimmers enter the water to attempt a rescue. In swift moving water, safety swimmers use a belay line to rescue individuals. In a training scenario, the swimmers wear life jackets.

There must be a safety line at a minimum of a 45-degree angle downstream skimming the top of the water. Those who slip or are swept downstream can grab the line and pull themselves to shore. If the individual is unconscious and is caught on the line, the safety swimmer enters the water and pulls that person to safety. Refer to MCRP 7-20B.5, *Marine Corps Water Survival*, for additional information.

Safety swimmers can be stationed downstream even if the unit members are crossing a stream where they can touch the bottom with their feet. Should someone trip and start moving down-stream toward a hazard, such as a rock jam or waterfall, the safety swimmer can make a field expedient throw bag with 550 cord and a sleeping mat.

A safety line should be used whenever the stream current is strong, or if Marines cannot touch the bottom of the stream. Marines attach themselves to the line and stay together as they glide across the stream.

Individual Crossing Preparations and Methods

Individual Preparations. Before crossing a stream, Marines take the following precautions—

- Wear their pack with shoulder straps tightly fastened. Waterproof the pack for buoyancy, if possible.
- Sling weapons diagonally over the shoulder between the pack and the individual's back.
- Button all pockets and remove blousing garters to prevent the water from flowing into open pockets and creating added drag.
- Wear boots to protect the feet but remove socks and insoles to keep them dry.
- Wear minimum clothing to reduce the amount that must be dried after the crossing.
- Do not wear helmets in swift moving currents; the current could force the helmeted head under water.

Staff Method. A strong staff or pole that extends at least one foot above the Marine's head is used as a crossing aid. It should be strong enough to support the individual's weight and be trimmed clean of any branches. Placing both hands on the pole, the Marine should place the staff upstream of the intended path, use the staff as the third leg of a tripod, and move only one leg or the staff at a time (Marines should drag their feet instead of picking them up). The Marine should face upstream using the staff for balance (see Figure 5-1). The staff is also used as a probe to locate tripping hazards.

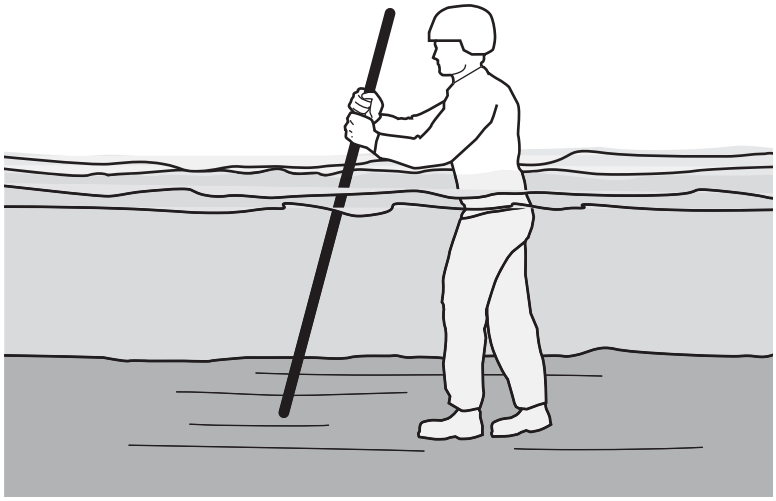


Figure 5-1. Staff Method.

Swimming. In fast, shallow water, Marines should cross on their backs with feet downstream and heads upstream. They move at an angle across the stream, moving with the water. They should use their hands to tread water and feet to fend off obstructions. In fast, deep water, the Marines should angle across the stream on their stomachs with their heads upstream to establish a proper crossing angle.

Ferry Line Method. Marines in chest deep water can secure a rope from bank to bank with the far anchor downstream from the near anchor and anchor the rope so that it lays, at minimum, a 45-degree angle. Marines attach themselves to the rope by using a sling rope as a safety line, tying a bowline around their waist and a figure-eight loop with a locking carabiner inserted. The figure-eight loop must be within an arm's length. They attach the pack to the line and then attach themselves. Marines grasp the pack and cross using the current to assist themselves.

Team Crossing Methods

There are three team crossing methods—line abreast (chain), line astern, and huddle.

Line Abreast Method. Small units (squad to platoon) can cross in moderate currents up to chest deep by linking arms in a line abreast or chain method. The largest person of the chain is placed on the upstream side of the group. The group enters the stream parallel to the flow of the stream. The middle person in the chain controls the group's movement and gives the command to step (see Figure 5-2).

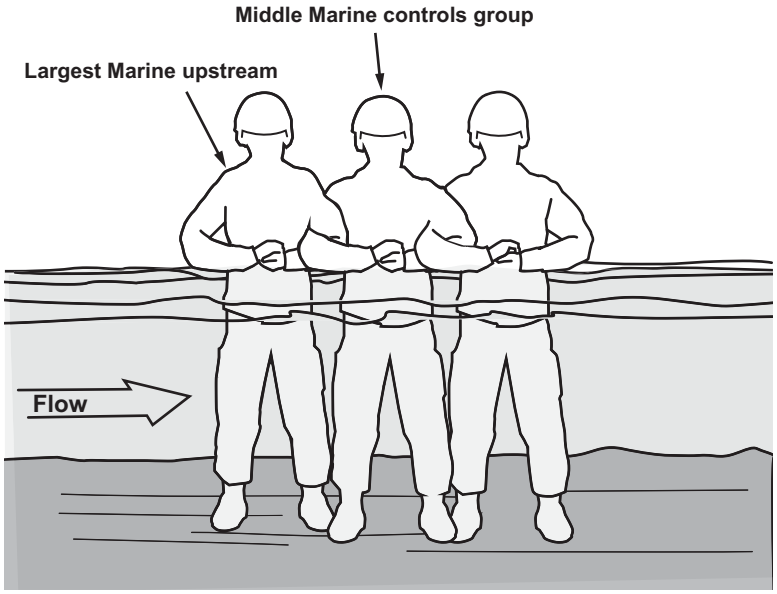


Figure 5-2. Line Abreast Method.

Line Astern Method. Using the line astern method, three or more Marines can line up facing the current (see Figure 5-3). The upstream person, who should be the largest person in the group, breaks the current while the downstream people hold the person ahead of them steady. The upstream person could use a staff, like the individual staff method, to steady themselves. All Marines side-step at the same time with one Marine calling the cadence.

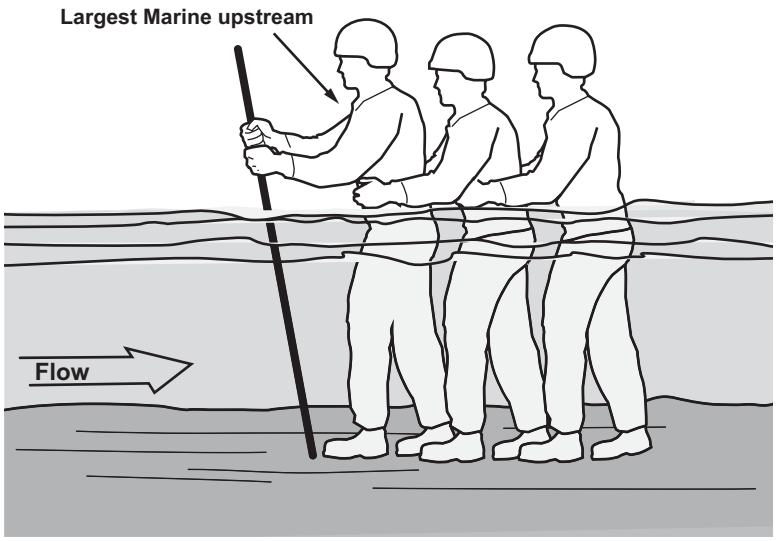


Figure 5-3. Line Astern Method.

Huddle Method. In the huddle method, three to eight Marines face inward as in a football huddle. They wrap their arms around each other's shoulders and cross the stream in this formation, as shown in Figure 5-4. The upstream person changes position as the formation rotates, which prevents one person from becoming exhausted in the upstream position.

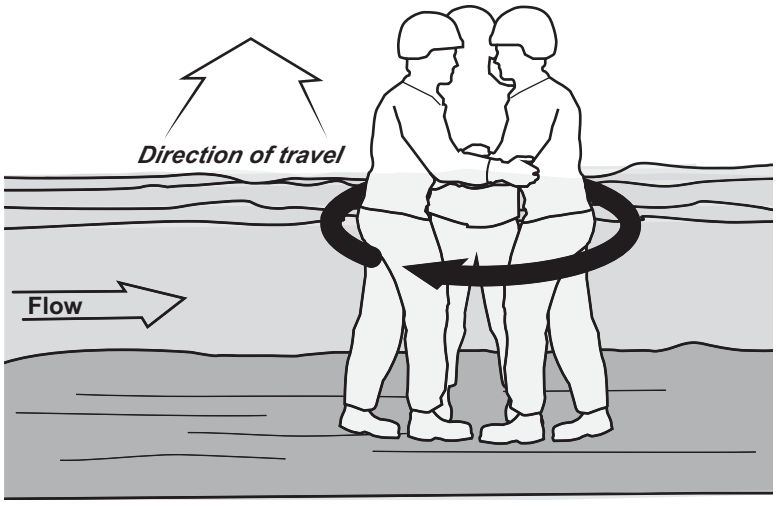


Figure 5-4. Huddle Method.

Tactical Stream Crossing

Figure 5-5 is an example of a tactical stream crossing SOP. Leaders may use this SOP, modify it, or develop their own SOP.

TACTICAL STREAM CROSSING SOP

Team 1 (the last team to cross)

Upon reaching the stream—

- Conduct reconnaissance of crossing site.
- Establish near side security.
- Determine whether a snow bridge needs to be constructed.
- Provide guide to bring remainder of the unit forward.
- Maintain security during the crossing. After crossing the stream—
  - Establish security as directed.
  - Wait for the order to move out.

Team 2 (the first team to cross)

Upon reaching the stream—

- Set up rally point with team 3.
- Move forward to construct a snow bridge for the crossing, if necessary.
- Wait for guide from team 1.
- While crossing the stream, maintain accountability of all Marines crossing the stream. After crossing—
  - Reconnoiter at the far side of the crossing site.
  - Establish 360-degree security on the far side.
  - Give signal for rest of unit to cross.
  - Place other teams in 360-degree security as they cross.
  - Wait for order to move out.

Team 3 (the second team to cross)

Upon reaching the crossing site—

- Establish 360-degree security.
- Wait for guide from team 1, then cross the stream. After crossing—
  - Establish security as directed by team 2.
  - Wait for order to move out.

Actions if Compromised:

- Prior to the crossing—the team leader makes the decision to attack or attempt the crossing, depending on the size of the enemy and the situation.
- During the crossing—depending on the situation, the team leader makes the decision to either cross the remainder of the unit or bring the Marines on the far side back across to engage the enemy.
- After the crossing—depending on the situation, the team leader makes the decision to engage the enemy or withdraw, possibly back across the stream.

NOTE

In most cases, the stream crossing may also be used as a water resupply point.

Figure 5-5. Example of a Tactical Stream Crossing Standing Operating Procedure.

CROSSING FROZEN WATERWAYS

A winter mountain leader or combat engineer conducts reconnaissance on frozen waterways. Details about properties of ice, equipment, "Gold's formula," and reconnaissance methods and procedures are found in MCTP 12-10A. Marines use Gold's formula to determine ice thickness safety.

The Crossing Route

The best conditions for crossing frozen waterways exist where the stream is broad and straight, with a bank that is relatively low or has a gentle slope and is easy to prepare. It should also have an even bottom, well-defined channels, and a water flow that is reasonably deep with a low, uniform velocity.

These conditions favor the formation of strong, thick ice that is suitable for ice bridges. Of particular interest is the effect of a small stream running into the outside curve of a main stream. Observations have shown that where a main current curves at a right angle and a secondary current enters perpendicular to or into the main current, the entire water movement slows in that area. This results in freezing from bank to bank, which can support troops on snowshoes or skis.

When conducting the ice reconnaissance of the route, Marines must—

- Designate the proposed route, approaches, exits, and sounding holes with bags, ice blocks, snow piles, stakes, or tape, depending on tactical considerations.
- Determine the width of the water obstacle.
- Determine whether any dams are upstream.
- Determine tidal rise and drop for bays and duration of high tide.
- Cut and drill holes along the axis and through the ice every 3 to 5 meters by the banks and every 10 meters in the channel.
- Sketch river profiles.
- Determine alternate routes.

Special Considerations for Crossing Ice

Crossing a frozen waterway should be treated like crossing a linear danger area for a stream or river or an area danger area for lakes or bays. Frozen waterways can also be used as main supply routes (MSRs) for foot or vehicular traffic and as landing zones (LZs) for helicopters, depending on the thickness of the ice and the tactical situation. The following special considerations should be made for a route on ice:

- Adjacent to the shore, the ice formation is thin, weak, and more likely to develop cracks than ice in the center of a frozen stream. Depending upon the gradient of the riverbed and the thickness of the ice near the shore, it is generally safer to maintain a route near the shore if the ice rests upon the river bottom.
- Where a water flows under a large ice area, the ice in contact with the current is subject to a greater variation in temperature over a given time and is thicker than the ice in adjacent areas.
- Shallow-water ice is usually thinner than deep-water ice.
- Good quality ice is clear and free from bubbles and cracks. If a body of water contains clear and cloudy ice, the clear ice is typically thinner than the cloudy ice.
- Lakes contain a great deal of vegetation. Decomposing vegetation results in weak ice.
- Flooded snow, when frozen, produces white slush ice, which can contain air bubbles. Slush ice has a load-carrying capacity approximately one-quarter less than that of prime natural ice.
- During freezing weather, the thickness of ice increases by removing its snow cover since snow acts like a blanket, insulating thin ice and preventing the formation of clear, blue ice.
- Ice that remains unsupported after a drop in the water beneath it has little strength, as exemplified in reservoirs or lakes with runoffs and hydro-electric dams.
- During extremely cold weather, cracks on the ice can expand under heavy traffic.
- Some rivers and lakes are controlled by floodgates designed to be opened by host-nation guard units upon attack.

- In spring, the main body of ice can be traveled over if water is only on the ice surface for a limited time. Potholes demand extra caution.
- A reinforced ice crossing close to a summer crossing site that uses floating equipment, should be located downstream of the summer crossing site to minimize the danger of damage to the bridging equipment during the thaw.

Ice Classification

Ice is classified in three types—salt water, fresh water, and land—and is detailed further in MCRP 12-10A.2. These types have widely different characteristics, occur in different areas, and present different problems. All can be used for construction. The strength of the ice depends upon ice structure, purity of water, freezing process, cycles of freezing and thawing, crystal orientation, temperature, ice thickness, snow cover, water current, underside support, and age. The amount of ice required to support individuals and vehicles with the proper distance between them is shown in Table 5-1.

Table 5-1. Ice Safety Table.

Item Loaded	Weight in Tons	Ice Thickness Needed in Inches (centimeters)	Distance Apart Needed in Feet (meters)
Individual on snowshoes or skis	0.1	2 (5)	15 (5)
Individual on foot	0.1	4 (11)	15 (5)
SUSV or cold-weather all-terrain vehicle	7.5	13 (33)	89 (27)

Having determined that the ice is thick enough to cross, Marines should take the following six safety precautions before crossing an ice-covered body of water:

- Loosen bindings on skis or snowshoes, if so equipped.
- Remove wrist loops of ski poles, if so equipped.
- Sling pack and weapons onto one shoulder.
- Only expose one person to the danger at a time or until weight factor is determined.
- Ropes should belay the first group of individuals. Belay is required if there is rapidly flowing water under the ice.
- Clothing should be worn snugly. All wrist straps, waist straps, collars, and trouser cuffs should be securely closed, which increases buoyancy if breakthrough occurs and reduces cold shock.

FORDING STREAMS

Broad floodplains with sandbars and shifting water produce weak or unsupported ice with open water areas and difficult working conditions. Such locations usually require a combination of an ice crossing and conventional floating bridges during a winter ford. In summer months or during other times when weather and water conditions are favorable, units should ford streams on foot.

Fording Streams During the Summer

Leaders must consider the variation in stream velocity and depth, particularly in streams and rivers from glacial or ice cap areas. Fording these streams might be feasible only during certain

hours of the day—usually early morning—or after the spring or early summer thaw when the water's volume and velocity are at a minimum. Precautions are necessary to prevent fording at unfavorable times and to aid equipment or personnel crossings if need arises.

Fording Streams During the Winter

Units should avoid fording streams in the winter because of the difficulties encountered in the crossing and the effects water can have on personnel and equipment in low ambient temperatures. Some streams, particularly those flowing in broad flood plains where valley icing occurs, have open channels that continually shift about the valley during early winter. Valley ice is treacherous because a shifting stream leaves sheets of ice unsupported. Equipment breaks through such ice and is difficult to recover. The sides of open water channels are frequently steep, and water is generally deep. If such fording operations become necessary, the route should be well marked, all unsupported ice should be removed, and special precautions should be taken (detailed in MCTP 12-10E, *Arctic and Extreme Cold Weather Operations*) to reinforce ice and maintain ford approaches to provide safe passage through active stream channels. Continual reconnaissance should be maintained upstream from the ford to determine probable shifts in the water channel. Upstream damming and diversion can sometimes control the position of the active stream channel. The whole water channel should be kept clear to a point below the ford.

RESCUE TECHNIQUES

If individuals or groups break through the ice on an ice-covered body of water, ropes should be thrown to them. Marines should not approach the breach. Marines who have fallen through the ice should carry out the following self-rescue techniques:

- Remove unnecessary gear, such as packs, weapons, and skis, throwing the gear onto the ice.
- Retain ski poles and use these as daggers to drag oneself up on to and across the ice by grasping each pole above the ski basket.
- Exit the hole by shallow swimming onto the ice. Do not push up on the edge because it may break off. If thrown a rope, twist the arm around it, as the cold reduces grip strength. Let the others pull; do not climb the rope. Once out, remain flat; do not stand up near the hole.
- Immediately carry out rewarming process. The usual result of sudden immersion is severe hypothermia and shock. Rewarming is critical following a rescue.

TACTICAL USES

There are several tactical uses to consider while planning to cross frozen waterways, such as—

- Preventing the enemy from using a frozen river or lake as an avenue of approach or MSR.
- Protecting defensive position on a lake or river line.
- Ambushing enemy troops, vehicles, or helicopters using a frozen body of water as an LZ.
- Using ice as a high-speed avenue of approach.
- Using ice as an MSR to conduct and expedite resupply.
- Using ice as an LZ.

CHAPTER 6.
AVALANCHES

A snow avalanche occurs when a mass of snow, ice, and incorporated debris slide down a slope at high speed. Avalanche formation is a complex interaction among terrain, snowpack, and meteorological conditions and is difficult to predict in a specific space and time. If possible, avoid planning routes in potential avalanche areas. These are areas with significant snow and unstable temperatures, or where there is evidence of existing slides. When traveling in these areas check weather and avalanche forecasts, equip Marines with safety gear, recognize red flag conditions, and identify dangerous terrain. MCRP 12-10A.2 provides more information on terrain analysis, causal factors, and testing snow conditions.

The following terms are necessary to understand when considering crossing avalanche-prone slopes:

- Avalanche. An avalanche is a falling mass of snow that can contain rock, soil, or ice, which travels over terrain of least resistance.
- Avalanche Path. The avalanche path is the area in which an avalanche runs. An avalanche is generally divided into three parts—starting zone, track, and runout zone (see Figure 6-1):
  - Starting Zone. The starting zone is where the unstable snow failed and began to move.
  - Track. The track is the downward slope or channel, in which snow moves at a uniform speed.
  - Runout Zone. The runout zone is where the snow slows, debris is deposited, and the avalanche stops.

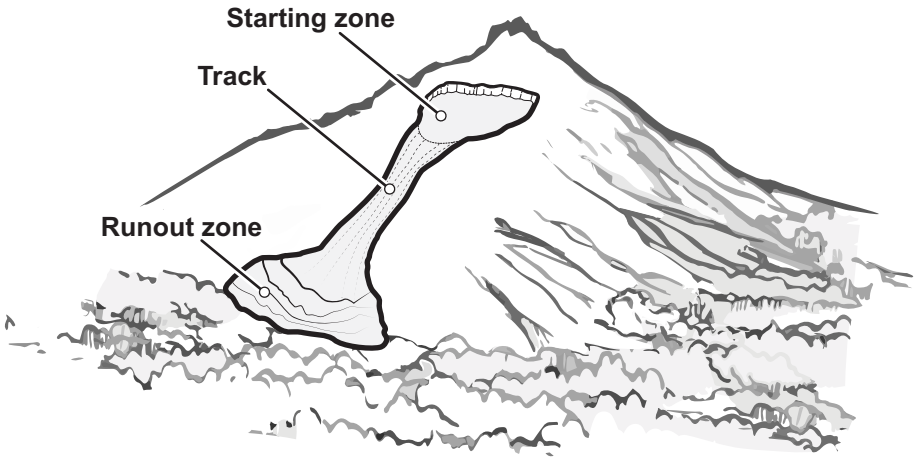


Figure 6-1. Avalanche Path.

TYPES OF AVALANCHES

Loose-Snow Avalanche

Loose-snow avalanches (also called point releases) start with a small amount of cohesion and snow and typically pick up more snow as they descend (see Figure 6-2). From a distance, they appear to start at a point and fan out into a triangle. They usually are small and involve only upper layers of snow, but they can become quite large and destructive.

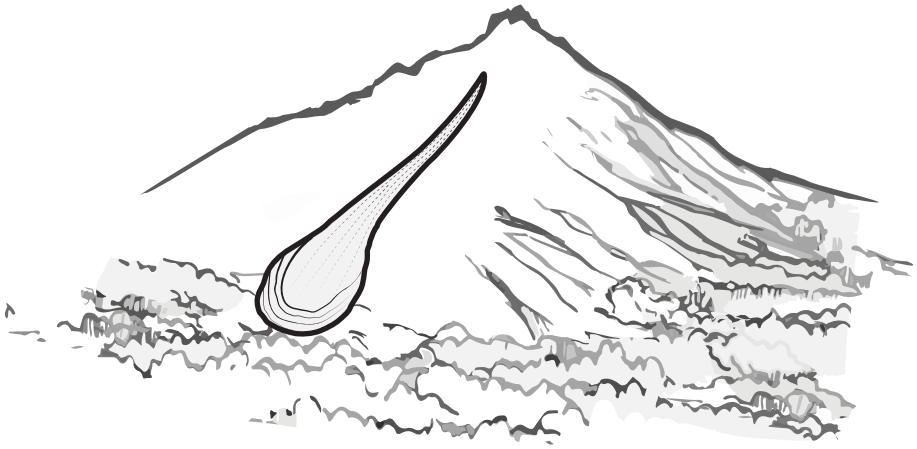


Figure 6-2. Loose-Snow Avalanche.

Loose-snow releases occur most often on steep slopes of 35 degrees or higher; during or shortly after a snowstorm; or during warming events caused by rain, rising temperatures, or solar radiation. Moving snow in a loose-snow slide can also trigger larger and deeper slab releases.

Slab Avalanche

Slab avalanches occur when one or more layers of cohesive snow break away as a unit. As the slab travels down the slope, it splits up into smaller blocks or clods, as seen in Figure 6-3. Slab failure is commonly initiated when the bond between the slab and the bed surface fails. This failure places stress on the other boundary regions that, in turn, are unable to hold the slab in place. Slab thickness can range from less than an inch to 35 feet or more and range in width from a few yards to well over a mile. Their makeup is also highly variable; however, they share the following features (see Figure 6-3):

- Crown. The crown is the breakaway wall of the top periphery of the slab. It is usually at a right angle to the bed surface. It is formed by tension fracture through the depth of the slab from bottom to top.
- Bed Surface. The bed surface is the surface over which the slab slides.
- Flanks. The flanks are the left and right sides of the slab.
- Stauchwall. The stauchwall is the lowest down slope fracture surface. It is usually overridden by the slab material, and it consists of a diagonal, wedge-like, shear fracture.

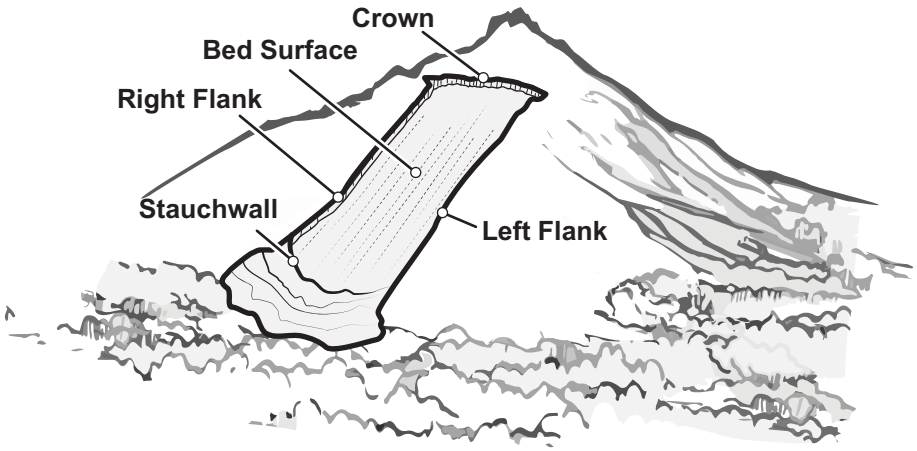


Figure 6-3. Slab Avalanche.

The a slab avalanche's speed can range from 65 miles per hour for a wet slab to 150 miles per hour for a dry slide. Most slab avalanches release on slopes with angles between 35 and 40 degrees.

AVALANCHE HAZARD EVALUATION PROCESS

To determine whether an avalanche is possible, Marines should evaluate how the following four variables interact (see Figure 6-4):

- Terrain. Analyze the terrain. Is the terrain capable of producing avalanches?
- Snowpack. Evaluate the stability of the snowpack. Could the snow slide?
- Weather. Forecast the weather. Is the weather contributing to instability?
- Human Factor. To determine whether an avalanche hazard exists, Marines must add another variable—people. Without the presence of people, there is no hazard. Consider the alternatives and their possible consequences.

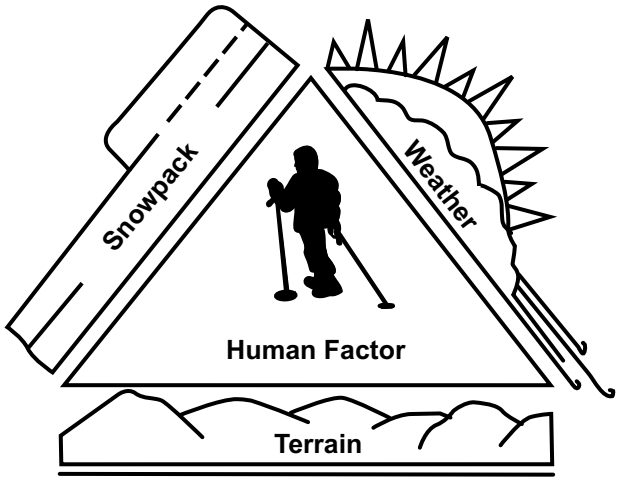


Figure 6-4. Data Triangle.

Terrain

Learning to recognize avalanche terrain is the critical starting point in the avalanche hazard evaluation process. Leaders should recognize that avalanches can occur on any size slope. Seven factors influence whether a given slope will avalanche:

- Slope angle.
- Slope aspect (orientation).
- Terrain roughness (anchoring).
- Slope shape.
- Vegetation.
- Elevation.
- Path history.

Slope Angle. Slope angle is a critical variable when determining the possibility that a given slope will avalanche. The underlying concept is that as the slope angle increases, so does the stress exerted on all boundary regions of the slab. The slope angle relationship to avalanche hazard is shown in Figure 6-5.

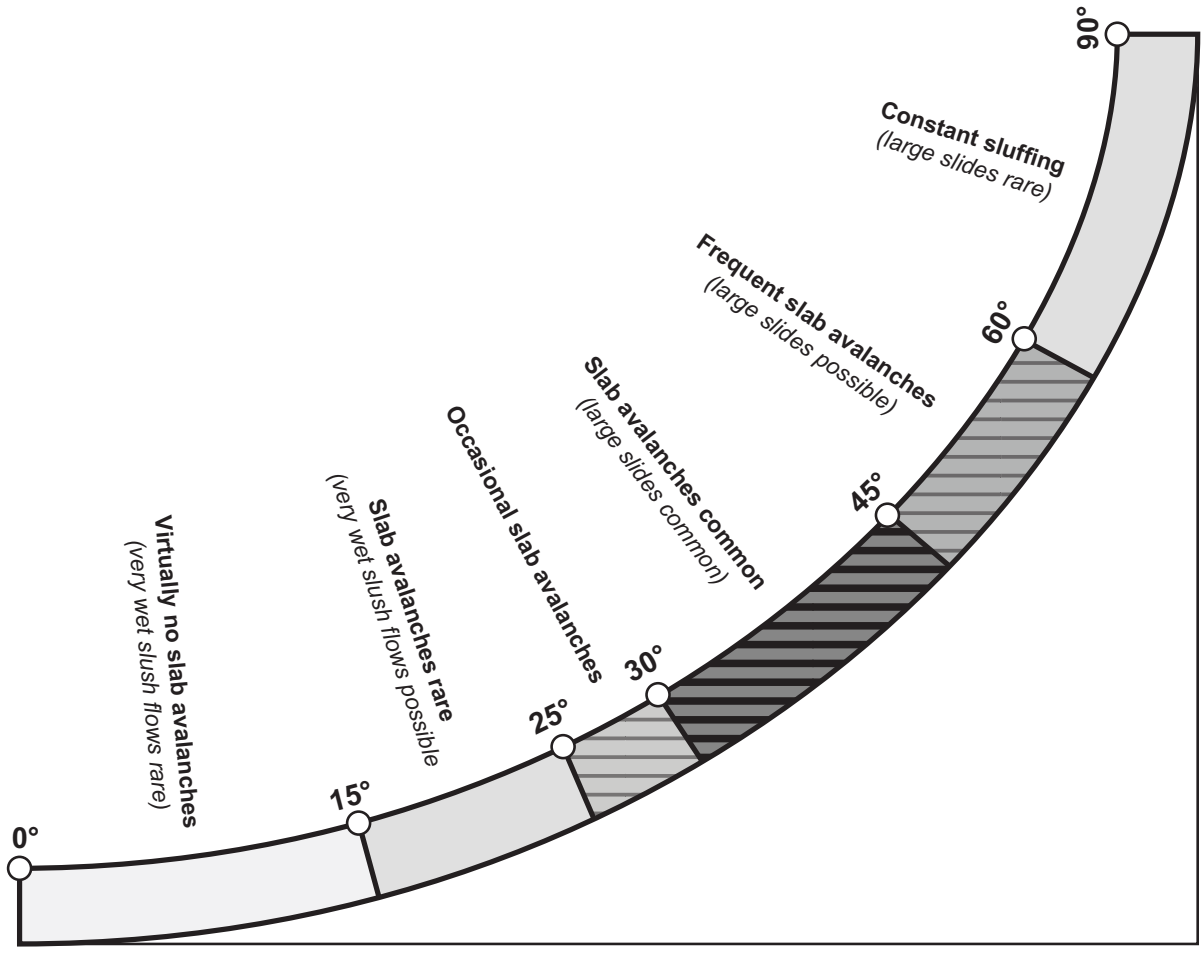


Figure 6-5. Slope Angle Relationship to Avalanches.

Snow on slope angles less than 25 degrees rarely slides because there is little stress on the snowpack. Slab avalanches in cold snow are possible between the slope angles of 25 and 60 degrees. Most slab avalanches release on slopes with starting zone angles between 30 and 45 degrees and with the peak in frequency near 40 degrees. Slope angles 60 degrees or greater continually slough due to large amounts of stress to the snowpack.

> NOTE: Motion or body weight can trigger an avalanche even when Marines are on a low-angle slope or on the flats if the terrain is connected to a slope with an angle of roughly 25 degrees and instability exists.

Slope Aspect. The following changes in slope aspect and their effects affect the snow's stability:

- Leeward deposits of wind-transported snow increase the stress on the snowpack and enhance slab formation.
- Moderate warming by the sun can help strengthen and stabilize the snowpack, but intense, direct sunlight has the opposite effect by weakening and lubricating the bonds between grains.
- Weak layers could remain longer on shaded slopes; therefore, units should assume shadowed slopes are unstable.

  > NOTE: For operational planning purposes, north-facing and shaded slopes tend to be more dangerous during the mid-winter period. South-facing slopes tend to be most dangerous during spring thaw, particularly on sunny days.

Terrain Roughness. Slopes with anchors are less likely to avalanche than open slopes. Terrain anchoring is shown in Figure 6-6. Boulders, trees, and ledges act as anchors and help hold the snow in place until they are buried. Smooth slopes (e.g., smooth granite or grass) may only need one foot of snow to release.

Anchors are commonly areas of stress concentration because the snow up-slope of them is being held in place while the snow below or to the sides is being pulled downhill by gravity. For this reason, anchors can be starting points of initial failure, and fractures often run from tree to tree to rock.

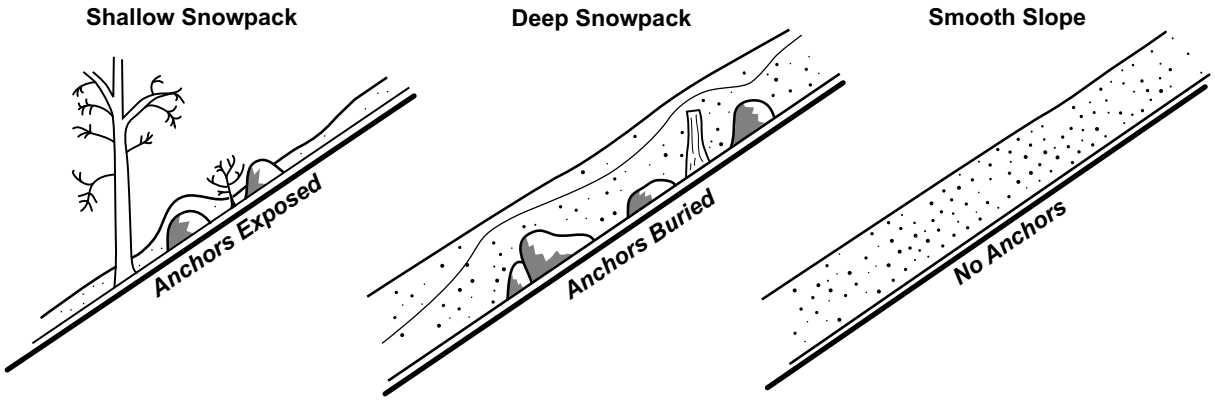


Figure 6-6. Terrain Anchoring.

Slope Shape. Avalanches can occur on any snow-covered slope steep enough to slide, such as on—

- Convex Slopes. On convex slopes, slabs are most likely to fracture just below the bulge where stresses are greatest (see Figure 6-7).
- Concave Slopes. Concave slopes provide a certain amount of support through compression at the base of the hollow, but they are still capable of avalanching, particularly on large slopes (see Figure 6-7).
- Planar Slopes. On planar slopes, which are broad and smooth, avalanches can happen anywhere. Slabs often fracture below cliff bands.

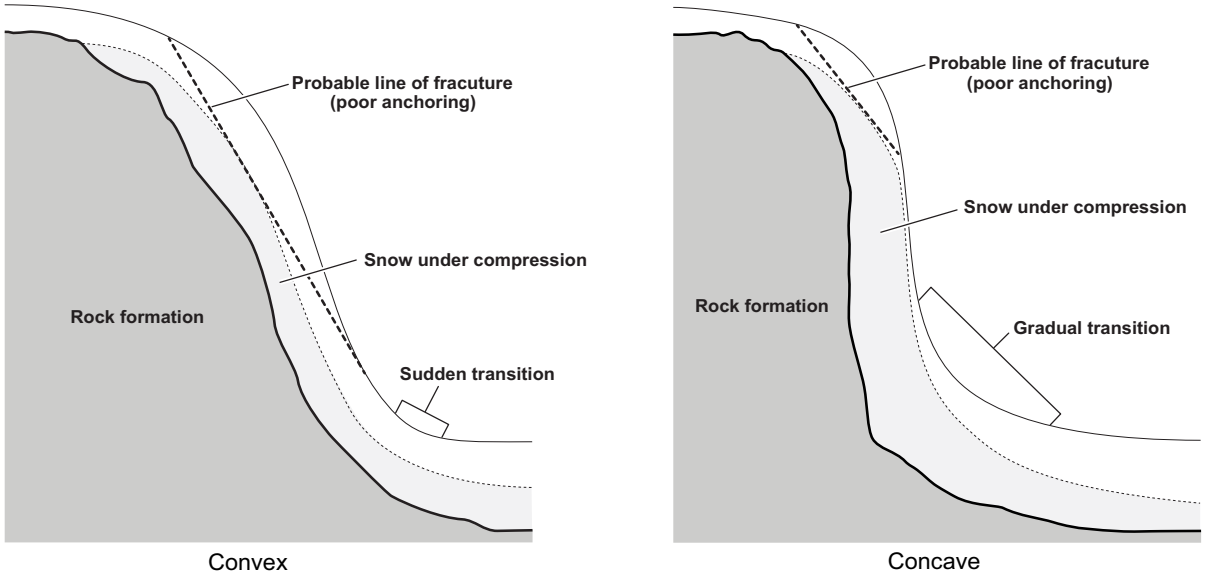


Figure 6-7. Convex and Concave Slopes.

Vegetation. Vegetation can provide evidence of both the frequency and magnitude of past avalanche occurrences and indicate potential avalanche-prone terrain or avalanche-prone paths. Vegetative indicators include—

- Swaths of open slope between forested or vegetated areas.
- Bent, broken, uprooted, or "broomed" trees (previously broken but with new growth tops), and vegetation that is polished or "flagged" (missing branches on the uphill side). Flagging can also indicate the flow height of the avalanches that have affected the area.
- Marked difference in height of trees, such as smaller spruce in the path and larger on the edges.

Elevation. Temperature, wind, and precipitation often vary significantly at different elevations. Common differences are rain at lower elevations with snow at higher elevations or differences in precipitation amounts or wind speed with elevation. Marines should not assume that conditions on a slope at a particular elevation reflect those of a slope at a different elevation.

Path History. All avalanche paths have history, whether it is their magnitude or how often they slide. Before going into an avalanche-prone area, units should garner as much historical information as possible.

Snowpack

The unit's winter mountain leader can analyze the snowpack to estimate the risk of an avalanche occurring. The snowpack accumulates layer by layer with each new snow or wind event. These layers are then subject to changes in texture and strength throughout the winter, which influences how well individual snow grains are bonded to each other within the layer and between layers. Many combinations of strong and weak layers can exist within the snowpack (see Figure 6-8). The snowpack's structure varies depending on the season, location, climate, slope aspect, inclination, and shape.

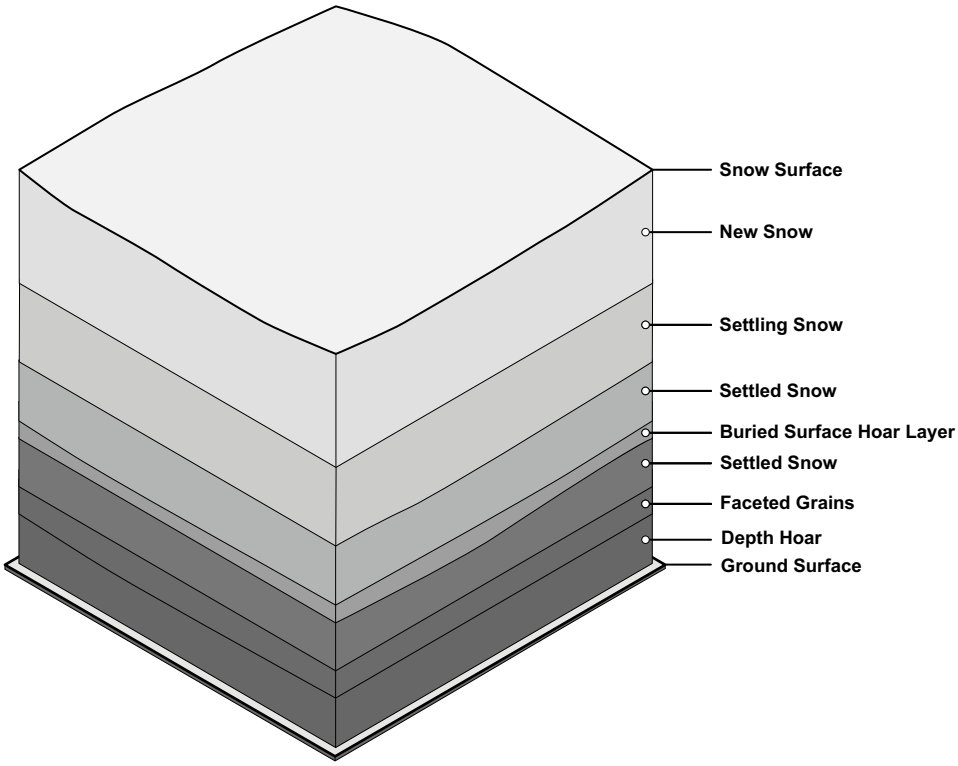


Figure 6-8. Example of Layers Within a Snowpack.

Snow metamorphism describes the changes in structure that take place over time within the snowpack's layers. There are several types of snow metamorphism. Each occurs under different conditions, and each affects the snowpack's strength. As conditions change, the dominant type of metamorphism in each layer may change. Also, different types of metamorphism can occur in various layers at the same time. The three snow metamorphic types encountered in a snowpack are rounding, faceting, and melt-freeze.

Rounding. Rounded grains develop when temperatures in a layer or between layers are uniform. This process produces fine, rounded, well-bonded grains and the result is that relatively strong layers form within a snowpack.

Faceting. Faceted grains develop when a significant temperature change exists within or between layers. The shallower the snowpacks, the greater the temperature changes within the snowpack. This process produces large, angular grains, which are poorly bonded and weak. As a result, relatively weak layers form within a snowpack.

Melt-Freeze. A melt-freeze occurs during mid-winter thaws or in the spring when melting snow or rain enters the snowpack and the snowpack temperature reaches 32 °F. In the freeze phase, these grains are well bonded and strong, creating a stable snowpack; however, the resulting ice crust can create a surface for slabs to form on top of the crust. In the melt phase, the wet grains rapidly weaken, as they are lubricated by the presence of free water, creating an unstable snowpack. Timing during movement is critical in the spring near steep slopes that are being subjected to warming cycles.

Weather

Weather affects the stability of the snowpack by altering the critical balance between strength and stress. Most natural avalanches occur during or shortly after storms because the snowpack often cannot adjust to the new weight added in a short time. The three main contributing factors are precipitation, wind, and temperature.

Precipitation. Precipitation increases stress exerted on a snowpack by adding weight. New snow can provide a certain amount of strength to a snowpack but can also cause rapid build up during a storm. Heavy rain weakens the snowpack by warming and eroding the bond between grains and slab layers.

Wind. Wind speed and direction affect which slopes are built up, and are become important factors in avalanche considerations. Top loading (Figure 6-9) is caused when wind accelerates on the windward side of terrain features, picks up loose snow, carries it over the crest, and deposits it on the leeward side where the wind decelerates.

Side loading (Figure 6-10), also known as cross loading, can be harder to detect, particularly in areas of gentle gullies.

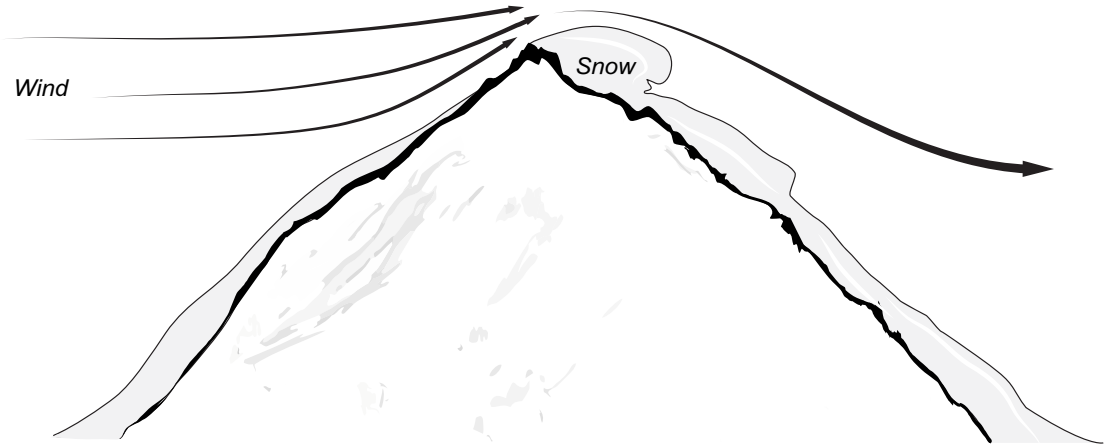


Figure 6-9. Top Loading.

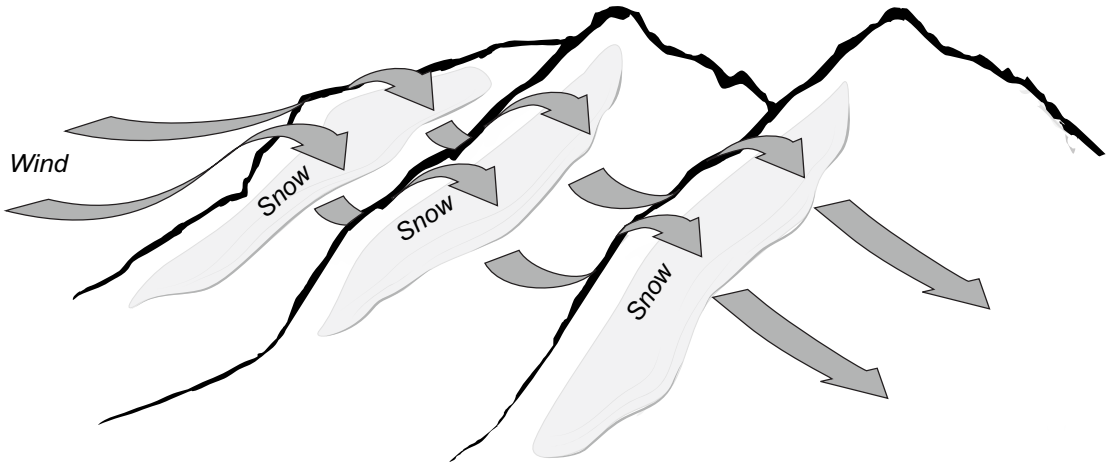


Figure 6-10. Side Loading.

Temperature. Ground and air temperatures, solar radiation, and terrestrial radiation affect the snow's temperature, which affects snow stability. Temperature affects snow in the following ways:

- A warm snowpack settles rapidly, becoming denser and stronger. It is associated with cloudy skies because clouds trap warm air against the earth's surface.
- Though gradual warming increases the snowpack's strength and stabilization, intense warming weakens the bonds between grains and increases the rate of the down slope deformation in affected layers.
- On shaded slopes, the snowpack undergoes less (or slower) settlement because of cooler temperatures and develops weak layers, such as faceted snow or surface hoar. Temperature gradients within the snow surface and snowpack can be more pronounced and persist for longer periods.
- Storms that start out cold and become progressively warmer are more likely to produce avalanches than those that start out warm and progressively become cooler.
- Any rapid, prolonged rise in temperature following long periods of cold weather could lead to instability.

Human Factor

Marines risk creating a hazard by traveling in avalanche terrain; however, careful route selection and preparation can limit the danger.

Route Selection over an Avalanche-Prone Slope. Careful route selection can greatly reduce the chances of being caught in an avalanche and, in some areas, make it possible to travel during periods of high instability (see Figure 6-11).

Marines should choose a route that—

- Starts in zones as high as possible, on high points and ridges.
- Traverses to the sides of the start zone.
- Avoids wind-loaded, leeward slopes.
- Favors terrain with anchors, such as a tree-covered area and over open slopes.

- Has flat, open runouts so burial depth would be decreased.
- Avoids areas that feed into gullies, crevasses, and over cliffs.
- Avoids V-shaped valleys. In V-shaped valleys, avalanches could run from either side and continue up the opposite side, so there would be little or no safe ground.
- Consider initiating avalanches with supporting fires. This eliminates the hazard but may require engineer assets forward to clear roads after triggering.

  NOTE: The enemy can use supporting fires to initiate avalanches on Marine units crossing on or below avalanche-prone slopes. Planning fires to initiate avalanches also mitigates this potential enemy threat.

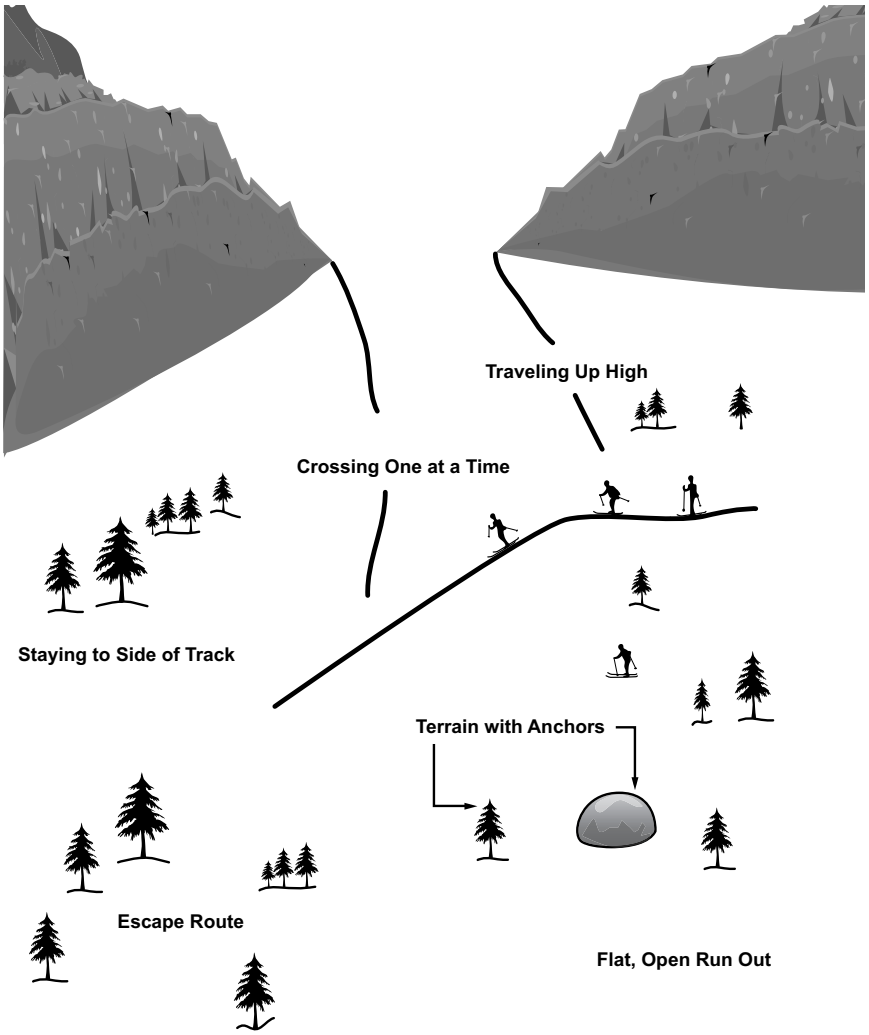


Figure 6-11. Crossing an Avalanche-Prone Slope.

Preparing to Cross an Avalanche-Prone Slope. Marines should only cross avalanche-prone slopes as a last resort. Before crossing a potential avalanche slope, Marines should—

- Remove skis and switch to snowshoes when using the military ski system. When using skis with a breakaway binding, keep the skis on.
- Remove hands from ski pole straps.

- Secure all-purpose environmental clothing system (APECS) hood tightly, covering face, and trail a 10-meter avalanche cord if available.
- Go around if possible. Travel straight downhill or uphill on foot rather than ski and look for possible escape routes. Do not traverse back and forth.
- Cross one at a time; belay if possible. Even if one person crosses safely, Marines should still take precautions while other cross.

POST-AVALANCHE ACTIONS

Actions for an Individual Caught in an Avalanche

If caught in an avalanche, a Marine should—

- Attempt to delay by grabbing onto a tree or rock or digging in a ski pole or ice axe (if equipped) and hanging on, letting as much of the avalanche as possible pass by.
- Call out while being carried so the other patrol members can watch the path. Then keep the mouth closed to prevent ingesting snow.
- Assess best line of escape.
- Try to work to the side. There will be less force of the avalanche at the edge of the flow.
- Try to swim out using swimming and rolling action to stay on the surface of the snow.
- Thrust an arm or hand or any part of the body above the snow surface so that others can see it after the avalanche has slowed down.

  NOTE: It is common to be so disoriented that the Marine does not know where the surface is; however, the individual should still attempt to signal others.
- Cup the arm or hand in front of the face to clear an air space before the snow comes to a stop. If possible, try to expand the chest during this time.
- Stop fighting and relax to preserve oxygen if buried. Do not panic.

Observer Actions

Observer actions to enable rescue include the following:

- Use the memory aid STOP [stop, think, observe, and plan quickly] and GO [go into action and organize the rescuers].
- Watch the victim's trajectory down the slope. If the victim disappears under the moving snow, keep the eyes fixed on the mass of snow in which the victim was enveloped until it stops. The victim may be under the snow surface in that area.
- Using a ski pole, mark any position where the victim reappeared during their journey down the hill.
- Make a quick visual search of the area for any arms, legs, avalanche cord, and pieces of equipment that are sticking up and dig them out.
- Make a quick surface search if nothing is apparent at first. If nothing is found, a more systematic search should be made from the bottom working up. If rescue Marines cannot find anything, the next step is to probe.
- Stay on site and search. Almost all hope of a live rescue depends on the Marines present.

Avalanche Search Organization

In the event of an avalanche, it is critical for a unit to be familiar with the techniques and procedures for conducting a search in an expedient and methodical manner. If a victim is rescued within 15 minutes of being buried there is a 92 percent chance of survival. The odds of being rescued alive go down 3 percent per minute after 15 minutes. Statistically, a victim has less than a 50 percent chance of survival if buried 30 minutes. Outside help usually cannot arrive in 30 minutes. Units should practice SOPs for search organization rehearsals. The following paragraphs provide the basic avalanche search and rescue techniques that form the basis of a unit's SOPs.

Hasty Search. The following actions should be taken by those witnessing an avalanche:

- Ensure all survivors are in a safe location.
- Immediately make note of the point the victims were last seen.
- Conduct a head count to confirm who the victims of the avalanche are.
- Assess the hazard of other possible avalanches. Post an avalanche sentry (most likely the radio operator) at a safe spot.
- Conduct a visual search of the deposit surface. Concentrate on locating parts of the victims and their equipment.
- Draw a line from where the victim was caught, to the location of equipment, and then to the victim's last seen point. The end of this line may point to the most likely burial location (see Figure 6-12).

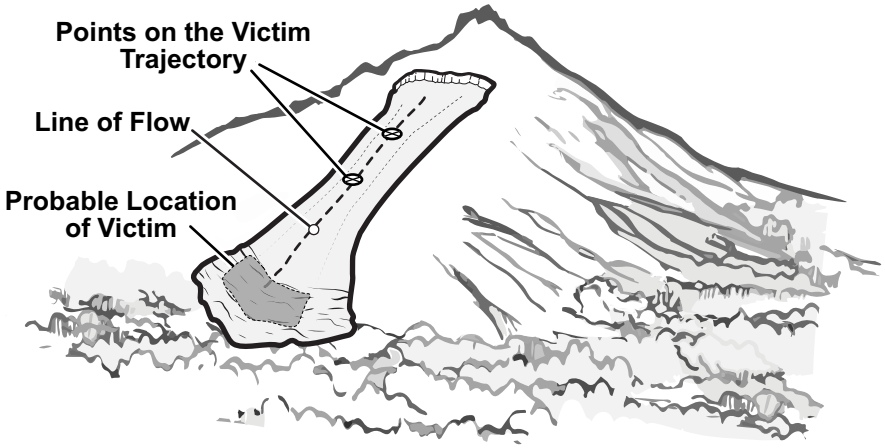


Figure 6-12. Suspected Burial Location.

- Alert higher headquarters of the situation, location, and number of victims. Immediately request an avalanche search organization and assistance.
- Begin thoroughly searching the most likely burial areas.
- Make frequent stops to call out to the victims and listen for voices of the buried persons.
- Keep shovels, probes, and first aid equipment readily available.
- Upon locating victims, quickly dig them out and perform first aid as necessary.

- Determine whether all victims are accounted for. If some are still missing, mark the locations of clues found on the surface and spot probe around them. Additional likely areas of burial include areas uphill of trees or rocks, in depressions, and in the runout zone, as depicted in Figure 6-13.
- Organize a hasty probe line to conduct a more thorough search of the most likely burial areas. Mark areas already probed with ski poles, skis, and branches.
- Continue the hasty probe line search until avalanche search replacements arrive.

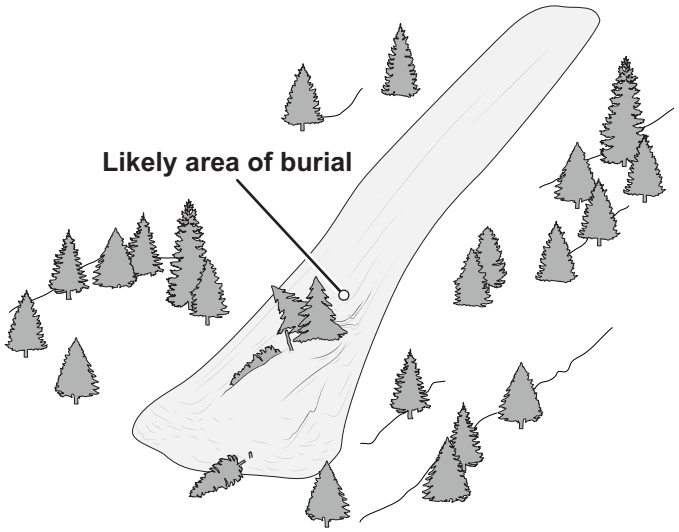


Figure 6-13. Suspected Search Areas Near Obstacles and Runout Zone.

Organized Rescue or Recovery. An organized rescue is conducted by a unit trained in avalanche search and rescue techniques and equipment (see Figure 6-14).

NOTE: The tactical situation might dictate how long the search can be conducted.

The company commander should—

- Evaluate the avalanche site.
- Make an estimate of the situation.
- Prepare to execute the appropriate avalanche rescue techniques using the following prioritized list:
  - Post an avalanche guard and arrange for a warning signal (such as a whistle blast) in the event of follow-on avalanches.
  - Designate escape routes.
  - Question witnesses and survivors at the scene:
    - How the accident happened.
    - Number of persons buried.
    - Locations of victims when the avalanche occurred.
    - Last seen point of the victims.
    - Search efforts conducted so far.
- Provide care to the survivors.

- Determine most likely burial areas quickly and immediately commence a hasty search with those personnel available.
- Keep notes of actions and sketch a map of the avalanche site with location of clues.
- Establish a command post in a safe location, which can also serve as a warming tent.
- Designate a helicopter LZ.
- Consider the enemy situation.
- Execute the following upon arrival at the site:
  - Have the platoons stage equipment at a safe area away from the avalanche site.
  - Inform platoon commanders about safety measures, the accident, and actions taken so far.
  - Delegate tasks to each platoon, such as hasty search teams, avalanche guards, and probe lines.
  - Have platoon commanders organize the probe lines.
  - Consider equipment, food, and support that may be required for a prolonged rescue.
  - Keep the search organization focused.

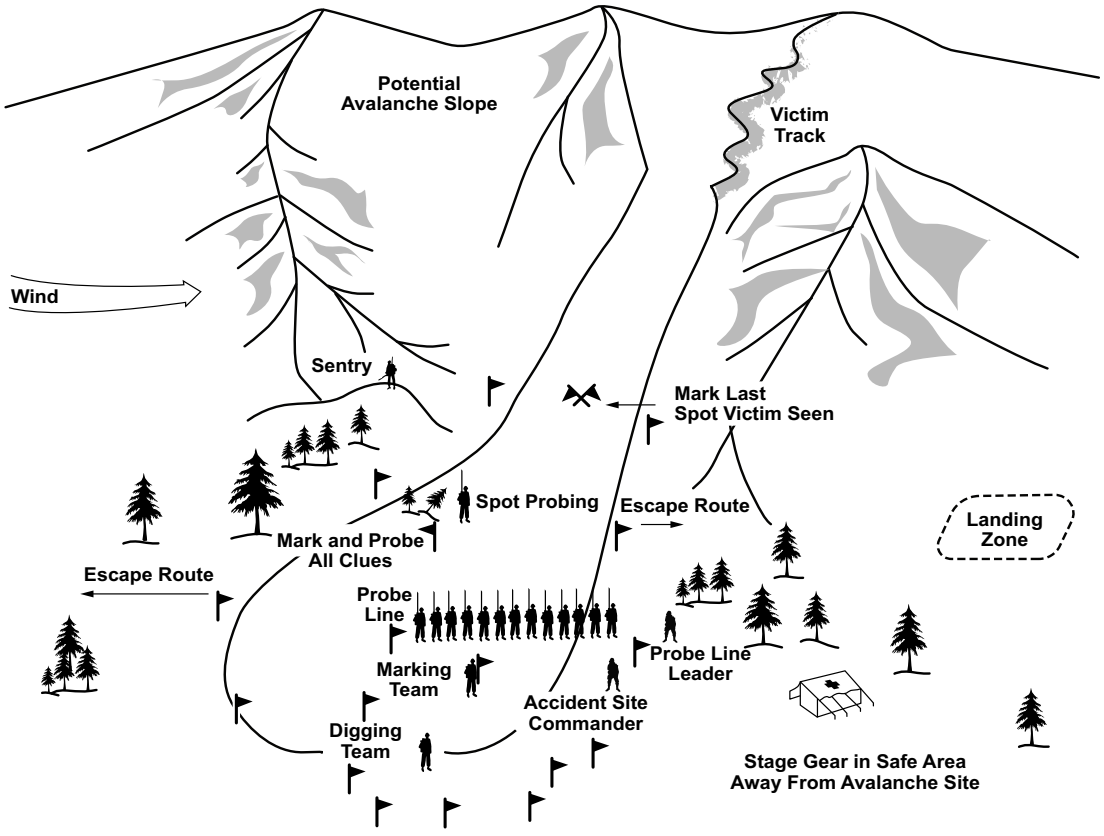


Figure 6-14. Avalanche Search Site.

A platoon should—

- Post avalanche sentries:
  - Sentries are established above natural anchors and starting zones.
  - Sentries must prevent anyone from entering starting zone areas.

  - Sentries must be positioned to observe any adjacent starting zones and prevent anyone from entering these zones.
  - Sentries must remain out of danger themselves.
  - Sentries must be equipped with a signal device that warn everyone in the event of follow-on avalanche threats.
  - Sentries may also serve as a security element for the search organization.
- Establish the command post:
  - Establish the command post close enough to support the search yet a safe distance from any avalanche hazards.
  - Establish warming tents and heat water to rewarm victims and sustain searchers.
  - Establish an aid station.
  - Prepare emergency medical sleds. Ensure sleds have sleeping bags and each team is assigned a corpsman. Teams should be prepared to react immediately to recovered victims.
  - Stamp out and mark the LZ.
  - Ensure that all radios are monitoring a common network, and that communication is established to the next higher command.
  - Provide guides to escort personnel from the road head to the accident site.
- Provide hasty search teams:
  - Search gullies and ravines, which could channelize a victim.
  - Search uphill of avalanche runout areas that could be a potential burial site, such as gullies, ravines, rock outcrops, trees, fallen logs, and benches in the slope.
- Conduct probe lines:
  - Snowshoes or skis should not be worn on the probe line, as the debris of a hard slab avalanche makes snowshoe and ski movement difficult.
  - The ends of two adjacent probe lines must overlap by two Marines to ensure that there is no gap between the lines.
  - Probe line leaders must ensure that the probe lines remain aligned and in order.
  - Flanks and runout zones are overlapped by at least 20 feet. Ensure there are no victims in these areas.
  - All search areas are marked to avoid confusion.

Other considerations include using dogs (if available) or individuals with transceivers to independently search the probe line; however, there should be probers and personnel with shovels readily available to uncover any possible strikes.

Probing. There are two probing techniques—the coarse probe and the fine probe. Each probe line consists of two squads—personnel to mark and personnel to shovel. The platoon sergeant is the probe line leader. The platoon sergeant controls the probe line's tempo and ensures that the probing squads remain aligned. Multiple probe lines abreast can be used simultaneously, depending upon the width of the avalanche's track and number of platoons available.

Coarse Probe. The coarse probe is used independent of the hasty search and prior to using the fine probe for speed purposes.

The technique is performed as follows:

- With two squads on line, at double arms interval, the Marines each place their probe between their feet.
- The probe line leader and markers are behind the probe line.
- The markers' mission is to place a mark where a strike has been indicated by a prober.
- A two- to four-person team with shovels follow the markers to uncover any probe strikes.
- The probe line leader gives the command DOWN PROBE and the probes are pushed down at a 15-degree angle to the left. The probe is pushed through each layer of the snow, being careful not to impale a victim if a strike is made.
- The probe line leader must continuously check the alignment, spacing, and penetration of the probes.
- The next command given is UP PROBE and all the probes are withdrawn from the snow.
- The probe line leader gives the command DOWN PROBE and the probes are then pushed straight down.
- The next command given is UP PROBE and all the probes are withdrawn from the snow.
- The probe line leader gives the command DOWN PROBE and the probes are pushed down at a 15-degree angle to the right.
- The next command given is UP PROBE and all the probes are withdrawn from the snow.
- If a strike is made at any time, the prober signals to the marker to place a mark on the spot. The personnel with shovels then dig to uncover the strike. The line never stops at a strike.
- At the command STEP, each person takes a 30-inch step and then repeats the process (see Figure 6-15).

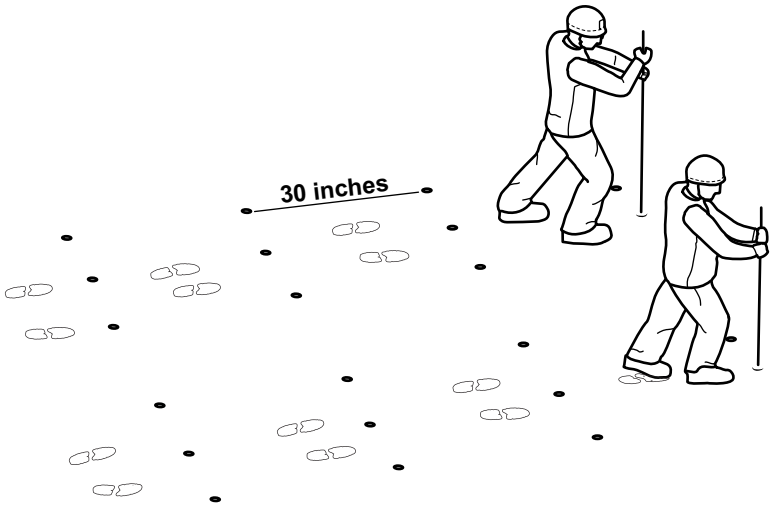


Figure 6-15. Coarse Probe.

Fine Probe. The fine probe (Figure 6-16) is used after completing the course probe if there are still individuals to recover. However, at this point, the search typically becomes a search and recover vice a search and rescue. A fine probe is usually a body recovery effort and should only be started when all hope of a live recovery is exhausted. A fine probe search takes four to five times longer than a coarse probe.

The technique is like a coarse probe except—

- Probing is performed over the left, middle, and right foot.
- A 15-inch step is taken rather than a 30-inch step.

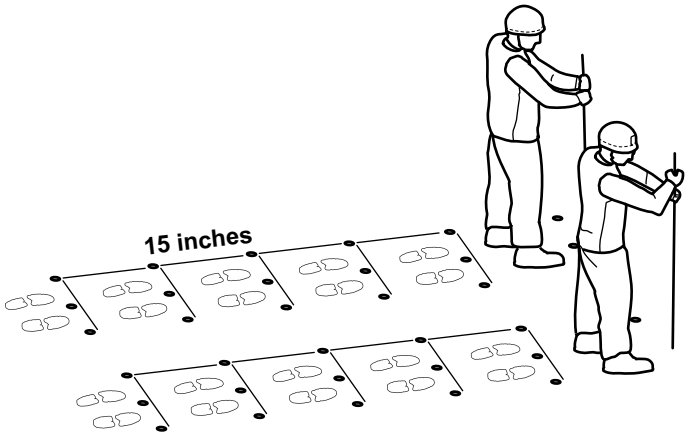


Figure 6-16. Fine Probe.

Shoveling Techniques. The most efficient approach is to line up downslope of the probe, one meter apart. The shoveler at the front of the line digs down, moving blocks of snow behind to the next person in line (Figures 6-17 and 6-18). Each shoveler in the lineup uses a paddling motion to keep that snow moving to the next person in line.

Figure 6-17. Team Shoveling Snow, Side View.

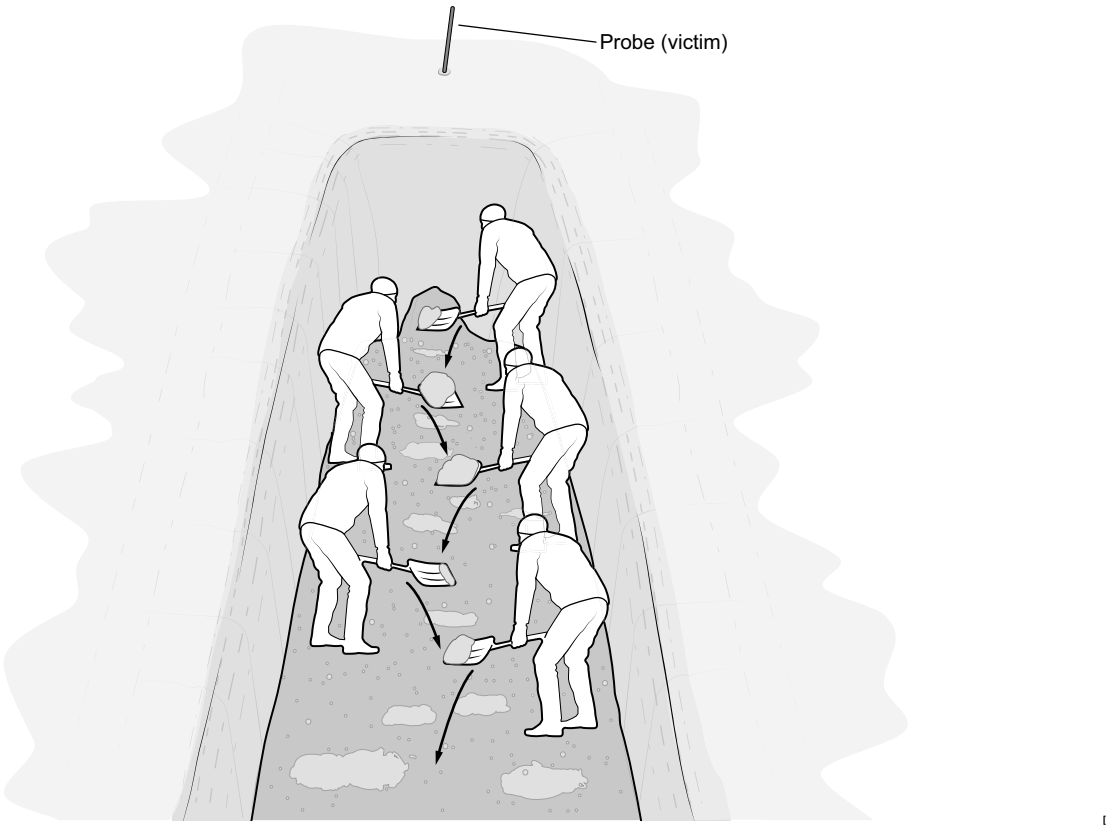


Figure 6-18. Team Shoveling Snow, Rear View.

Specialized Searches. Specialized searchers operate independently from other searchers and can use dogs or transceivers.

Dogs. If available, a trained avalanche rescue dog is efficient for locating buried persons and articles. Dogs can search large areas rapidly; however, the unit should still conduct searches while waiting for the avalanche dogs and their handlers to arrive.

Transceivers. Mountain leaders or other trained individuals use transceivers to locate individuals who were equipped with transceivers. Usually, those using transceivers are small teams of scout skiers operating independently as mountain pickets. This technique is discussed in further detail in the MCRP 12-10A.2.

CHAPTER 7.
MOVEMENT OVER SNOW

SNOWSHOES

Over-the-snow movement requires specialized equipment to maximize unit mobility and tempo. Marines can use snowshoes to glide over snow-covered terrain. They help conserve valuable energy but decrease movement rates. In general, snowshoes enable a Marine to move through the snow at approximately the same pace as they would achieve walking on hard ground; however, speed varies with the depth and consistency of the snow. The more compact the snow, the faster a Marine can move.

The advantages of snowshoeing are—

- Little training time is required to become proficient.
- Little maintenance is required.
- Carrying and pulling heavy loads on gentle terrain is relatively easy.
- Movement in confined areas and around equipment is relatively easy. Snowshoes are particularly useful for individuals working in confined areas, such as patrol bases, bivouac sites, and supply dumps.

The disadvantages of snowshoeing are—

- Movement on moderate to steep slopes is difficult.
- Movement through thick or cut-off brush is difficult.
- Quick movement, as needed during fires and maneuver, is difficult.
- For information on snowshoe movement rates, see Table 4-1 in Chapter 4.

The Snowshoe

The assault snowshoe (see Figure 7-1) has a detachable, 8-inch tail for use with varying snow conditions and loads. It is more versatile and maneuverable than the magnesium snowshoe because of the detachable tail and aggressive steel teeth under the footplate.

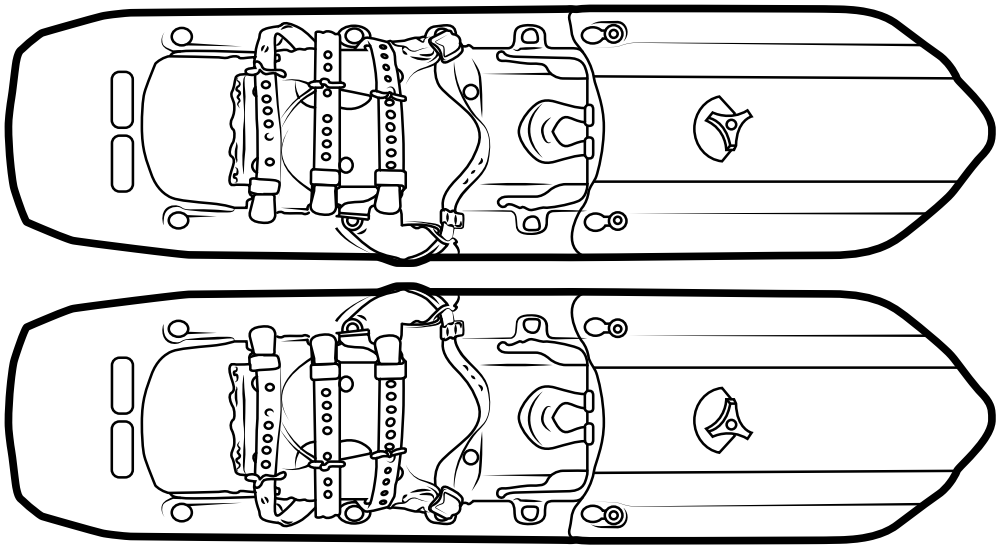


Figure 7-1. Assault Snowshoe.

Nomenclature. The assault snowshoe consists of the following parts:

- Tip. The tip is the front portion of the snowshoe frame.
- Tail. The tail is the detachable, 8-inch back portion of the snowshoe frame.
- Binding. Bindings are constructed of rubber straps that fit any boot.
- Footplate. The footplate is where the ball of the foot is placed, the footplate pivots on an alloy crossbar.
- Window. The window is the opening in the snowshoe through which the toe of the boot can pivot.
- Shovel. The shovel is the curve at the front of the snowshoe, which looks like a shovel.
- Body. The body is constructed of plastic to provide flotation in snow.
- Teeth. The teeth are located on the underside of the footplate; teeth provide more traction.

Care and Storage. Marines should—

- Check their footplates for pivot action and binding straps and buckles for serviceability.
- Check the frame and plastic for cracks.
- Dry snowshoes completely before storing.
- Conduct serviceability check prior to storage.

Binding Adjustment. Proper snowshoe binding adjustment (see Figure 7-2) ensures the—

- Foot pivots freely about the ball of the foot so that the toe of the foot moves through the window of the snowshoe.
- Heel of the foot is centered on the snowshoe.
- Binding fits snugly to provide adequate control, but not so tightly that circulation in the foot is impaired. A poorly fitting snowshoe makes movement extremely difficult.

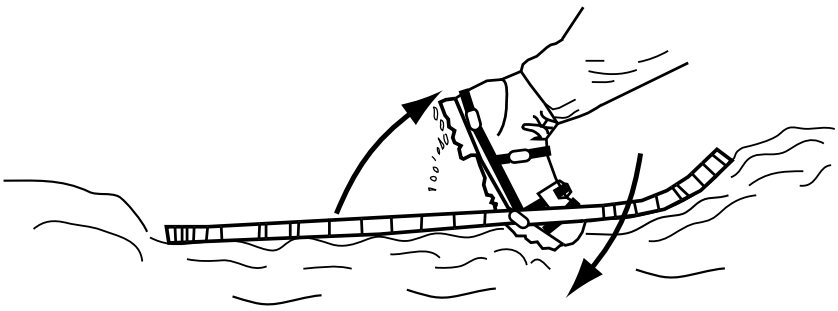


Figure 7-2. Proper Snowshoe Binding Adjustment.

Techniques for Use

With standard military snowshoes, the stride is somewhat longer than in normal walking, but the shape of the snowshoe allows the wearer's stance to be a normal width, thereby reducing strain and fatigue on hips and legs. The individual snowshoeing should walk in a relaxed and normal rolling toe manner and should only lift the snowshoe high enough to clear the surface of the snow. Snowshoeing can be done with or without ski poles. Specific snowshoeing techniques are discussed in the following subparagraphs.

Kick Turn. The kick turn is typically the easiest way to change directions on level ground. One snowshoe is swung up to the front so that its tail is on the snow. Then, it is allowed to pivot toward the new direction. The other snowshoe is then brought around. On steep terrain, the uphill foot steps off when changing direction. Snowshoers should try to stay uphill of the previous trail because it has undercut the snow on which the Marine is now building the turn. As each succeeding Marine uses the turn, it tends to slough on the shoulders, making it more difficult for the Marines at the end of the column to maneuver. Marines can prevent this by placing their snowshoes precisely where those in front of them were placed.

Star Turn. The star turn can also be used to change direction by executing a series of half facing movements, pivoting around the tails. When climbing, gentle inclines should be used for turns. The snowshoer should pick a route that avoids steep inclines by making short switchbacks.

Side Step. The side step is used when the slope is at a critical angle. Short steps are taken directly sideways up or down a slope, keeping the weight over the teeth of the snowshoe for traction.

Herringbone. The herringbone is used when the slope is at a medium angle. Snowshoers take V-shaped steps.

Crossing Obstacles

When crossing obstacles while wearing snowshoes, Marines should consider the following:

- Always step over obstacles to avoid damaging snowshoes and losing balance.
- Never bridge a gap with a snowshoe. If the tip and tail are higher than the center, the weight can damage the snowshoe.
- In shallow snow, there is a danger of tripping. Snowshoers may snag on tree stumps or bushes that are only slightly covered.

- Wet snow frequently balls up under the feet, interfering with comfortable walking. This snow should be knocked off as soon as possible.
- Breaking trail in deep snow consumes much energy, so Marines should frequently switch the lead person with another Marine.
- Using ski poles can be very helpful when crossing obstacles.
- Stepping into water with snowshoes can form ice, to which significant amounts of snow can cling, making the snowshoe very heavy.

MOVEMENT BY SLED

Combat operations in a mountainous, cold weather environment require Marines to carry more specialized equipment. Units can efficiently transport team equipment over snow-covered terrain by using sleds. By stowing equipment in sleds, Marines distribute the weight they are required to move and increase their individual mobility while preserving energy. Techniques to maximize the use of sleds include organizing the trail-breaking party, determining the equipment to be carried, and assigning specific duties to each Marine on a sled team.

Trail Breaking

Trail breaking uses a small body of troops to prepare a track or trail so that the main body can move as easily and quickly as possible, arriving at their destination ready for follow-on missions. A trail-breaking party is generally responsible for performing four tasks—reconnaissance and selection of the route, navigation, preparation of the route, and advanced guard for the main body.

Whenever a commander contemplates an over-the-snow movement that does not use existing tracks, the commander should incorporate a trail-breaking party into the plan. The leader of the trail-breaking party selects the route.

Initial Route Selection. Initial route selection is based on maps, aerial photographs, and any information that can be gathered from reconnaissance reports or local inhabitants. Additional selection factors include—

- The tactical situation.
- The main body's method of movement and the equipment it will carry.
- The terrain.
- Snow, weather, and light conditions.

Size of the Trail-Breaking Party. The commander determines the size of the trail-breaking party; however, it is typically one third of the unit so that the unit can maintain security and rotate Marines in the trail-breaking party (e.g., a squad breaks trail for the platoon).

Other determining factors include—

- The number of trails required to accommodate the size of the main body. Often, several trail-breaking parties might need to be employed so that other formations besides a column can be used.
- The likelihood of enemy contact. A security force may need to accompany the trail breakers.
- Anticipated difficulties in opening the route.

Lead Time for the Trail-Breaking Party. The commander should determine how far in advance of the main body the trail-breaking party should depart in time to reach the destination and to provide local security before the main body's arrival. The trailbreakers should remain within the radius of the main body's available indirect supporting fires. They must also maintain contact with the main body so that they can inform the commander of any changes to the route or tactical situation. When determining the trail-breaking team's departure time, the commander should consider the number of trails to be broken and the degree to which the trails need improvement.

Organization. Once a unit leader has been tasked to perform the trail-breaking mission, they must organize and assign duties within the team. The leader should make every effort to preserve the element's tactical integrity. The order of march and organization of the trail-breaking party, as shown in Figure 7-3, is as follows:

- The breaker is the point position within the trail-breaking party. This person breaks the initial trail in the direction indicated by the section leader. In deep snow and steep terrain, this Marine tires quickly so the breaker position should be rotated frequently.
- The straightener improves the direction of the trail to enable the sleds' movement.
- The party leader selects the routes, navigates, and rotates tasks within the team. They position themselves to best control the team.
- The right cutter clears obstructions on the right side of the trail and might expand and level out the trail if necessary to clear the route for sleds.
- The left cutter clears obstructions on the left side of the trail and might expand and level out the trail if necessary to clear the route for sleds.
- The remainder of the party constitutes the packing team. They improve the trail by filling in depressions, flattening the trail where it is uneven, and marking the route.

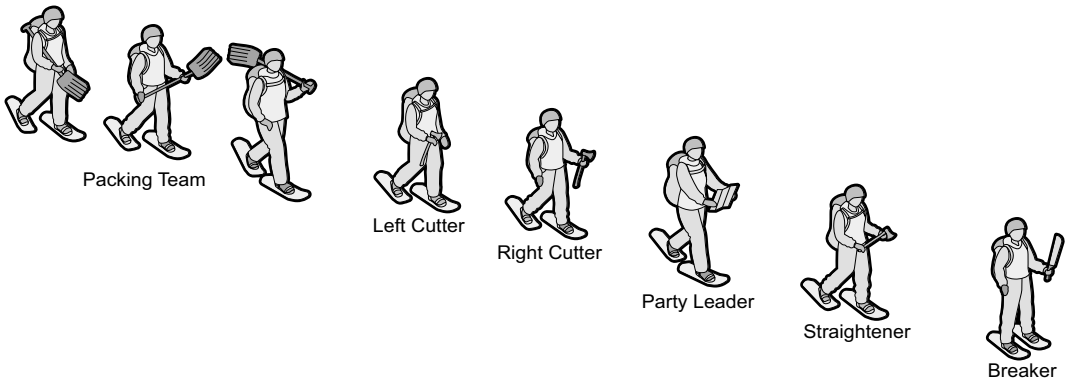


Figure 7-3. Examples of Trail-Breaking Duties.

Equipment. Each member of the trail-breaking party carries certain equipment:

- Party leader carries a compass, map, route card, or overlay.
- Breakers and straighteners carry a hatchet or machete and wire cutters.
- Cutters carry a hatchet or machete.
- Packers carry trail-marking material and a shovel.

Rotation of Duties. To avoid exhaustion in a given position, the party leader must regularly rotate the duties among Marines.

Marking The Trail

A trail usually needs to be marked to prepare for limited-visibility conditions. Methods for marking the trail include the following:

- Breaking branches on trees and bushes in a pre-determined manner.
- Placing flags, sticks, or guiding arrows in the snow.
- Tying markers made of rags or engineer tape to trees.
- Making cairns (manmade mounds) of snow or small piles of brush.
- Using cyalume lights (chem light). However, light should be shielded from enemy observation. Cyalume, when cold, illuminates weakly.
- Using the beverage base powder from meals, ready to eat (MREs).

SLED PULLING

Leaders must select the movement technique most appropriate to the conditions and the Marine's level of training. Trail-breaking techniques may be done on snowshoes or skis. Towing a sled while on skis demands a high level of proficiency. However, most units use snowshoes (see Figure 7-4). If skis are used, the personnel towing equipment should have climbing skins; if skins are not available, personnel should use snowshoes.

Figure 7-4. Basic Snowshoe Movement with a Sled.

Personnel might have to disconnect the trace from the sled and reconnect it at a different attaching point as the terrain changes. The following tips offer different configurations for flat ground, ascending, descending, and moving side slope, regardless of whether Marines are traveling on skis or snowshoes:

- One team member can assist the sled puller by pushing the sled from the rear with the poles, as shown in Figure 7-5.

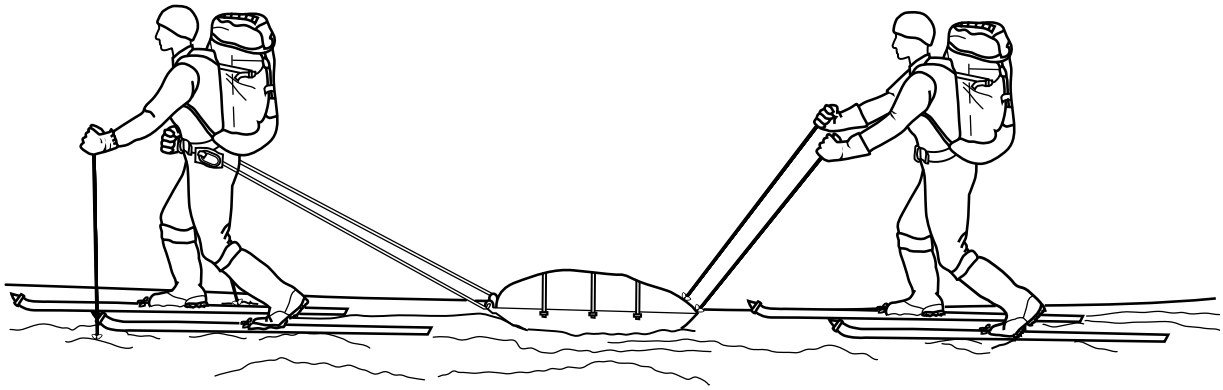


Figure 7-5. Assisting the Sled Puller.

- When descending moderate slopes, one Marine should attach a trace from themself to the rear of the sled and move behind the sled while assisting the sled puller in the descent, as shown in Figure 7-6.

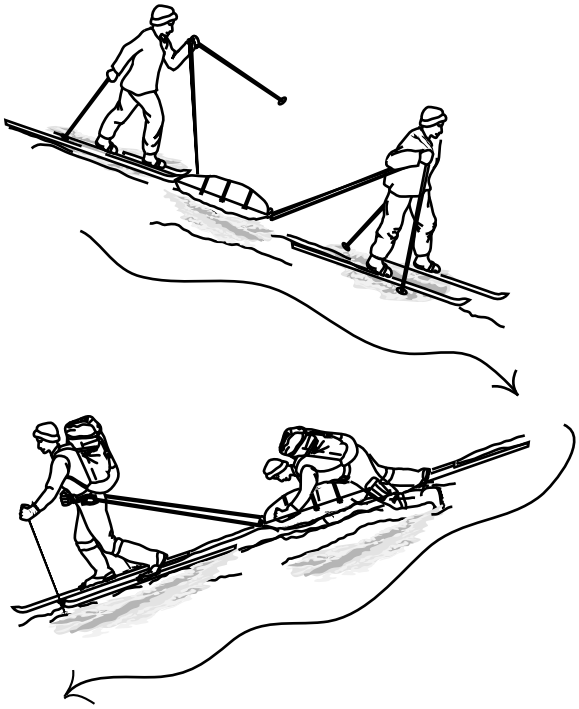


Figure 7-6. Moving Down a Moderate Slope.

- Attach a trace to the sled when traversing a moderate slope. A Marine uphill from the sled attaches the trace from themself to both sides of the sled to maintain balance and prevent the sled from sliding out, as shown in Figure 7-7.

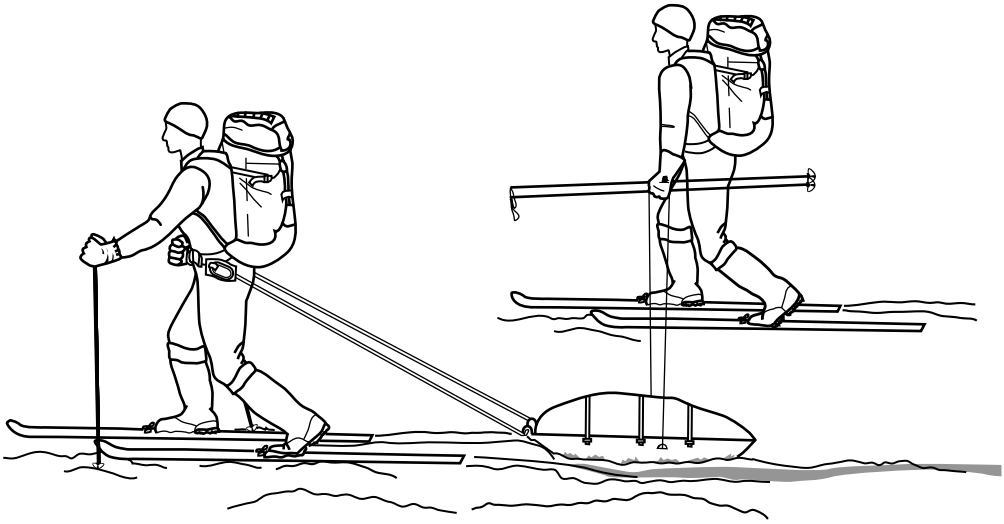


Figure 7-7. Traversing a Moderate Slope.

- Sled-pulling teams must be rotated frequently to avoid exhaustion.
- A belay rope may be used to assist moving the sled on steep slopes.
- Ascending steep slopes may require two sled pullers with assistance from a third using ski poles, as shown in Figure 7-8.

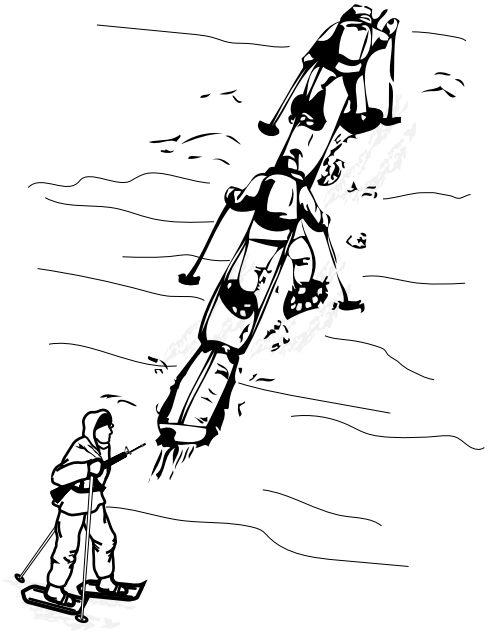


Figure 7-8. Ascending Steep Slopes.

CHAPTER 8.
CASUALTY EVACUATION IN MOUNTAIN WARFARE

GENERAL CONSIDERATIONS

Marines use a general set of guidelines for casualty evacuations regardless of how serious the injury is. These considerations can be remembered using the mnemonic "A PASS NGG":

- **A**pply essential first aid. Apply lifesaving steps, such as splints or pressure bandages.
- **P**rotect the patient from the elements. Provide the casualty with proper insulation from the ground, such as a sleeping bag, field tarpaulin, or bivvy cover, ensuring that they are warm and dry. If there are any natural hazards, such as falling rocks or lightning, the casualty should be moved as quickly as possible, or responders should ensure that they are well protected and helmeted.
- **A**void unnecessary handling of patient.
- **S**elect easiest route. Send scouts ahead, if possible, to break trails.
- **S**et up relay points and a warming station. If the route is long and arduous, set up relay points where a fresh litter team may be waiting or where a system for raising or lowering has been emplaced. These relay points should also provide warming stations with minimum amount of medical personnel to—
  - Permit emergency treatment. Treat for shock, hemorrhage, or other conditions that may arise.
  - Constantly re-evaluate the patient. If the patient develops increased signs of shock or other symptoms during the evacuation, they may be retained at an emergency station until stable.
- **N**ormal litter teams must be augmented in arduous terrain. In a mountainous environment, a minimum of six Marines makes up a normal litter team.
- **G**ive litter teams specific goals. The litter team's job is extremely tiring, both physically and mentally. The litter teams must be given realistic goals.
- **G**ear remains with casualty. Ensure all the patient's gear is kept with them throughout the evacuation.

EXPEDIENT LITTERS

Marines use five expedient litters —the sling rope carry, rope coil carry, pole carry, the alpine basket, and the field tarpaulin litter.

Sling Rope Carry

The sling rope carry requires a 15-foot sling rope and two people. One person is the bearer, and the other is an assistant to help secure the casualty to the bearer. Casualties—conscious or unconscious—can be transported in the following manner:

- Bearer kneels on all fours and the assistant places the casualty face down on the bearer's back, ensuring the casualty's armpits are even with the bearer's shoulders.
- The assistant then finds the middle of the sling rope and places it between the casualty's shoulders and the ends of the sling rope are run under the casualty's armpits, crossed, over the bearer's shoulders, and under their arms.
- Then the ropes are run between the casualty's legs, around the thighs, and tied with a square knot with two overhands just above the bearer's belt buckle (see Figure 8-1).

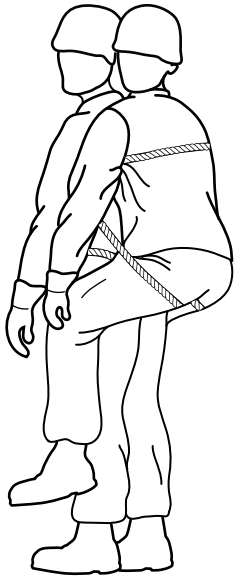


Figure 8-1. Sling Rope Carry.

The assistant ensures the rope is tight. Padding, when available, should be placed where the rope passes over the bearer's shoulders and under the casualty's thighs.

Rope Coil Carry

The rope coil carry requires a bearer and a rope coil. Casualties—conscious or unconscious—can be transported in the following manner:

- The bearer positions the casualty on their back.
- The bearer separates the loops of the mountain coil into two approximately equal groups and then slips one-half of the coil over the casualty's left leg and one-half over their right leg so that the wraps holding the coil are in the casualty's crotch and the loops extend upward toward the armpits (see Figure 8-2).

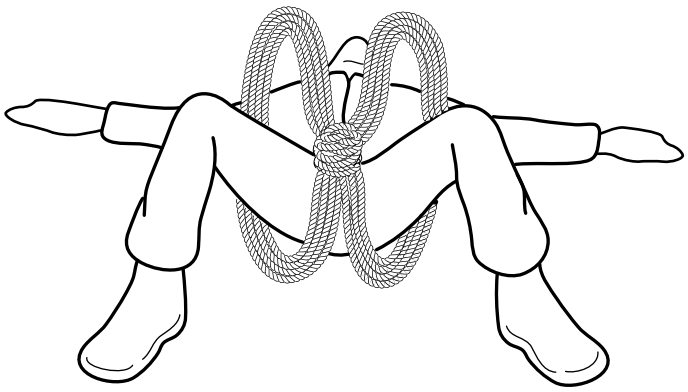


Figure 8-2. Rope Coil Carry Rope Placement.

- The bearer lies on their back between the casualty's legs and slips their arms through the loops. The bearer then moves forward until the coil is extended.
- Grasping the casualty's right or left arm, the bearer rolls over, rolling to the casualty's uninjured side, pulling the casualty onto their back.
- Holding the casualty's wrists, the bearer carefully stands, using their legs to lift up and keeping their back as straight as possible (see Figure 8-3).

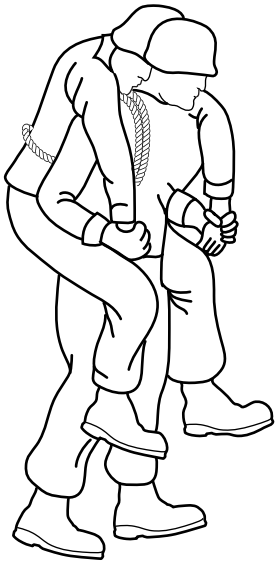


Figure 8-3. Rope Coil Carry.

NOTE: The length of the coils on the rope coil and the height of the bearer are to be considered. If the coils are too long and the bearer happens to be a shorter person, the coils must be uncoiled and shortened. If this is not done, then the casualty hangs too low on the bearer's back and make it a very cumbersome evacuation. A sling rope harness can be used around the victim's back and the bearer's chest, which frees the bearer's hands.

Pole Carry

The pole carry is a field expedient method. This method should be considered as a last resort only when narrow ledges must be traversed, or vegetation limits the bearers to a narrow trail. This method is difficult for the bearers and uncomfortable for the casualty. Two bearers, four sling ropes, and a 12-foot pole (3 inches in diameter) are required for this carry:

- The casualty is placed on their back in a sleeping bag or wrapped in a field tarpaulin or blanket, and then placed on an insulated pad.
- One sling rope is placed under the casualty below the armpits and tied with a square knot across the casualty's chest. The second sling rope is tied in the same manner at the casualty's waist. The third sling rope is placed at the casualty's legs below the knee. The fourth sling rope is tied around the ankles (see Figure 8-4).

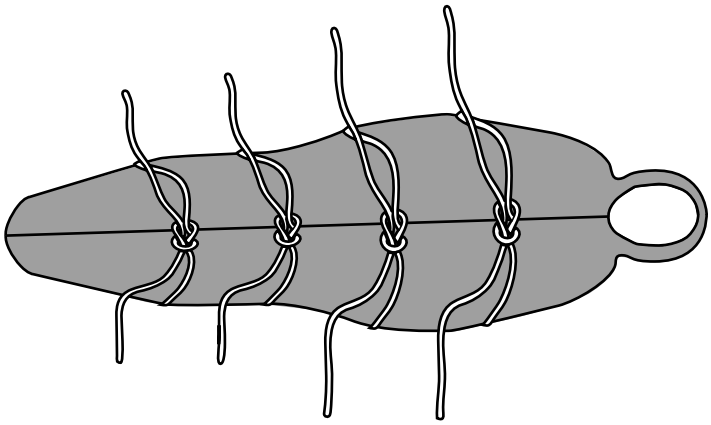


Figure 8-4. Pole Carry Rope Placement.

- The pole is placed along the casualty's length and secured using square knots with two over-hands with the ends of the sling ropes. The square knots should be so tight that the over-hands are tied onto themselves (see Figure 8-5).
- The casualty should hang below the pole, as close to the pole as possible, to prevent swinging during movement.
- The casualty's head may be supported using a triangular bandage or a cartridge belt passed around the pole.

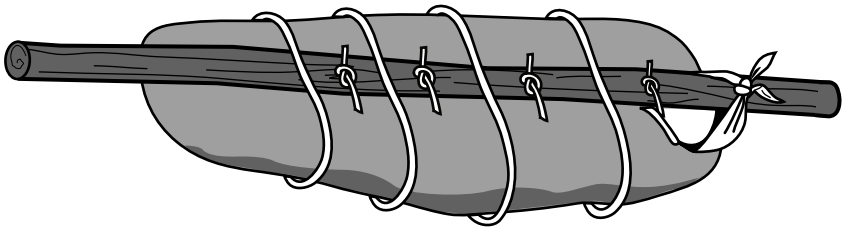


Figure 8-5. Pole Carry.

For additional support while moving, two additional bearers may be required, as well as a mountain coil. The mountain coil is split into two equal coils. Then the knot of the mountain coil is placed under the casualty's lower back. Additional bearers slip into each half of the hasty coil, one on each side of the casualty, aiding in support and movement of the casualty.

Alpine Basket

The alpine basket is an expedient rope litter constructed using a 165-foot static or dynamic rope.

Constructing the Alpine Basket. The following are instructions to construct an alpine basket:

1. Start by tying an end-of-the-line figure-eight loop and then laying down the rope to make 24 to 36 inch-long bights that span the height of the casualty's body (see Figure 8-6). Ensure the bights stay no more than 4 inches apart from one another.

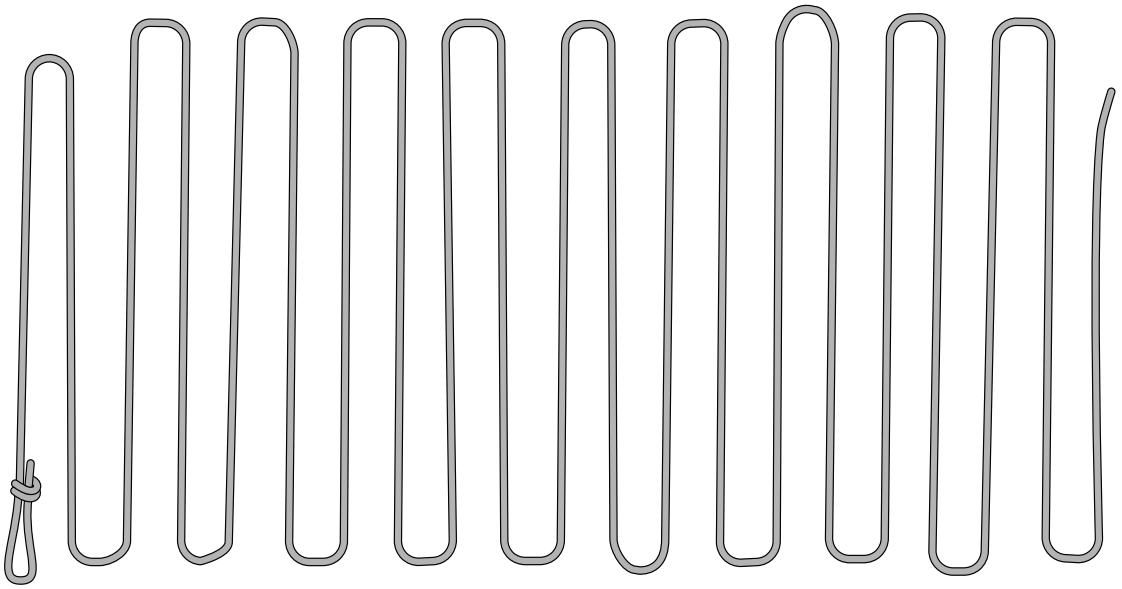


Figure 8-6. Laying the Rope to Construct an Alpine Basket.

2. Place padding, such as an improved sleeping mat or sleeping bag, on top of the bights and then lay the casualty on the padding and bights, as shown in Figure 8-7. The litter can be made rigid by adding poles, sticks, or skis.

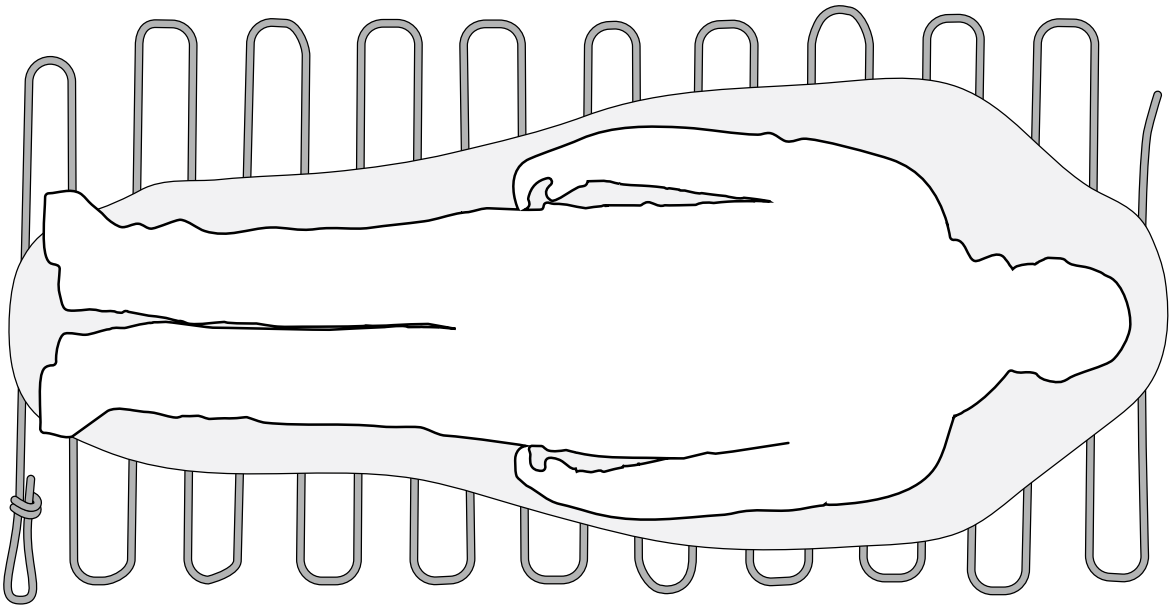


Figure 8-7. Placing the Casualty on the Rope.

3. Start at the left or right side of casualty's feet and pull the first bight up around the casualty's ankles and through the figure-eight loop tied into the starting end of the rope, ensuring that the figure-eight loop goes around the soles of the feet, as shown in Figure 8-8.

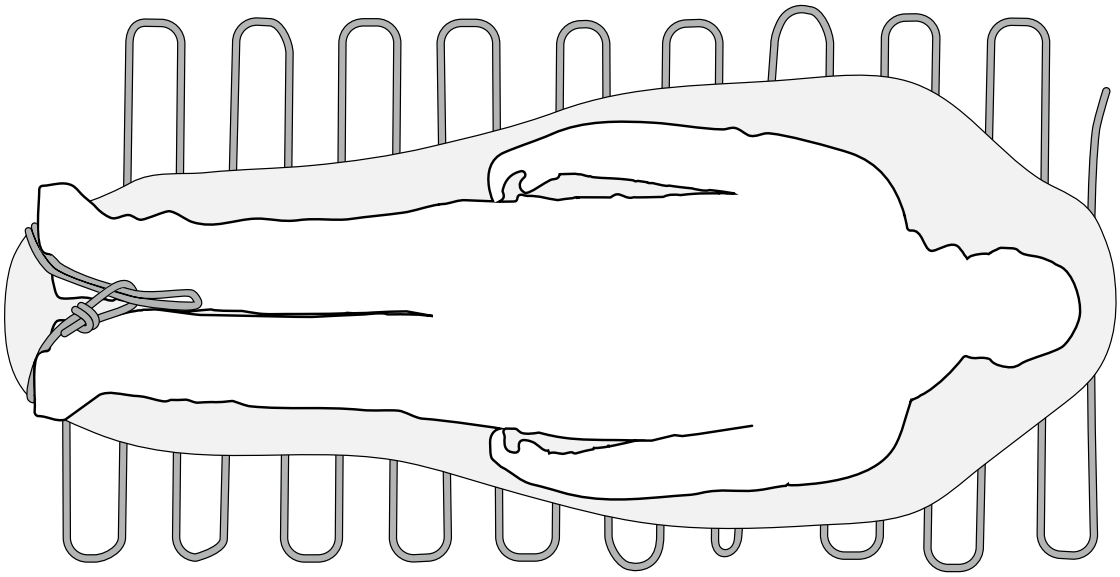


Figure 8-8. Securing the Casualty's Feet.

4. Cross to the opposite side of the casualty and pull up the second bight through the loop formed by the bight that was pulled through the figure-eight loop. Continue the process until getting to the casualty's armpits, as shown in Figure 8-9.

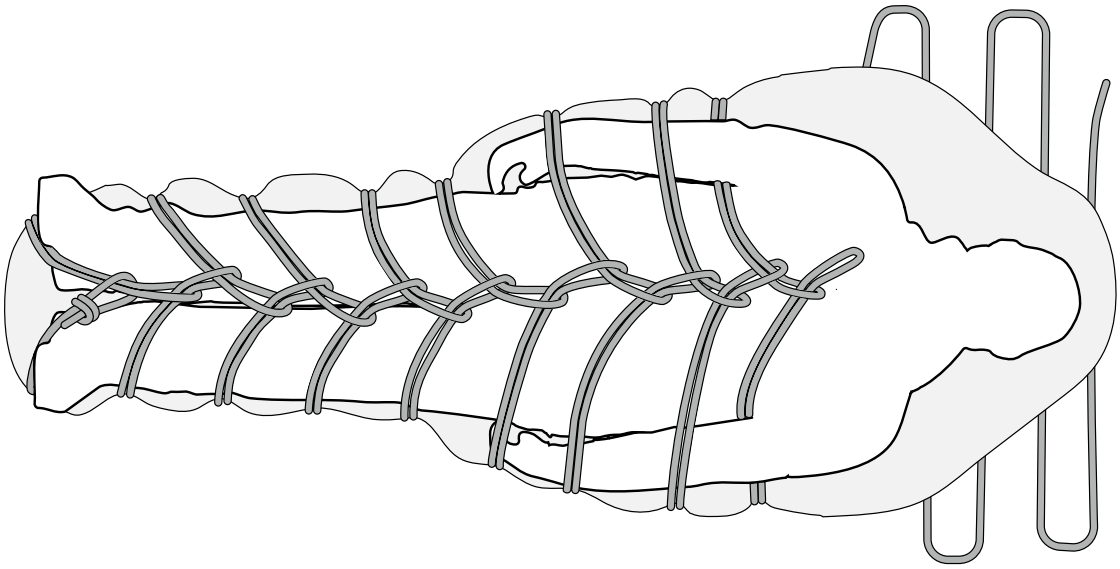


Figure 8-9. Securing the Casualty to the Rope.

5. Twist the second to the last bight creating a half hitch underneath the back of the casualty and then bring it up over the casualty's shoulder and into the last bight formed.
6. Twist the last bight creating a half hitch under-neath the back of the casualty and then bring it up over the casualty's other shoulder and into the last bight formed.

7. From the running end of the rope, bring a bight over the casualty's shoulder and through the last bight formed, as shown in Figure 8-10.

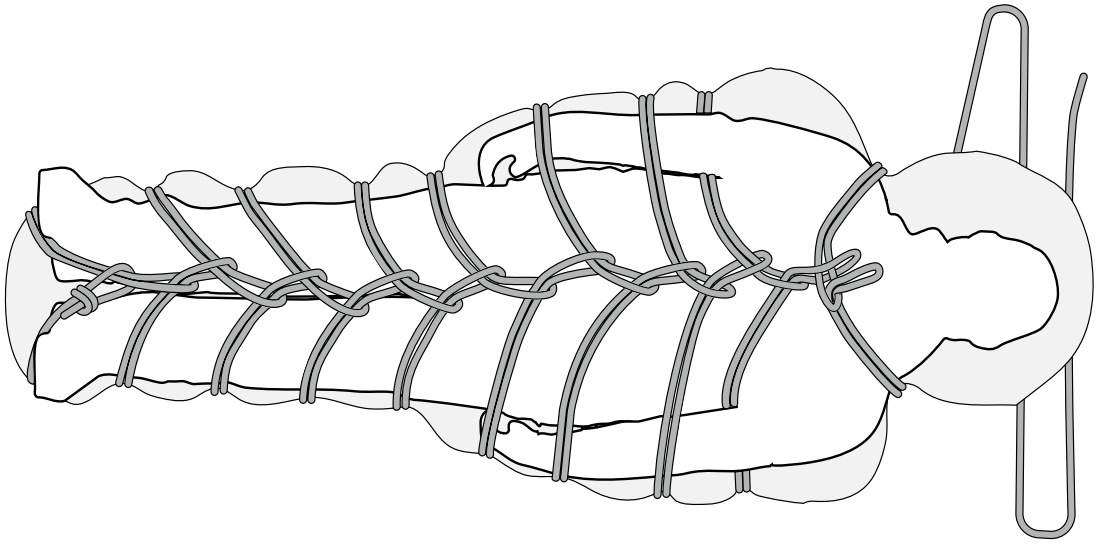


Figure 8-10. Securing the Casualty's Shoulders.

8. Secure the last bight with a round turn and two half hitches, leaving a big enough bight to tie a figure-eight loop at the end, as shown in Figure 8-11. This loop becomes the hook in point for vertical lowering.

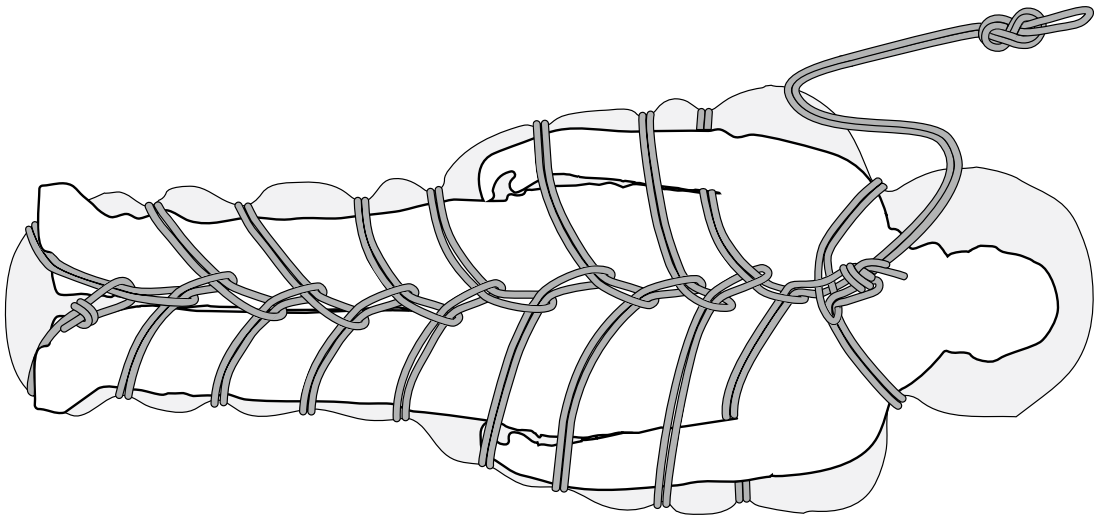


Figure 8-11. Securing the Last Bight.

Belaying the Alpine Basket. For vertical raising or lowering, hook the belay line into the figure-eight loop hook in point previously discussed. For horizontal raising or lowering, three pre-rigs are attached to the bights that were formed coming through the loops at the feet, at the waist, and at the chest. A tag line from the bottom must be implemented to keep the casualty away from the cliff face on the descent.

Field Tarpaulin Litter

A field tarpaulin, field tarpaulin liner, bivvy cover, or similar piece of material may be used to create a field tarpaulin litter. In addition, six individuals with sling ropes are needed. The following are instructions on how to employ a field tarpaulin litter:

1. Lay field tarpaulin litter flat on the ground.
2. Select six rocks about the size of a golf ball. Place one rock under each of the corners and under the middle on each side of the tarpaulin. If a bivvy cover is used, the casualty should be zipped inside the bivvy cover. The rocks should then be arranged in the same manner only on the inside below the zipper.
3. Tie the sling rope together with an overhand knot. Take the middle of the rope and secure it around the rock with a clove hitch.
4. Place the casualty on the litter. The sling ropes are adjusted by feeding the pigtails of the over-hand knot through itself to adjust for length. The loop is then put over the inboard shoulder of the carriers. Ensure that the casualty is carried level.

NOTE: A sleeping mat may be laid on the field tarpaulin to help make the litter firmer.

ROUGH TERRAIN LITTERS

Two litters are typically used for rough terrain CASEVACs in moderate to vertical terrain—pliable or lightweight flexible litters and rescue baskets. Each has a set of procedures for securing a casualty and rigging the litters for either raising or lowering.

Flexible, Lightweight Litters

Flexible, lightweight litters (see Figure 8-12) are constructed of thin plastic, straps, and grommets.

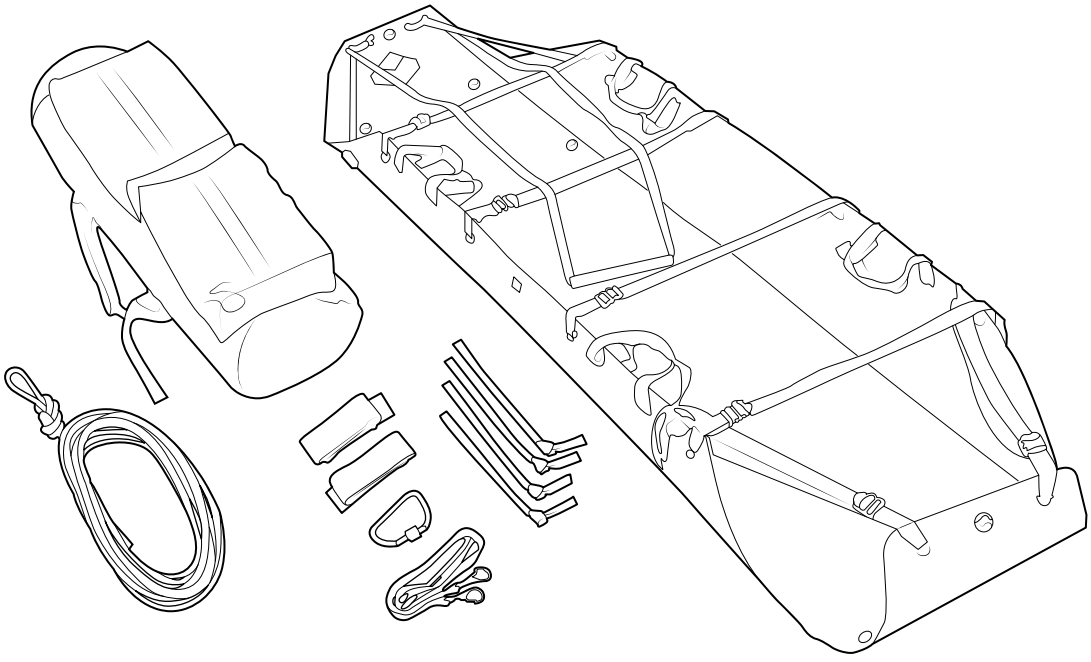


Figure 8-12. Litter and Components.

Securing a Casualty to the Litter. To secure a casualty to a litter, the rescuer must—

1. Unroll the litter. The litter must be rerolled the opposite way to allow the litter to lay flat. Then lay the litter next to the casualty.
2. Spine splint any suspected spinal injury. Experienced medical personnel are recommended if spinal immobilization is necessary.
3. Tie a safety line, using a sling rope, around the casualty with both an around-the-body bowline and an end-of-the-line figure-eight loop. Ensure the safety line is long enough to remain slack if the litter is connected to a lowering or raising system.
4. Insulate the body as needed, such as with a sleeping mat or sleeping bag, and place the casualty on the litter. If spinal injury is suspected, carefully roll the casualty onto the litter. Use the four body straps to secure the casualty to the litter. Secure the buckles by tying half hitches around the straps. Unless injuries prevent this, the casualty's arms should be at their sides to prevent further injuries to themself or the rescuers.
5. Secure the feet straps once the casualty is secured with the body straps. The feet straps are secured last to ensure the casualty is in the proper position on the litter. The feet can be positioned in three ways: feet together with the straps running on the outside of the feet, feet apart with the straps running on the inside of the feet, or feet stacked. Once the feet are positioned, the feet straps must be secured. Bend the feet end of the litter to form a platform for the feet, loop the feet straps through the second grommets on each side, and feed them back through the buckles. Secure the buckles by tying half hitches around the straps.

   NOTE: The third position is the most uncomfortable position and not recommended for casualties with possible spinal cord injuries. This position is formed by placing the heel of one foot on top of the toes of the other and should only be used if in confined spaces.

6. Form the head end to protect the casualty's head, but, if possible, they should wear a helmet. Form the head end by tying the pull strap up and securing it to the first body strap with a round turn and two half hitches.

Evacuating the Casualty. There are many ways to move a casualty once in the litter; however, the CASEVAC team must keep the general considerations in mind, including the possibility that Marines may not know what terrain will be encountered during a CASEVAC. Therefore, Marines should rig for the vertical and horizontal lifting before the CASEVAC begins. The two simplest methods that require the least amount of additional rigging are—

- To drag the casualty by the drag strap located at the head end of the litter on wet grass, scree, ice, or snow. Rescuers can also use the litter's carrying bag as a harness with the pull strap and towing harness that is rated to 300 pounds. If additional bearers are required, cordage can be added to the pull strap or the front carrying handles.
- To carry the casualty using the carrying handles. Runners and sling ropes can be tied on carrying handles to create shoulder slings for initial bearers. Additional runners and sling ropes can be attached to intermediate grommets to create carry handles and slings for additional bearers.

Rigging the Litter for Vertical Terrain and Helicopter Lift. On vertical terrain, the vertical raise or lower can be used if the cliff is not uniform, there is a chance of rock fall, or the casualty is to be lowered through trees. Ensure that the casualty's head is always above their feet. The following special steps must be taken to vertically raise or lower a casualty in the litter:

1. Identify the 30-foot practice coil, which is rated at 5,200 pounds, that comes with the litter. Then, tie a figure-eight loop in the middle of the rope.
2. Pass each end of the rope through the grommets at the head of the litter, leaving approximately 6 inches of rope between the stretcher and the knot. The top of the loop should be within an arm's distance from the top of the litter.
3. Tie an overhand knot on both lengths of rope just behind the grommets near the head. These stopper knots prevent the litter from collapsing around the casualty when the line is pulled.
4. Continue to feed each end of the rope through the grommets and the carrying handles toward the foot end of the litter. The rope must pass through a minimum of two carrying handles and five grommets per side.
5. Pass the ends of the rope through the last grommets at the foot end, ensuring that they run below the feet, and secure the two ends with a square knot and two overhand knots.
6. Connect the figure-eight loop from the 30-foot practice coil and the figure-eight loop of the safety line with the large locking carabiner that comes with the litter rated at 9,000 pounds. If the carabiner is worn or missing, opposing issue locking carabiners can suffice.

> NOTE: If the rope is worn or missing, the same process can be done with two sling ropes. Tie the sling ropes together with an end-of-the-line knot and offset the knot slightly before tying the middle-of-the-line figure-eight loop.

Rigging the Litter for a Horizontal Employment. A horizontal raise or lower is preferred on uniform vertical terrain. The horizontal employment allows the rescuer to assist the casualty on either a raise or lower. It also allows the rescuer the ability to monitor the casualty's condition and to treat them, if necessary. Rigging the litter for horizontal employment is done by—

1. Identifying the two nylon-webbing straps rated at 9,000 pounds each. They should be two lengths, one 4 inches shorter than the other. The shorter strap should be marked HEAD STRAP.
2. Inserting one end of the head strap into the larger diagonal slot near the head of the litter, wrapping the rest of the straps under the litter, and passing the other end through the opposing slot. Do the same at the foot end of the litter with the other strap using the two diagonal slots found there, ensuring that the straps run smoothly under the litter.
3. Connecting the strap ends and the figure-eight loop of the safety line with the large locking carabiner that comes with the litter rated at 9,000 pounds. If the carabiner is worn or missing, then opposing standard issue locking carabiners can suffice.

> NOTE: When lifting the casualty with a helicopter, a tag line should be employed to prevent the litter from spinning.

Rescue Baskets

Rescue baskets are constructed of metal tubing with a plastic covering. It is formed in a rectangular basket shape with mesh attached to the frame, as in Figure 8-13. The rescue basket should be padded for the casualty as with any other type of evacuation method.

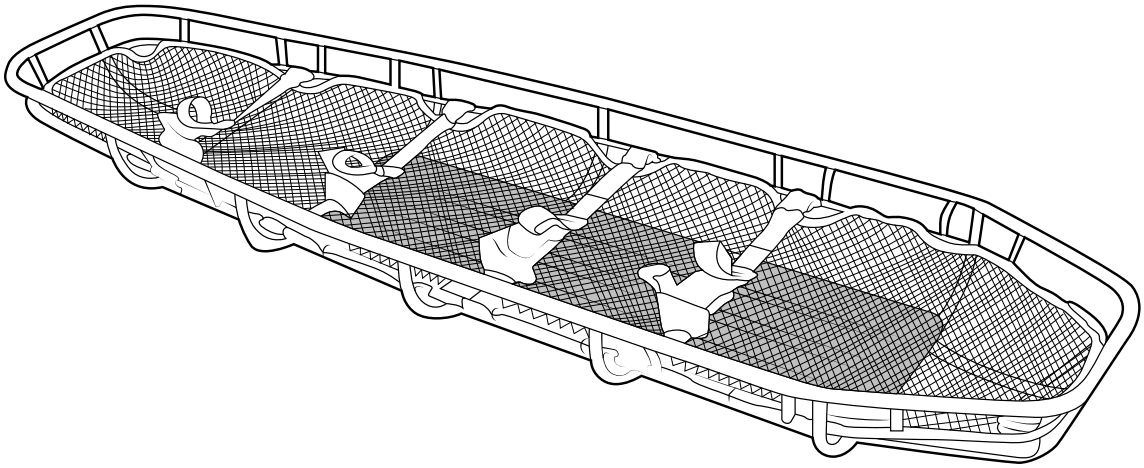


Figure 8-13. Rescue Basket.

If the "seat belts" are missing, sling ropes can be used to secure the casualty into the rescue basket:

1. Tie two sling ropes together using square knots with overhand knots.
2. Tie a stirrup hitch around the ankles and feet and feed the two pigtails through the right angles of the basket. Do not cross the ropes at the ankles.
3. Lace the sling rope toward the casualty's head by passing the rope through the right angles—not over the top of the rails—of the basket.
4. Secure the ends of the sling ropes by tying a clove hitch with two half hitches on the thick vertical bar located by the victim's shoulder.

ASCENT OR DESCENT OVER STEEP TO MODERATE SLOPES

When the litter team is ascending or descending a slope, they must consider the potential for further injury to the casualty or to themselves. If the risk of injury is high, a belay line may be used to prevent injury to the casualty and the rescuers. The site selection considerations for a belay line are suitable anchor points, clearance for casualty along the route, and good loading and unloading points.

Preparing the Casualty

Marines should prepare the casualty for vertical employment when on steep to moderate terrain, selecting the smoothest possible route. Rescuers can use two methods to move a casualty in step to moderate terrain—standard and caterpillar. In both methods, the rescuers should ensure the casualty's head is above their feet when they are lifted.

Standard Method. The standard method requires four people to position themselves on each side of the litter. They can then carry the litter using the handles or shoulder slings. In steep terrain, rescuers are belayed by attaching themselves to the litter.

Caterpillar Method. The caterpillar method requires at least six individuals (two on each side to balance the casualty, and two to move the casualty up or down). As the litter is raised or lowered, each member hands the litter to the next member in the tunnel. As the litter passes to each person, that person peels off and assumes the lead at either the top or bottom of the tunnel. This process continues until the litter reaches its desired destination.

Using a Belay Line

On steeper terrain or on vertical terrain no higher than 15 feet, one static rope from above can be used to belay the casualty and the rescuers. There are two belay methods that can be used: body and direct.

> NOTE: Whichever system is used, the rescuers need to be able to disconnect themselves from the litter in an expedient manner.

Body Belay. Rescuers should only use the body method on moderate terrain. After anchoring the rope, the belay person sits behind a suitable anchor, such as a rock or a tree and passes the standing end of the rope behind their back. The running end of the rope feeds out from the belay person's right side. A figure-eight loop is tied to the end of the running end of the rope. It is then attached to the litter's figure-eight loop with a locking carabiner. The belay person removes all the slack between themself and the litter. The standing end of the rope should be stacked on the belay person's left side and run through their left side. As the casualty is lowered, the belay person feeds the rope from behind their back allowing it to run through their right hand. If the belay person needs to stop the casualty, they clench the rope in their left hand and bring the rope to the center of their chest.

Direct Belay. The direct belay method is the safest for either raising or lowering a casualty in moderate to steep terrain. If more than one lowering/raising system is required, relay teams must be sent out ahead of time to emplace the successive systems so that less time is lost during the process. Rescuers should consider the length of the available rope when selecting successive anchor points and loading and unloading stations. Whether or not additional ropes are used, the litter must be on belay on the new system before it is taken off belay and disconnected from the previous system. If additional ropes are not used on the litter, the standing end of the rope is not connected to an anchor; instead, a stopper knot is tied at the end. On steep terrain, rescuers may require a belay, which can be accomplished using one of following methods:

- Around the chest bowline with an end-of-the-line figure-eight loop.
- Swiss seat with or without a cow's tail.
- Sit harness with or without a cow's tail.

For more information about these methods, refer to MCRP 12-10A.3.

Lowering a Casualty. To lower a casualty, the rescuers tie and establish a suitable anchor. Two locking carabiners are clipped into the anchor with gates up. A figure-eight loop is tied into the running end of the rope and attached to the litter with a locking carabiner. The standing end of the rope is secured around a suitable anchor. After all the slack has been taken up between the litter and the anchor, the rope must be tied through an apparopriate belay device. If a belay device is being used, ensure the rope is redirected into the shelf to maintain the brake position. If a belay device is not available, use a munter hitch on a locking carabiner with a 12 o'clock brake position. The belay device is attached to the anchor through one of the two locking carabiners on the anchor (see Figure 8-14).

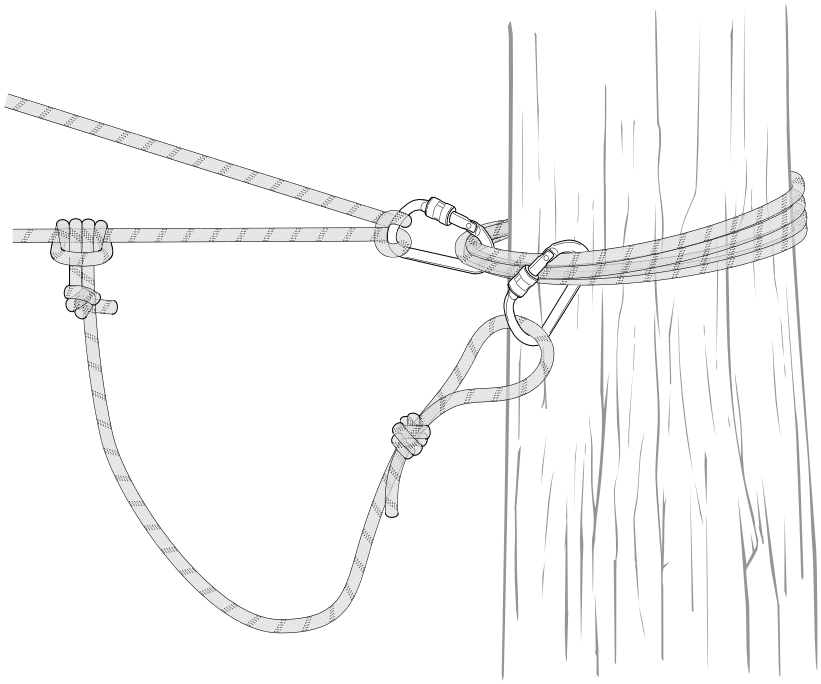


Figure 8-14. Direct Belay for Lowering.

A safety prusik, (end-of-the-line or middle-of-the-line) prusik (see Figure 8-15), will be tied to the running end (or middle) of the rope and clipped into the second locking carabiner on the anchor. While the casualty is being lowered, one person controls the rope running through the belay device. The safety prusik is controlled by a second person. Should the primary belay person lose control, the person operating the safety prusik would let go and the prusik binds onto the rope, stopping the casualty.

> NOTE: If enough gear and suitable anchors are present, it is preferred to use a separate anchor and tie-in point for the safety prusik.

Raising a Casualty. To raise a casualty, the anchors are established in the same manner as discussed in lowering the casualty; however, instead of running the rope through a belay device, the rope runs only through a locking carabiner. The load is raised using a mule team, which is composed of 6 or more Marines. The mule team raises the load in as straight a line from the anchor as possible. If the space does not permit the mule team to walk straight back, a 90-degree offset from the anchor can be used. The mule team walks backward until the last person reaches the limit of advance. Once the Marine reaches that limit, they peel off the end and return to the front of the mule team. This process continues until the casualty reaches the top. If the load becomes unmanageable, the team should use the safety prusik while the mule team repositions. If the person operating the safety prusik cannot see the casualty, a point-person (typically an NCO) oversees communication with the mule team. If a mule team is not available, a mechanical advantage system can be employed. For example, if the path of the casualty does not run in a straight line, the team can redirect the casualty by slinging a suitable intermediate anchor and clipping the rope to it using a non-locking carabiner.

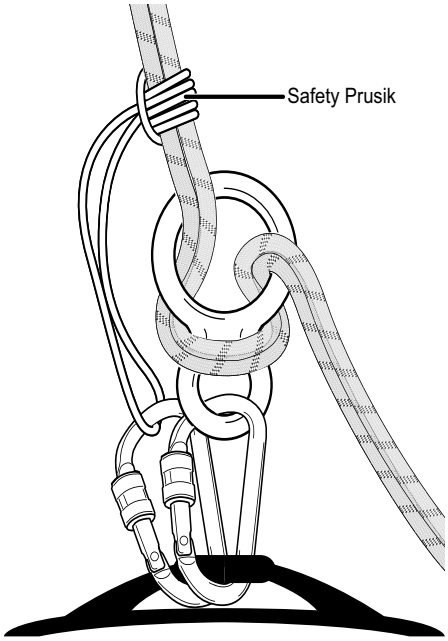


Figure 8-15. Safety Prusik.

VERTICAL HAULING OR LOWERING SYSTEM

The purpose of the vertical hauling or lowering system is to move equipment and personnel over vertical terrain. Given complexity of the system, mountain leaders should be used to construct the vertical hauling or lowering system. It can be used with an alpine basket or a flexible litter or rescue basket. For more information on constructing and attaching the attended, patient, or equipment to the vertical hauling or lowering system, refer to MCRP 12-10A.3.

TANDEM LOWER

The tandem lowering system can be used for the walking wounded, or enemy prisoners of war.

Rigging

The assistant to the casualty should first tie a rappel seat and then assist the casualty with their own; sit harnesses may also be used. The assistant ties an end-of-the-line figure-eight loop to the belay line and clips it into the rappel seat using a locking carabiner. An alpine butterfly knot is tied 12 to 18 inches up the rope from the figure-eight loop, as shown in Figure 8-16 and clipped to the casualty's rappel seat using a locking carabiner.

If needed, an adjustment prusik should be tied above the casualty's directional figure-eight loop. It is used to adjust the position of the rescuer in relation to the casualty. The prusik is clipped in the rescuer carabiner along with the end-of-the-line figure-eight loop.

Figure 8-16. Rigging Tandem Lower.

Execution

The casualty straddles the rescuer and both lower as one, with the rescuer helping on the way down the cliff.

SUSPENSION TRAVERSE OR ROPE BRIDGE EVACUATIONS

All techniques discussed for the evacuation of a casualty from top to bottom can also be used on a suspension traverse or rope bridge, with a slight variation in the belay line. Two belay lines can be used for rope bridges and the suspension traverse if they are available. No matter what type of litter is used, Marines involved in the evacuation must ensure that the head is not lower than the feet.

OVER-THE-SNOW LITTER

The team sled MCCWIK can be used for over-the-snow CASEVAC and is discussed more in Chapter 14. Joint or allied partners may use different or larger sleds. Casualties can be prepared for movement in both the team and large sleds in the following ways:

- Team Sled. Place the casualty's sleeping mat or extra clothing inside the sled as insulation and padding. Place the casualty's sleeping bag inside the team sled with them in it. Secure the straps across the casualty's chest, knees, and shins. Rescuers can also place skis under the victim to provide spine precautions and to help support the legs out of the sled. When transporting, try to keep the victims head uphill.
- Large Sled. Place the casualty's sleeping mat or extra clothing inside the sled as insulation and padding. Place the casualty's sleeping bag inside the sled and them in it. Secure the casualty with the internal straps and by closing the sled cover over them. The decision to cover the face is based on weather conditions. Try to keep the patient's head uphill.

EVACUATION BY GROUND VEHICLES

Vehicle requirements vary depending on the mission and the terrain. Wheeled vehicles are usually limited to maintained roads (i.e., snow plowed). Chains are frequently required, even with four-wheel drive. Tracked vehicles, LAVs, and ACVs are also limited. Over-the-snow vehicles, such as snowmobiles or SUSVs, are ideal for snow-covered terrain.

EVACUATION BY AIR

Casualty evacuation by air is ideal because it is quick and less stressful for the patient. However, there may be restrictions placed on the aircraft due to enemy situation, altitude, temperature, weather, and deep snow considerations.

CHAPTER 9.
MOUNTAIN PATROLLING

Mountainous terrain forces decentralized operations by small units. Although there are various missions in mountain operations, patrolling forms the backbone of all small-unit actions. Patrol leaders should ensure that all Marines are well informed of the mission, route plans, time estimates, key guiding features, catching features, lost Marine plan, CASEVAC plan, areas of hazard, and have an overview of the terrain that will be traveled (that includes elevation gain and loss). It is critical to select the right equipment to balance weight, mission-critical items, and personal survival items to conduct a successful patrol.

EQUIPMENT AND SUPPLIES

During planning, leaders should consider the following mountain-specific factors:

- Unnecessary equipment leads to unnecessary weight and strain on the body. Patrol leaders must decide what equipment is critical. Calculated risks must be considered to reduce the individual's burden so that the patrol can physically complete the mission.
- Using the mountainous, cold-weather warfighting loads as a guide, leaders can ensure that their Marines are prepared for inclement weather and, if necessary, capable of establishing an expedient shelter.
- Units can use sleds used to carry mission-essential equipment but may result in a reduction of the patrol's agility and overall speed.
- More water than food should be carried. The unit should carry a water purifier, or everyone should carry purification tablets for use with natural water sources.
- Everyone should have a small trauma first aid kit, and the unit should have means to conduct CASEVAC.
- Ropes can help overcome obstacles but are heavy. Thorough planning must be conducted to determine the number or ropes required.
- Track discipline must be strictly enforced. Whenever feasible, patrols should be inserted by air.

GENERAL ORGANIZATION

Units can use general patrolling formations with the following considerations:

- The patrol's exact size and composition depends on the mission; however, the "arctic buddy system" should be used for security, chow, and bivouac routine.
- Mountain and arctic patrols are usually larger so they can carry more gear, provide additional firepower, and assist in trail breaking and CASEVACs.

- The unit may have additional attachments, such as mountain leaders, assault climbers, scout swimmers, and pack animals.
- Using sleds on patrols should be avoided to maintain mobility and minimize signature.
- Compartmentalized terrain limits communication and control of subordinate units. All elements should be able to operate on their own and be prepared to move in independent lanes as satellite units.

ESTIMATE OF THE SITUATION

As in a temperate climate, a patrol leader must make an estimate of the situation. Although the basics are similar, some additional considerations must be addressed in a mountainous, cold weather environment regarding METT-T, space, and logistics considerations.

Mission

Along with reconnaissance and combat patrols, various other patrolling missions peculiar to a cold weather environment are—

- Reconnaissance of the battle area and particular targets, while establishing a forward presence.
- Harassing the enemy lines and depriving them of shelter and rest.
- Using ski or helicopter deep penetration to destroy logistic supply lines.
- Installing observation posts and radio relay and retransmit sites.
- Picketing on the high ground of a unit's flanks during the advance.
- Tactical recovery of aircraft and personnel.

Enemy

To assess the enemy, a SALUTE [size, activity, location, unit, time, and equipment] report is the standard format used, with some additional considerations peculiar to this environment. One method for determining these considerations is to evaluate one's own unit. Understanding how the human nature aspect might influence one's unit can help determine how the enemy deals with the elements and can be crucial in predicting how the enemy would select a route. Marines should be aware of how natural lines of drift tend to influence a unit and should consider the following:

- The type of mobility and ability level the enemy is using.
- The unit's discipline.
- The unit's morale.
- The enemy's last known action.
- The unit's resupply capabilities.

Terrain and Weather

The leader must gather as much information as possible about incoming weather patterns and do a thorough study of the terrain in which they will move.

Terrain. At high elevations, cold weather and even snow can be encountered all year. Slope angle and altitude slow the unit as they increase. Mobility becomes extremely difficult because of these factors, and it can tax the unit's endurance. The varied terrain encountered affects movement speed, concealment, and security. Units should consider the following:

- Above the tree line, the exposed terrain makes movement and security more difficult. Units should use micro terrain and shadows as much as possible to make observation from the enemy more difficult. Units should move during the hours of darkness whenever possible.
- Below the tree line, movement and patrol bases can be concealed by vegetation.
- A unit's mobility is decreased in mountainous terrain.
- Danger areas tend to be larger than other environments and have more on affect tempo and mobility more so than other environments.

Weather. Changing weather in the mountains requires leaders to be flexible in their planning. Severe weather can move in suddenly and last for several days, so Marines should always plan for the worst-case scenario and be aware of the following:

- Cold temperatures and high winds affect Marines, their weapons, and equipment. Individual response time is slowed, and the time schedule must reflect this.
- Snow cover affects the rate and mode of movement. Terrain can be affected if avalanche conditions exist. Snow depth and consistency may change considerably during the patrol and may greatly affect movement.
- Visibility becomes reduced during storms.
- High-latitude areas experience about four hours of daylight from November to February in the northern hemisphere (reverse seasons in the southern hemisphere). Mid-December has only a few hours of twilight per day.

Troops and Support Available

A mountainous, cold weather environment limits the use of some troop and fire support assets. The leader must consider how much support to expect from available assets.

Troops. Personnel considerations include the following:

- The size of the patrol depends on the mission.
- Members should be employed in arctic buddy teams.
- Cold weather patrols are generally larger because of the gear requirements, such as clothing or CASEVAC gear, and substantial firepower assets must be spread loaded among the members of the patrol. Keep the gear list limited to only that essential to the mission. Anything more can hamper mobility.
- Personnel must possess the physical abilities required to accomplish the mission under extremely arduous conditions.

Support Available. Support assets are going to be limited by the same conditions that the patrol is experiencing. Their reaction time may be slower because of the cold, and they may have difficulties operating their equipment. Ammunition may be less effective against certain targets. See Chapter 10 for additional information about the effects of cold weather on weapons and optics. General support considerations include the following:

- Air support may be grounded due to weather.
- Artillery may not be able to displace and typically has a slower response time in cold weather. In addition, terrain may mask portions of the area of operations.
- Mortars are an effective weapon in this terrain but are limited by their firepower and range.
- Rockets are effective but may be limited in extreme cold due to ice fog.
- Small arms may be limited in extreme cold because of reduced rate of fire and range of projectiles due to decreased burn rate of propellants, reduced chamber pressure, reduced muzzle velocity, and increased air density.
- Grenades and smoke must be pre-rigged with a floating device for snow before leaving the patrol base. Rocky terrain can absorb or amplify fragments depending on whether a grenade goes off above or below the rocks.

Time Available

In a cold-weather environment, leaders should consider the following when planning timelines—

- March rates are affected by terrain, weather, and visibility; type of mobility; danger areas; and avalanche conditions.
- Simple tasks typically take longer because of slower response times and difficulties handling gear in the cold.

Security will also be affected, particularly when the movement requires the commander to establish mountain pickets or use over-watch techniques. Speed, as a form of security, can be effective in some situations.

Space

Mountainous terrain typically appears more accessible on maps; however, planners must consider the elevation changes when selecting routes. A useful tool when planning for mountainous terrain is the TDF (see Chapter 4).

Logistics

Unusual weather and terrain conditions make supply, CASEVACs, transportation, and services more difficult and more time-consuming. More time is needed when moving supplies and troops because of the environment. The capacity of any support element to provide adequate logistic support may be the determining factor when evaluating the feasibility of an operation. Leaders must always be prepared to alter the plan. More detail on logistical considerations is found in Chapter 11.

PATROL LEADERS' CONSIDERATIONS

Planning must be precise, extremely detailed, and continually improved. In a cold weather, mountainous environment, there are specific planning and preparation considerations for a patrol such as the following:

- Designating wax and skins if the unit uses skis.
- Carrying shelter and equipment.
- Designating and briefing the trail-breaking party.
- Conducting immediate action drills for the type of mobility.
- Establishing objective rally points (ORPs) and patrol bases.
- Using skijoring activities.
- Communication (see Chapter 2).
- Transportation considerations (see Chapter 11).
- Selecting a route. More information on route selection is available in Chapter 4.
- Accountability of personnel. Patrol leaders should increase the frequency of head counts and always employ the buddy system, matching personnel of the same skill levels if possible, to ensure slower or less-experienced Marines are not separated.

See Appendix C for an example of a patrol order with winter considerations. See Appendix D for an example of a winter warning order matrix.

PATROL PREPARATION

Preparing equipment and personnel must be thorough. The challenging environment requires Marines to place more dependence on their equipment and fellow Marines. Orders should be complete and concise, using aerial photos, terrain models, and route cards. Every phase of the patrol must be rehearsed.

Camouflage

"Overwhites," or tactical winter outer clothing, need to be packed if there is snow anywhere on the route and they must be clean. The patrol leader dictates the overwhite pattern or outer camouflage layer in which to start and any changes during the patrol; individuals regulate their insulating layers. White tape should be firmly applied to all load-bearing equipment and weapons when in snow.

Immediate-Action Drills

It is essential to rehearse immediate-action drills for each mode of mobility until the reactions become second nature.

> NOTE: Because units conduct drills on snowshoes or skis and on varying terrain, training on appropriate firing positions and crawls should continue until the unit leader gets the results desired.

Break Contact. Conducting the "break contact" drill remains the same as in other environments; however, units must consider the firing positions. A Marine's initial reaction might be to drop down and return fire to suppress an engaging unit; however, because of the snow's consistency, Marines may drop into the prone position and be submerged into the snow, unable to return fire. Moreover, getting out of the prone position can be tiring and slow, causing Marines to be in the kill zone longer. Marines should lean or kneel behind cover and could use their rucksacks as a firing platform if out in the open. Depending on how Marines are carrying the weapon systems, reaction time is a critical factor to the success of the break in contact.

Once the Marine's snowshoes or skis are in the opposite direction of the enemy, all firing is conducted with the snowshoes or skis facing the direction of movement; the Marines adopt a suitable firing position from this stance, such as stemming one ski out to the side and firing to the rear. Such a stance allows simultaneous effective speed, movement, and fire.

Hasty Ambushes. The goal of the hasty ambush drill is the same as in a temperate climate; however, Marines should take more precaution when selecting and concealing ambush sites. Marines should always be aware of their patrol's tracks, which can tip off their position to the enemy.

If an enemy force is tracking the patrol during movement, it may be necessary to "button-hook" into the ambush site to be effective. This method can deceive a tracking enemy into the kill zone while the unit maintains its track discipline. The button-hook should encompass terrain that favors the ambush, providing security and observation of the oncoming enemy.

If the enemy is to the flanks or front, it may be advisable to go into the ambush site on foot to ensure noise discipline and avoidance of obstacles on snowshoes or skis. If the goal of the ambush is to harass, this would probably not be a good course of action, as rapid withdrawal from the ambush site would be difficult.

The ambush site should facilitate an efficient avenue of withdrawal should a superior enemy force be encountered. This withdrawal route should allow rapid downhill movement to put as much distance as possible between the ambush force and the enemy.

Counter-Ambush. Drills for near and far ambush remain the same. The following considerations should be noted:

- Firing positions, along with placing weapon systems into action, should be rehearsed before patrolling operations.
- Snow has a dampening effect on explosives and smoke devices, so proper preparation of this ordnance before conducting the patrol should take place.

Skijoring. Marines should consider the following if they encounter an enemy while skijoring:

- All drivers should be aware of possible ambush sites and accelerate through these sites. If fire is received, skijoring Marines should present as low a silhouette as possible.
- If the vehicles are attacked and rendered inoperable, counter-ambush drills should be applied to clear the enemy force.
- Crew-served weapons can be mounted on a vehicle's roof for fire support.

PATROL BASES

Marines should use the following deceptive actions (see Figure 9-1) in a snow-covered environment:

- Jump-Off Point. The jump-off point is made on slopes or in dense woods where it is possible to hide the real track and where enemy pursuit would have such a high speed of travel that it is difficult for them to discover the real track or any boobytraps. The deceptive track should be made as far away as time permits.
- Buttonhook. The buttonhook 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.
- Deceptive Tracks. Deceptive tracks are used to mislead the enemy from the jump-off point. They should be in an area where one can observe them and cover them with small arms fire from the patrol base. Leaders must balance time and efforts to construct deceptive tracks with adversary capabilities since unmanned aircraft system can determine deceptive tracks as well as dummy positions.
- Dummy Position. The dummy position is located at the end of the deceptive track and used as a decoy to draw the enemy away from the unit's position; the dummy position must look realistic for it to be effective. The patrol unit should continuously observe the dummy position, which should be located within the range of the patrol bases' small arms fire assets.

While occupying a patrol base, minimal activity should take place; therefore, it may not be advisable to dig communications trenches and defensive positions. Marines should prepare food, procure water, maintain weapons in a covered area.

Units should always make and practice—and implement if need be—a contingency plan for escape should a superior enemy force detect or engage the patrol base. To decrease the enemy's chance of detecting the patrol base, Marines should practice disciplined bivouac routine and security. When patrolling, units should take the following precautions:

- Marines should pack all equipment not in use, such as sleeping bag, stove, fuel, or extra clothing, in their packs.
- Each buddy team should have one combat load.

Marines should pack all gear and equipment not being brought on the patrol and cache it outside the patrol base.

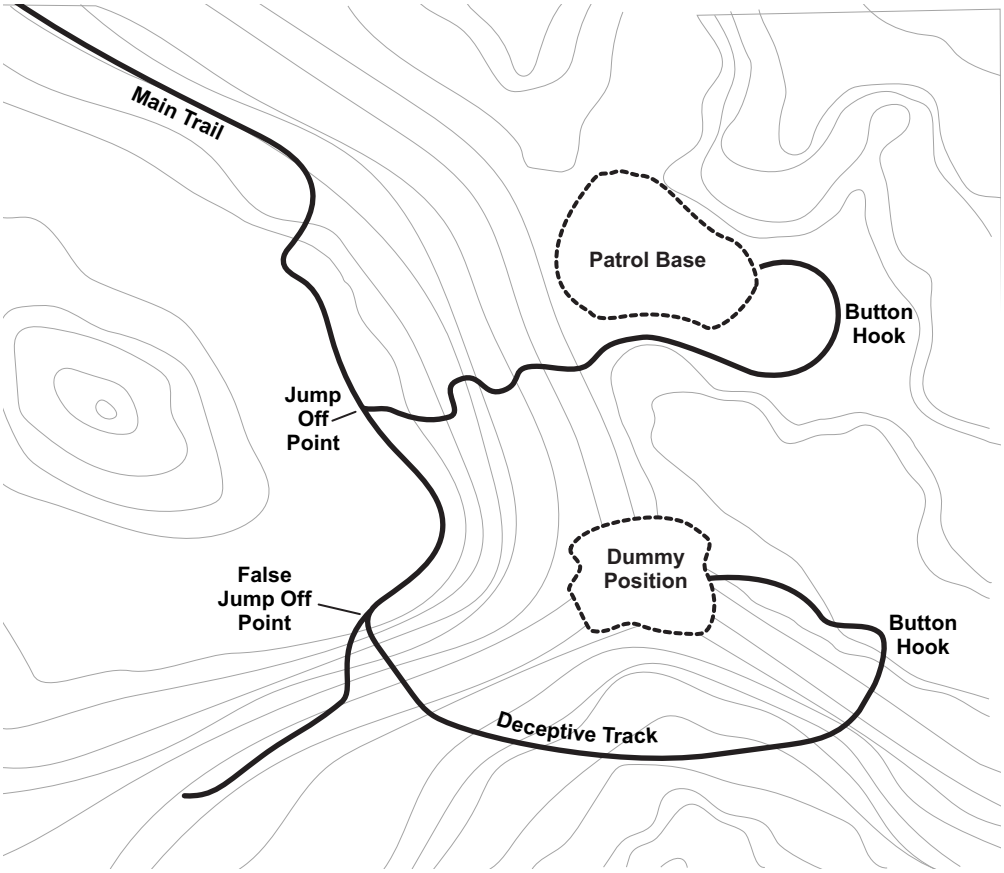


Figure 9-1. Patrol Base Plan.

AMBUSH IN COLD WEATHER OR SNOW

When conducting a reconnaissance of an ambush site in a snow-covered environment, it is difficult to get close to the site without leaving a trail. When selecting the route to the ambush site, planners should consider the ability to cover the unit's tracks. For approximately the final kilometer, the route to the ambush site should be at a 90-degree angle to the objective. Ideally, units should move during limited-visibility conditions, which can obscure their tracks; however, Marines should find terrain that enables them to enter the position while concealing tracks regardless of the visibility conditions.

The Ambush Position

The ORP site should afford concealment from enemy observation and cover from fire. It should also be reasonably close to the ambush line if the ambush lies on a linear feature. In the ORP, a warming tent may need to be set up; ideally, the four-person tent vestibule would be used. In an area ambush, there may be more than one ORP, so more than one warming tent would be required.

Leaders should decide whether the ambush party should take snowshoes or skis into the ambush position or leave them at the ORP. Leaders should use the following questions—which have been answered by the reconnaissance element—to guide their decision:

- Is it a near or far ambush?
- Does the ambush party have to move through heavy vegetation to get to the position?
- Is the route to the objective downhill or uphill?
- Is the route over easy terrain that affords good concealment into the position?

Actions in the Ambush Position

When moving into a position in snow-covered terrain, particular care must be taken to avoid tracking up the area. An approach should be chosen that provides as much concealment as possible from enemy observation. The firing positions within the ambush site should be out of sight from the enemy, appearing natural and undisturbed. Additionally, they must provide adequate cover from enemy fire.

The success of the ambush force's concealment can be bolstered through the good use of the terrain; however, varying types of snow conditions can either hamper or help concealment. Marines should consider the following factors:

- Powder snow enables Marines to easily create a fighting trench position in about 10 to 15 minutes, which, when smoothed out, can conceal Marines from enemy observation and provide some protection against small-arms fire.
- Hard compact snow can make it difficult to dig a fighting position and takes considerably longer—15 to 30 minutes—than powder snow. However, hard, compact snow provides excellent protection against small-arms fire.
- Thick ice makes it almost impossible to dig a fighting position.
- In most ambushes, the attacker loads the firepower in their favor by laying claymore munitions and boobytraps near the boundaries of the kill zone. Using these devices is usually impossible in a snow-covered environment because of the tracks that are left by the installers. When using these devices, conduct checks on all explosives inside a warming tent or in the patrol base, if possible. Waterproof any electric or time-fuze connections with plastic bags and duct tape. Place dry rags inside the plastic bags to absorb moisture. Waterproof the fuze igniters.
- When working with explosives, make sure to store plastic explosives, firing wire, detonation cord, time fuze, and other flexible items inside the Marines' warming layer or warming tent until they are ready for use. Cold weather can make the plastic sheathing brittle, leading to cracking or deterioration, elevating the risk of misfires.

A patrol leader can prolong the time a person can stay warm in an ambush area by—

- Instructing everyone, upon reaching the ORP, to put on all warming layers.
- Selecting an ambush site out of the wind. Situation permitting, Marines may dig into fighting positions, adding a one-person sleeping bench along the back.
- Ensuring all Marines have a dry sleeping mat on which to lie. The thicker the insulation pad(s), the better.
- Employing Marines in buddy teams on 50 percent alert.

- Ensuring each Marine has a full, hot thermos. Heat sources should not be used in the ambush site to make hot water. Buddy teams should only use one thermos at a time to maximize the heat maintained in the thermos.
- Ensuring Marines keep moving their toes and hands to maintain circulation.
- Rotating Marines in and out of the warming tent (tactical situation permitting).
- Ensuring Marines use one sleeping bag per buddy team for hot bagging.

Despite all these precautions, a Marine can only lie so long on a sleeping mat in the cold before they start to become hypothermic. Set a no-show time for extraction for their physical protection.

Weapons

Cold and snow can affect weapons' reliability. For example:

> *A Company training in Norway in the 1990s was tasked with an ambush 6 kilometers from their position. They moved out at last light and got into position at about 2330. On the way there, they had to move through a valley in which the temperature was much colder than the area they had left. About 3 hours into the ambush, the enemy was sighted, but, at the signal to fire, the machine gun next to the company commander, which was to commence the fire, would not fire. The second machine gun also malfunctioned, so the company commander attempted to give the signal with their personal weapon, which also failed to operate. The company commander then shouted, "FIRE." The company, seeing the enemy and hearing the order, tried to engage, but only 4 of the 120 weapons functioned. On the subsequent investigation, it was found that the weather conditions had caused the problems. On the ski march to the ambush site, it had been snowing lightly, the temperature just below freezing. The temperature in the valley that they had moved through was around -24 °C. It was surmised that the snow on the weapons melted slightly and got into the working parts. The drop into the valley caused the melted snow to freeze and jammed the weapons.*

In cold weather, a propellant's burn time generally increases (meaning it will burn slower) as lower temperatures decrease the combustion rate of the propellant, resulting in a longer burn duration.

Illumination rounds work well in snow-covered terrain as the light is reflected off the snow. However, care must be taken where the light is placed in the sky, as the additional magnification can also highlight Marine positions.

Search Teams

When employing search teams, leaders must consider the time and difficulty of the route into the kill zone and back. It might not be practical to use a search team in the mountains or deep snow.

Withdrawal

If the decision is to stay and search, Marines should wait for the search team's return before withdrawing to the ORP. The ORP party should take down the warming shelter and have sleds ready to retrieve any wounded personnel.

FIRING POSITIONS

In snow-covered terrain, Marines can use their poles, snowshoes, or skis to increase stability in a firing position. The firing positions—standing, kneeling, sitting, and prone—require additional accommodations when employed on skis or snowshoes.

From a standing firing position—

- Point the left or the right snowshoe or ski in the direction of fire. Right-handed shooters should have their left snowshoe or ski pointed toward the enemy; left-handed shooters should have their right snowshoe or ski pointed toward the enemy. Plant the opposite snowshoe or ski outward, edging the inside of the snowshoe or ski to form a half-herringbone.
- Remove the straps from the wrist when using ski poles. Next, plant one ski pole on either side of the snowshoe or ski pointing toward the target approximately 12 inches forward of the snowshoe or ski bindings. Cross the top of the ski poles forming an "X." The straps of the ski poles may be interlocked to provide a more stable platform.
- Unsling the weapon and assume a firing position, bending the rear knee forward toward the ski poles. Place the weapon in the cradle of the "X" formed by the ski poles. Place the nonfiring hand on the "X" of the ski poles, crouch forward, aim, and fire (see Figure 9-2).

Figure 9-2. Firing from a Standing Position.

Kneeling

From a kneeling firing position—

- Point either the right or left snowshoe or ski in the direction of fire desired. Plant the opposite snowshoe or ski outward, edging the inside part forming a half-herringbone. Bend the rear leg forward and rotate the ankle until the knee touches the snow.
- Remove the straps from the wrists, if using ski poles, and plant the ski poles as for the standing position. Form an "X" with the ski poles at approximately eye level with the nonfiring hand.
- Unsling the weapon and assume the firing position, placing the weapon in the cradle of the "X" formed by the ski poles. Grasp under the weapon with the nonfiring hand, just behind the "X" formed by the ski poles, lean forward, aim, and fire (see Figure 9-3).

Figure 9-3. Firing from a Kneeling Position.

Sitting

When assuming a sitting firing position on snowshoes or skis—

- Face the target and sit upslope, as in a controlled fall position (on either the left or right side).
- Extend snowshoes and skis to provide support for the firing position, stabilizing elbows against the inner thigh or the knees.

Prone

When assuming a prone firing position, with snowshoes or skis on—

- Form a herringbone and then bend both knees forward until they touch the snow. Once the knees contact snow, grasp both ski poles in the center with the nonfiring hand, fall forward, and break the fall with the ski poles.
- Place the ski poles perpendicular to the direction of fire, approximately 18 inches to the front.
- Bring the weapon to the prone firing position with the elbow resting on the ski poles (see Figure 9-4).

Figure 9-4. Prone Firing Position with Ski Poles as Elbow Rest.

Snowshoes or skis can be used as weapon supports using the following steps (see Figure 9-5):

- Assume a prone firing position.
- Place the snowshoe or ski perpendicular to the direction of fire, approximately 3 feet to the front. Place the ski poles at the side.
- Bring the weapon to the prone firing position with the forearm, or bipod, resting on the snowshoe and ski as in any prone-supported firing position.

Figure 9-5. Prone Firing Position with Snowshoe Support.

Marines should use the side prone variation (see Figure 9-6) when confronting the enemy to the right or left. To assume this position, Marines should—

- With snowshoes or skis perpendicular to the direction of the target, ski poles in one hand, and rifle gripped at the pistol grip in the other, fall to the ground using poles to break the fall.
- When falling to the left, fire the weapon right-handed. When falling to the right, fire the weapon left-handed.

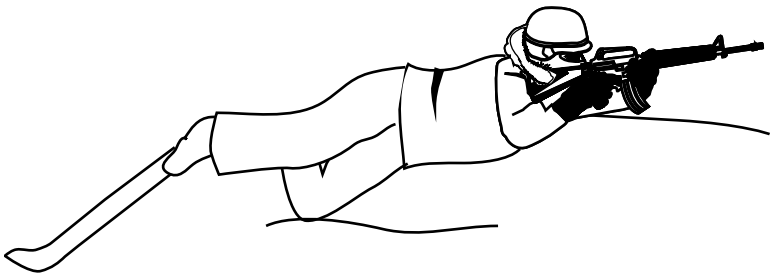


Figure 9-6. Side Prone.

Sleds also make stable firing platforms (see Figure 9-7). Shooters can use them, but they are best used for crew-served weapons, such as machine guns.

Figure 9-7. Using a Sled as a Firing Platform.

CONSIDERATIONS FOR FIRING

Marines should consider the following factors when firing in a cold weather environment:

- When moving downhill, it is easier to turn into the strong side and return fire vice trying to shoot on the move.
- When receiving fire from below while traversing a slope, sit when returning fire, because it is easier to sit uphill and face and fire downhill.
- When receiving fire from above while traversing a slope, kneel when returning fire, because it is easier to kneel and fire uphill.
- To prevent slipping, always ensure to set the edges of the skis (i.e., dig in) when firing.
- The use of ski poles in the standing position is not practical for a quick-fire technique. For quick-fire, come to a stop and squat, using the thighs to support the rifle.

CHAPTER 10.
FIRES

WEAPONS EMPLOYMENT CONSIDERATIONS

Weapons are particularly vulnerable to a mountainous, cold weather environment. Maintainers and operators should refer to the item-specific technical manual, which is the primary source for maintenance procedures.

Effects of Cold Temperatures on Materials

Cold temperatures affect the material with which weapons are made. Each material is affected differently. Examples of how materials are effected include the following:

- Metal, plastic, and rubber become brittle and more susceptible to damage as the temperature drops.
- The impact strength of steel slowly weakens until it reaches a critical temperature, then it drops dramatically. This critical temperature varies, depending on the quality and heat treatment of the steel.
- Metal components of weapons contract, particularly in close-tolerance parts, such as bearings. During firing, these components heat up and expand rapidly and, possibly, unevenly, increasing the chances of breakage or malfunction.
- Lubricants and other liquids can freeze or become thick or gummy.
- Propellants burn slower.
- Batteries deliver less power at low temperatures. Dry batteries should be stored above 10 °F and should be gently warmed before use. Lithium batteries perform best and last longer when kept cool, rather than frozen. Optimum storage temperature is 35 °F.

Common Cold Weather Problems and Solutions

Sluggishness. Sluggishness is typically caused by improper lubrication. A cleaner, lubricant, and preservative (CLP) product can function in cold climates from -35 °F and above; however, CLP thickens in cold weather and stoppages, or sluggish weapon action will result from their use. After cleaning a weapon with CLP, users should apply a light coat to provide extra lubrication and corrosion protection. In temperatures below 10 °F, lubricant arctic weather (LAW) should be used because at -10°F, CLP thickens enough to affect a weapon's automatic cycling. If LAW is unavailable, the weapon should be fired dry because lubricants freeze at 0 °F. Ice or snow in the firing mechanism may also cause sluggishness. Should sluggishness occur, the weapon must be cleaned, dried, and the appropriate lubricant applied.

Breakage and Malfunction. Breakage usually occurs on weapons during the first few rounds. Metal parts might unevenly expand due to the rapid temperature rise. Firing slowly or in short bursts at the sustained rate gives the weapon time to warm up, lessening the probability of it breaking. Careful handling and using muzzle covers can reduce malfunctions due to ice and snow. Marines should be avoid getting ice or snow in moving mechanisms.

Condensation. Condensation forms on weapons that have been brought from a cold environment into a heated shelter. When the weapon is returned outside, the condensation freezes, causing malfunctions. Condensation continues for approximately an hour from the time it is brought into a heated environment. After an hour, the weapon should be cleaned and lubricated. To prevent or reduce condensation, store weapons outside the tent in the rifle pit. If the tactical situation does not permit the weapons to be stored outside, store them weapons in the ECW tent's vestibule. Ammunition, including magazines, load-bearing equipment, and belts, should also be stored outside or in vestibule.

Visibility. In a cold weather environment, falling or blowing snow, whiteouts, and grayouts limit visibility and the ability to deliver accurate fire. Nights are longer in winter; the closer people are to the poles, the longer the nights last. Ice fog can occur in extreme cold (-35 °F and below) and where little or no wind exists (less than 3 miles per hour). Ice fog can form following firing a weapon and can hover over the weapon and along the path of a fired projectile for several minutes, obscuring vision and pinpointing the weapon's position. Marines must then displace their weapons to an alternate position.

Emplacement. Crew-served weapons requiring a base or platform for firing need special consideration. Emplacing a weapon on snow, ice, or frozen ground may result in breakage or inaccuracy, due to sinking or the inability to absorb shock.

Reduced Muzzle Velocity and Projectile Range. As the temperature drops, so does the muzzle velocity and the projectile range. Both internal and external ballistics affect velocity and range:

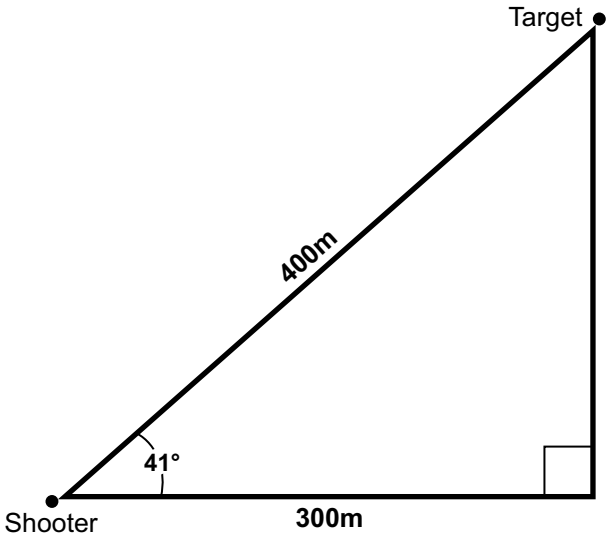
- Internal Ballistics. As the propellant's burning rate decreases, so does the rate of gas expansion, which, in turn, slows the speed of the projectile down the bore.
- External Ballistics. Decreased muzzle velocity reduces the stability of the projectile once it leaves the muzzle. This reduction in velocity may be severe enough to cause projectiles to tumble. At longer ranges, this further reduces velocity, range, and accuracy. Additionally, colder air is denser than warmer air, which increases drag on projectiles, further reducing range.

Weapons should be test fired to establish battle-sight zero and new range cards. There may be different range cards for day and night because of significant temperature fluctuations, or there may be changes in range cards because of significantly changing weather patterns.

Slope Angle Considerations. Gravity affects the trajectory of a round in the horizontal distance traveled when firing either uphill or downhill, causing overestimation of range (line-of-sight distance to target)—the shooter hits high whether firing uphill or down-hill. To compensate for slope angle, Marines should—

- Use the map distance for sight settings.
- Estimate range in the horizontal plane if a map is unavailable.
- Aim at 6 o'clock or lower.
- Adjust from impact (see Figure 10-1).

Laser range finders can give line-of-sight range or compensate for slope angle. If the laser range finder measures line of sight, sight data is always less accurate when using a laser range finder than when manually calculating for high-angled distances. The steeper the slope angle, the greater the sight data estimation problem. Marksmen use the cosine formula to get more precise sight data for first round accuracy when shooting at high angles. Table 10-1 portrays cosines of respective angles. Marines should multiply the line-of-sight distance by the cosine for the sight data range.



Distance to target: 400 meters
Shot angle: 41 degrees (cosine .7547).

.75 X 400m. = 300m.

Figure 10-1. Example of Slope Angle.

Table 10-1. Cosine of Slope Angle.

Angle	Cosine	Angle	Cosine	Angle	Cosine	Angle	Cosine
0.0	1.00	23.0	.9205	46.0	.6947	69.0	.3584
1.0	.9998	24.0	.9135	47.0	.6820	70.0	.3420
2.0	.9994	25.0	.9063	48.0	.6691	71.0	.3256
3.0	.9986	26.0	.8988	49.0	.6561	72.0	.3090
4.0	.9976	27.0	.8910	50.0	.6428	73.0	.2924
5.0	.9962	28.0	.8829	51.0	.6293	74.0	.2756
6.0	.9945	29.0	.8746	52.0	.6157	75.0	.2588
7.0	.9926	30.0	.8660	53.0	.6018	76.0	.2419
8.0	.9903	31.0	.8571	54.0	.5878	77.0	.2249
9.0	.9877	32.0	.8480	55.0	.5736	78.0	.2079
10.0	.9848	33.0	.8387	56.0	.5592	79.0	.1908
11.0	.9816	34.0	.8290	57.0	.5446	80.0	.1736
12.0	.9781	35.0	.8191	58.0	.5299	81.0	.1564
13.0	.9744	36.0	.8090	59.0	.5150	82.0	.1392
14.0	.9703	37.0	.7986	60.0	.5000	83.0	.1219
15.0	.9659	38.0	.7880	61.0	.4848	84.0	.1045
16.0	.9613	39.0	.7772	62.0	.4695	85.0	.0872
17.0	.9563	40.0	.7660	63.0	.4540	86.0	.0698
18.0	.9511	41.0	.7547	64.0	.4384	87.0	.0523
19.0	.9455	42.0	.7431	65.0	.4226	88.0	.0349
20.0	.9397	43.0	.7314	66.0	.4067	89.0	.0174
21.0	.9336	44.0	.7193	67.0	.3907	90.0	0.0

Infantry Weapons Problems and Solutions. Marines experience difficulties with infantry weapons in cold weather environments but have found ways to mitigate those challenges.

M18 Pistol. Rapidly warming temperatures or ice and snow in the weapon can cause damage or breakage to moving parts (e.g., firing pin, extractor, ejector). Marines may also have difficulty operating and firing the weapon while wearing mittens or gloves, so contact gloves should be worn. To prevent the magazine from freezing in the magazine well, Marines should extract and wipe off condensation from the magazine before leaving a shelter or vehicle.

M4 Rifle. Rapidly warming temperatures or ice and snow in the weapon can cause damage or breakage to moving parts (e.g., firing pin, extractor, ejector). Firing at the slow rate of fire warms up the rifle and helps reduce the risk of breaking. Condensation in the buffer tube can hamper shock absorption, which may result in retarded recoil and breakage. Retarded recoil can also result in a missed cocking in the cycle of operation. To prevent retarded recoil, seal the outlet hole with wax or gum and wipe out the buffer tube regularly. Rifles create ice fog under the right conditions, so Marines should plan for and prepare extra firing positions in the event their positions are revealed. To prepare the rifle for snow, Marines should use white cloth tape for camouflage and reinforce plastic handguards and the buttstock. They should select a muzzle cover (must be able to shoot through it for immediate action) and carry a spare (cloth medical tape works well), select a magazine well cover (a magazine works easiest), ensure the ejection port is always closed, and open the trigger guard for use with mittens or thick gloves.

M27 Infantry Automatic Rifle. Damage or breakage to moving parts of automatic weapons may occur due to rapid warming or ice and snow in the weapon. There is an increased instance of breakage, malfunction, and ice fog compared with the M16A4/M4 rifle due to the increased rate of fire. Trigger control should be used for slow fire to warm up the metal to reduce breakage.

M320 Grenade Launcher. The M320 is not very susceptible to breakage in extreme temperatures, but freezing may occur around the slide. The effectiveness of the round can be reduced because of the dampening effect of snow on shrapnel. Grenadiers may expect an increased number of duds due to the impact fuze not detonating in soft snow. Firing into trees for airbursts may be an effective option.

Grenades. The effective casualty radius is reduced due to the dampening effect of snow on shrapnel. Smoke or gas grenades must be tied to a platform to prevent sinking into the snow—one foot of snow absorbs most, if not all, of the smoke.

AT4 Light Antiarmor Weapon. The plastic sights and rubber end caps of the AT4 may become brittle and break or damage easily. Propellants burn slower and less efficiently in the cold; hence, missile velocity is slightly decreased. Snow and ice buildup on the cocking mechanism can make the AT4 difficult to cock. Backblast area is increased due to unburned propellants, snow or ice projectiles, lack of vegetation to absorb the blast, and air density, making the AT4 susceptible to ice fog when those conditions exist. Reduce signature by choosing a firing position that is windswept or a crusted or frozen snow surface. Cover hands and face for firing in case slow burning propellants are still burning when the rocket exits the launch tube. Displace immediately after firing.

Crew-Served Weapons Problems and Solutions. Because of the inherent complexity of crew served weapons, more problems arise in cold weather operations. For detailed operating instructions in a cold weather environment, refer to the TM pertaining to each weapon.

Machine Guns. Marines should consider the following regarding the M240B, M2, and MK19:

- All machine guns have a high rate of breakage due, in part, to the cold and their high rate of fire, so gun crews should carry extra gear and bolt components.
- Short, violent recoil can be caused by slower burning propellants or by a frozen buffer mechanism. This shortened recoil results in the increased probability of the weapon breaking, malfunctioning, or both.
- If temperatures are below -35 °F, all internal components and friction surfaces (i.e., bipods) should be lubricated with LAW. If LAW is not available, the weapon should be fired dry.
- Since ice fog greatly impairs the gunner's vision and identifies the gun's position, crews should be prepared to move to alternate positions.
- Firing platforms must be constructed to prevent the gun from sinking into snow, sliding on ice, or bouncing on frozen ground. Sandbags, MRE boxes, sleds (buffed and anchored), or evergreen boughs may be used to prevent sinking in snow or to cushion ice and frozen ground. Ski pole baskets may be wired to the bipod legs of medium machine guns for flotation. A sled may be used to provide a stable, yet mobile, platform for a tripod-mounted gun.
- Never place hot barrels directly on snow or ice because the sudden temperature change causes warping or cracking. The barrel may also sink out of sight causing a delay in changing barrels.
- Ammunition must be kept free of all snow and ice but should be stored outside to stay at the ambient air temperature. Ammunition should be stored in its original container, raised off the ground 4 to 6 inches, and covered to provide protection from the snow.

Mortars. Marines should consider the following when seating the gun in snow or cold:

- Yokes and base plates on uneven or frozen ground have been known to crack at temperatures below -25 °F. When possible, a position should be selected that has vegetation under the base plate or sandbags can be filled with rocks, snow, and ice to buffer it. The buffer should be thick enough to provide shock absorption between the base plate and the frozen ground, but not so thick that the gun bounces. If the snow is too deep to dig down, a flotation base must be built on the snow for the mortar: digging to the ground and breaking it up is the most preferred method, the least preferred is to pack the snow and place logs or any suitable material firmly on the snow and then place snow-filled sandbags on top of the logs.
- Two Marines should control the bipod when seating the gun on ice or at high angle elevation.
- Sighting and fire control leveling vials take longer to adjust due to the liquid thickening when cold.
- Marines should avoid breathing on the sights, as this can cause them to fog up.
- Aiming stakes can be placed by digging a hole, emplacing the stake, and then pouring water around the base and allowing it to freeze. Rocks or blocks of ice or snow can be used, but the melting of ice or snow may cause the stake to shift. This technique is called the chock method and is the most preferred. An ammunition can filled with rocks and dirt also works well.

  NOTE: The length of time in a position dictates the method used to secure the aiming stakes.

- Variable time fuzes are preferred in snow due to their severe dampening on shrapnel effect, making airbursts preferable. Malfunctions occur in direct proportion to the severity of the weather. Tests conducted at -25 °F showed a higher fuze failure at charge zero, but reliability increased when fired at a higher charge zone, such as one, two, three, or four.
- During emplacement and firing, hand protection must always be worn (contact gloves). The crew must keep their gloves or mittens on and avoid touching the metal surface with bare flesh. The gloves must not be loose, because when the ammo is being dropped into the tube, a vacuum occurs which can suck the glove into the tube creating a hazardous situation.

Antitank Guided Missile Systems. All antitank guided missile systems (tube launched, optically tracked, wire guided missile [TOW]; and Javelin) operate effectively in cold weather down to -25 °F, which is the military specification criterion. Problems that can be expected include—

- During cold weather firing (10 °F and below), reliability of the TOW missile may be reduced due to blowout of the missile capstan block, which connects the launcher to the missile guidance wire.
- When firing in cold weather, the maximum effective range of the TOW missile is reduced.
- The TOW missile and Javelin can be operated at temperatures down to -25 °F and stored at temperatures down to -65 °F.
- Before firing the TOW, the night sight must be turned on and focused. The missile guidance system may select the night sight due to obscuration from ice fog or falling or blowing snow and the gunner may have no control over which sight is used.
- The backblast area is tripled.
- Snow glare may create difficulties in tracking the missile to its target for the TOW. Eye protection should always be worn when looking through the sight.
- All exposed skin should be covered, including face, eyes, and hands to protect against burning launch propellants as the missile exits the tube.
- The Javelin has a slight drop when fired in the cold and should not be fired from partial defilade or reverse slope positions.
- The Javelin is easily team portable and emplaced in snow, but the TOW missile must be carried using a vehicle.
- Marines may be needed to augment sled teams when moving bulk missile reloads.

Optics. Because of the delicate nature of optics, the following items should be considered when using them in a cold weather environment:

- Night Vision Goggles. The cold weather battery adapter and demisting shield should be used, but extra care must be taken when dealing with the moving parts because they may become brittle in extreme cold.
- Thermal Sights. A cold weather environment enhances the thermal infrared signatures of targets unless weather conditions, such as falling snow, degrade them. An undisturbed snow cover presents a relatively uniform and clutter-free background to a thermal infrared sensor if the snow is deep enough to completely cover a large area. Thermal camouflage, such as reflective insulation (space blankets) or one foot of snow on a field tarpaulin, can be used to defeat these systems; however, movement, such as snowshoe, ski, or foot, through snow leaves a thermal trail in the snow for a short time.

- Light Amplification Sights. The daylight cover should be used while on the move to protect the lens from snow and ice.
- Lasers. Visibility problems, such as ice fog and blowing snow, affect laser sighting. Lasing a snow- or ice-covered target may result in refraction of the laser up to several miles off target. The handheld laser rangefinder can only view for about 300 meters in heavy ice fog or snow due to light refraction. The human eye can see approximately 200 meters further in the same conditions. When the weather is clear, cold, and dry, the handheld laser rangefinder is accurate to within one meter at a 10,000-meter range.

Demolitions. The cold affects the ability to effectively employ demolitions. The following considerations apply to demolitions:

- Handling becomes a team effort, due to the need to wear gloves.
- Plastic explosives, such as C-4, become very hard, making insertion of a blasting cap difficult unless done indoors prior to use. Storing C-4 beneath insulating layers, away from cold temperatures, helps maintain its flexibility.
- In extreme cold, C-4 has been known to shatter from the explosion of the blasting cap rather than to detonate.
- TNT [trinitrotoluene] blocks are excellent for use in cold weather for projects, such as hasty fighting or firing positions, because they are water resistance.
- Detonation cords become stiff, are difficult to tie, and break easily in ECW. Storing detonation cord beneath insulating layers, away from cold temperatures, helps maintain its flexibility.
- Time fuzes tend to maintain their curl when extremely cold. Unless done inside a warm shelter, uncurling usually results in breaking the fuze. Storing the time fuze beneath insulating layers, away from cold temperatures, helps maintain its flexibility. Test burns on site are highly recommended due to the significant slowing of time fuse burn rates caused by cold temperatures, high altitudes, and denser air.
- Condensation also contributes to the increased chance of misfires. Misfire and hang fire waiting times should be doubled in a cold environment.

FIRE SUPPORT CONSIDERATIONS IN MOUNTAIN WARFARE

Ammunition

Storage. Properly storing ammunition is paramount in extreme conditions as the cold weather may greatly affect the ordnance's capabilities of the. Ammunition should be stored at the same temperature as its associated weapon system. If Marines fire ammunition that has been stored at different temperatures from their weapon system, the fire direction center will have a difficult time maintaining accurate registration data. Consequently, the round's ranges will vary, based on how cold the propellant is, so proper handling and continual updating of propellant temperatures can help ensure effective gunnery.

Ammunition has a high malfunction or dud rate when brought from a warm environment to extremely cold temperatures because of condensation and freezing. Ammunition should not be stored inside tents or shelters that are warmed above freezing because the change in temperature

can cause condensation. Projectiles, powder canisters, fuzes, and primers may freeze when exposed to the colder air, which may damage propellants, increase difficulty in handling heavy projectiles, or prevent the proper mating of fuzes and projectiles. Old firing positions can be effectively used as ammunition storage points.

When storing ordnance in the cold, it should be kept off the ground with at least 6 inches of air circulating beneath the ammunition and as free of ice and snow as possible. The ammunition can be placed on dunnage or pallets and should be covered.

Because winter conditions typically cause a high dud rate and reduced visibility, and because it decreases the effects of ordnance in snow, leaders should plan to increase their ammunition requirements. Up to 80 percent of the fragmentation effects of the point detonating fuze can be absorbed by only 12 inches of snow. Properly planning for fuze requirements can avoid need for resupply when more rounds are being used to achieve the same effect on target. It may be necessary to establish predesignated levels of on-hand quantities and restrict firing when these levels have been reached. Every effort should be made to keep the basic load on hand to guard against interruption in resupply operations. Additionally, history has shown that ammunition requirements can increase two to four times for night operations due to more indiscriminate weapons firing.

Effectiveness. During extremely cold periods when temperature changes are sudden, the ballistic characteristics of weapons and ammunition change; the standard temperature for the firing table is 70 °F. Indirect fire support can be as much as 100 meters short for each 1,000 meters of desired range in the cold because it causes the propellant to burn more slowly and the round exiting the weapon system to have a slower muzzle velocity. For example, a 2,000-meter shot could fall 200 meters short of the target in ECW.

On frozen ground, ice-covered ground, or rocky terrain, point detonation increases the fragmentation of high explosive rounds due to the secondary fragmentation effects from the terrain. Fuze quick is ineffective in snow-covered terrain because up to 80 percent of the fragmentation is absorbed; hence, proximity or variable time fuzes should be used in snow-covered terrain. A delay fuze is used for frozen waterways, such as lakes or deep rivers. In this case, the water is used as tamping to heave up and break up more ice. More casualties can be caused by drowning and cold weather injuries than by fragmentation.

During extreme cold, the rate of fire slows until the weapons have warmed up, particularly with weapons that have a hydropneumatic type recoil. The rate of fire is also affected because users react slower and less deliberately in a very cold climate, so keeping personnel warm is critical.

Smoke rounds and white phosphorus smoke can be used very effectively for marking air, but Marines should consider the following:

- The rounds must be deployed above the snowpack, so the snow does not absorb the smoke.
- The color of the smoke must contrast with the snow or white phosphorus if in a wooded or nonwhite background.
- Illumination rounds are not very effective for adjusting close air support (CAS); however, they aid forward observers. The smoke cloud from the round helps artillery or mortar forward observers locate the spot of the round, whereas high explosive rounds are difficult to see.

Phosphorus shells, although producing desired smoke, contaminate the area of impact with phosphorus particles, which may remain buried under the snow. These particles affect the targeted area and surrounding areas during the spring melt-off much like chemical weapons.

Marines should consider the following when using family of scatterable mines and dual-purpose improved conventional munitions:

- Rapid temperature changes could cover or expose the ammunition, rendering them ineffective.
- They could come to rest in the snow at angles that cause a less effective, non-killing orientation of some of the mines.

  NOTE: The same considerations apply for ground mine dispensers that shoot mines out from canisters.

Fire Support Assets

Fire support assets must be as mobile as the force that they support; therefore, clearing roads of snow is essential. Avalanche-prone slopes should be considered in the fire plan. Thousands of troops were killed in World War I on the Italy-Austria front because of avalanche-initiating supporting arms. The enemy can also initiate avalanches by their supporting arms on Marine units as they cross on or below avalanche-prone slopes. Planning fires to initiate avalanches also mitigates this potential enemy threat. Engineer assets need to be positioned forward to clear roads, if applicable, when using this method. Plans must consider the impact of topography, weather, and terrain for intended support and positioning. Immediate crests, defined as any obstruction immediately in front of the firing unit, and intervening crests, defined as any obstruction between the firing unit and the target are not visible from the firing unit, must be considered.

Mortars. Mortars are the most dependable supporting arms in mountainous, snow-covered terrain.

Artillery. Marines must make the following considerations regarding artillery:

- Artillery offers the longer range required and can be positioned further to the rear; nevertheless, it is often limited by higher terrain crest clearance and mobility.
- The advantage of medium-weight howitzers is that they have to displace less and have longer ranges, adding more firepower and flexibility to maneuver elements during operations. Increased amount of dead space cannot be covered by artillery, depending upon the positioning of the howitzers.
- Artillery is difficult to move in snow-covered terrain because it is typically carried by 7-ton trucks, which limits gun line selection to flat areas next to a maintained MSR. There are few MSRs in a winter mountainous environment and the SUVS is not capable of towing artillery, but transport may be available by helicopter.
- The ability of artillery to maneuver on and off roads is restricted due to its size and weight.
- Defensively, well-positioned artillery batteries can deny advancing enemy units use of MSRs and likely avenues of approach.
- The rate of fire for artillery are slower than typical until the recoil system warms up and, when firing at a high angle of fire, the rate of fire is slow because of breech loading (lowering and raising the tube between each round). Probable error in range is greater for high angle fires than low angle fires, which results in higher reliance on tabular firing tables for high angle fire.

- In snow, artillery must be dug in all the way to the ground.
- Meteorological data is generally only consistent to 20 kilometers, resulting in the need for individual meteorological capability for disaggregated positions. As conditions change, frequency of updates is also required.

Refer to MCRP 3-10E.2, *Marine Rocket Artillery Battalion Operations*, for more information on rocket artillery.

Naval Surface Fire Support. Naval surface fire support, if available and within range, is limited by its flat trajectory. Fire support stations with several alternate stations in phased sequence could be required due to mountain corridor angles, instead of the more flexible fire support areas. This support would permit shifting ships to support the operation, allowing them to be prepositioned to fire up valleys and corridors. Targets in valleys or on reverse slopes would be difficult to effectively engage due to the flat trajectory and high muzzle velocity of the rounds. The advantages of naval surface fire support are that the weapon systems are neither affected by environmental conditions nor by limited rounds or sustainment considerations as those employed ashore.

Close Air Support. Tactical air operations provide the most mobile and often the most economical fire support available. The hazards of flying place some limitations on the use of low-flying aircraft, but the restrictive nature of the terrain and limited road networks present many opportunities for aircraft to render critical support, particularly against enemy positions on reverse slopes. Terrain may also limit attack options available to forward air controllers (FACs), who must be ski or snowshoe trained, and pilots.

Mountainous, cold weather operating areas often experience foul weather, which can sometimes prevent aviation capabilities for extended periods. Command and control may prove to be difficult due to impeded communications in polar regions and visibility encountered by FACs. On the other hand, CAS is less affected by climate and can serve a key role in fire support in the cold.

Rotary-wing CAS at high altitudes is characterized by reduced ordnance and time on station because of reduced lift capability. Rotary-wing support is not usually used between 10,000 and 12,500 feet.

This environment is limiting to CAS aircraft. Typically, CAS missions are completed the same way as in a temperate, low-lying area. The limiting factor is the ability to get the bombs on the target. It is much more difficult to pick out targets or even see the mark in terrain that is characterized by steep valleys, rapidly rising mountains, different colored rocks, trees, and grasses. This terrain may be coupled with other challenges, such as dead space due to surrounding terrain for artillery and mortar rounds to mark or the inability for a FAC to maneuver into a position to make good corrections.

Marking for targets in a winter environment is like doing so in a temperate environment except for a few nuances. Joint Publication 3-09.3, *Close Air Support*, describes numerous ways to mark for CAS aircraft. The following subparagraphs discuss some of these techniques and how a snow-covered environment may affect them.

White Phosphorous. The most common mark used in training environments today is white phosphorous. Whether in the desert, jungle, or coastal plains, this mark provides the pilot with an adjustable, distinctive reference point. In a snow-covered environment, however, white phosphorous could prove ineffective because discerning a white cloud of smoke out of a white background from high altitudes is next to impossible. It is possible, though, to use white phosphorous for aircraft at low altitudes. For example, a helicopter that provides CAS or an A-10 that can remain low and at relatively slow airspeeds can still see the vertical development from the white smoke. As an aircraft increases in altitude, this vertical development becomes increasingly difficult to discern. For night CAS, white phosphorous may still prove effective because it reflects off the snow.

An important aspect of CAS and marking is the reduction of effects from the blast. Studies by the US Army's Cold Regions Research and Engineering Lab have shown up to an 80 percent reduction in the blast effect of a round or bomb that detonates in the snow (depending on snow depth). Hence, it is important to have a good mark to generate desired effects on the target. This may also affect suppression of enemy air defense missions that are being conducted in conjunction with CAS.

Illumination Round. An illumination round on the deck to mark quickly melts through the snow. The round should be timed to detonate at an altitude above the ground that allows the pilot to obtain a visual before it disappears into the snow. The difficulty would be for the FAC to make a correction from the round while it is still descending. This challenge, coupled with the instability of the mark due to winds from the time the correction is given, make this technique difficult. These factors are dependent upon the depth of the snow, but this option may be useful at night due to the amount of light that would reflect off or through the snow.

Laser. The laser systems are still useful in a snow-covered environment. One consideration is the reflectivity of snow or ice and how that may affect the laser energy. There have been documented cases during exercises in Norway of missiles tracking off the reflected energy from a laser.

High Explosive. These rounds may work well in this environment for marking depending upon the snow depth, since a dark cloud of debris may be easier to discern against the white background. When using high-explosive rounds, bear in mind the path of potential avalanches out of the target zone so that friendly personnel do not become collateral damage.

Low-Altitude Air Defense. Using the Stinger weapon system in mountainous terrain requires considerations, such as the following:

- Elevated firing stations provides a greater area of coverage but may permit enemy air assets to transit below the position with relative safety.
- Conversely, firing stations on low ground restrict coverage and mask possible targets.
- In cold, there is increased missile warm up time and a slower engagement sequence due to cold weather clothing.
- The Stinger can be fired down to -40 °F and stored to -50 °F.
- Personnel within 50 meters of a launch at -25 °F or below must hold their breath for 20 seconds.

Nonlethal Effects

When planning for nonlethal effects in mountainous, cold-weather terrain, the following must be considered:

- Information Operations. Compartmentalized terrain leads to isolated, often very different human terrain within relatively short lateral distances, requiring specialized products and materials. Effectiveness of equipment may be affected by complex terrain. Radio in a box and long-range acoustic devices are limited in distance.
- Civil-Military Operations. There is an increased security footprint necessary to mitigate dead space and potential enemy avenues of approach, such as when conducting medical civic action programs. The reparation process also takes longer due to the increased time it takes to travel to remote and isolated valleys.
- Electromagnetic Warfare. There are force protection implications when considering how terrain affects electromagnetic warfare capabilities.

Emplacement, Positioning, and Camouflage

Emplacing, positioning, and camouflaging guns must be considered in a cold weather environment.

Emplacement. Before occupying a position, the terrain should be carefully reconnoitered and gun positions, traffic lanes, and snow parapets should be prepared. Even in deep snow, bulldozers are needed to dig all the way down.

Positioning. If no suitable position can be located off the MSR, positioning immediately adjacent on the shoulders or in one lane can be substituted. Positions on commanding terrain should provide defilade. The relative scarcity of good firing positions increases the probability of receiving enemy fires when occupying a desirable position. Good gun positions are hard to find and are selected for flash defilade, cover, and accessibility to road networks and LZs. Positions on commanding terrain are preferable to low ground positions because they—

- Have less chance of being struck by rockslides or avalanches.
- Have a reduced amount of dead space in the target area.
- Are less exposed to small arms fire from surrounding heights.
- Avoid flooded, marshy areas during spring snow melt.

Camouflage. Camouflage discipline must be strictly enforced. Marines can create limited camouflage by using paints and nets, but tracks left in the snow cannot be effectively covered except by fresh snowfall. Vehicles and troops should only move on designated trails and roads.

Fire Support Planning

Considerations for fire support planning include the following:

- Rugged terrain and reduced mobility place increased reliability on artillery fire support and planners must consider the increased consumption rate of ammunition. The duration of a suppression mission takes longer to cover the slower moving unit.
- Fire support must be closer to maneuvering elements than normal to be effective.

- Communication between supporting fire elements and maneuver elements and the coordination of fire with organic infantry support weapons requires special attention. Retransmission sites may often be necessary.
- An infantry attack over rising terrain is easier to support than one over descending terrain. In the final stage of the attack, organic infantry support weapons may provide the most effective fire support.
- Combat outposts should normally have priority of supporting fires.
- Observed fires should cover obstacles, barriers, and dead space.
- More suppression missions and fewer destruction missions should be planned in snow or compartmented terrain.
- Frozen waterways, which are avenues of approach in the winter and not obstacles, should be covered.

Targeting

Because of the decentralized nature of mountain/cold weather operations, targets warranting massed fires may present themselves less often than in open terrain. Narrow defiles, used as routes of supply, advance, or withdrawal by the enemy, may be profitable targets for interdiction fires or heavy surprise concentrations. Large masses of snow or rocks above enemy positions and along MSRs are also good targets.

If a barrier is desired when targeting frozen waterways, then the ice must be breached daily, depending on temperatures, to avoid refreezing. If the enemy is likely to cross it, a perpendicular sheaf to the enemy would split their forces on each side of the ice obstacle. If the enemy is using it as an MSR, parallel sheaves to the enemy would kill as many as possible. If the enemy reaches the safety of the banks, airbursts should be used. Only one round in effect to breach ice using a delay fuze. The sheaf in effect is shifted and repeated based on the length of the column or the enemy's attempt to maneuver around unbroken ice.

Fire Control

Gunnery can be difficult because—

- High angles of fire increase the time of flight for rounds to impact and the time between each round due to breech loading.
- Vast reverse-slope areas are hidden from observation.
- There are increased amounts of dead space, which cannot be hit by artillery fire.
- There are usually differences in altitude between firing units and targets.
- Most indirect fires are observed, particularly close support and defensive fires. Unobserved fires are frequently unreliable because weather conditions change rapidly and registration corrections for high-angle fire are fleetingly valid.
- Firing tables are constructed during extreme cold due to the slow burn of propellants. Many variables, such as temperature of the air and propellant, winds, barometric pressure, altitude, and humidity, must be entered into the fire direction center computer.
- Communication can be unreliable and can create significant obstacles to overcome. Digital is preferred to voice, and SATCOM could be all that works in such extreme terrain.

Observation and Adjusting Fire

The forward observers are greatly affected by highly compartmented, mountainous terrain when calling and adjusting missions and must remember that—

- The capabilities of aerial observers should be exploited, particularly for adjusting fires in dead spaces.
- Those adjusting indirect fire on a slope need to understand that shifting deflection often also affects range. This spatial problem can necessitate more round adjustment than that required on flat ground.
- During the winter months, short periods of daylight limit observation; however, reflected light caused by snow cover can greatly enhance night observation and can be an asset. Snow cover also reduces depth perception and obscures ground features and landmarks.
- Ice fog can limit observation during adjustment.
- Lasers can reflect off ice or smooth snow when designating targets.
- Ground bursts can be difficult to observe due to the dampening effect of the snow. Preliminary adjustments may have to be determined using airbursts.
- In compartmented terrain, there would be an increased number of lost rounds.
- Line of sight can be longer on slopes. The steeper the slope, the more spread out the sheaf would become, reducing the effect on the target.

CHAPTER 11.
LOGISTICS AND SUSTAINMENT

LOGISTICAL CONSIDERATIONS IN MOUNTAIN WARFARE

Principles of Logistics in Mountain Warfare

Marines should use the following principles when planning logistics in a mountainous, cold-weather environment:

- A sound logistics plan is essential to mission accomplishment.
- Transporting supplies requires more time than in warmer environments.
- Aircraft performance is severely degraded.
- Health service requirements are greatly increased.
- Essential equipment must be safeguarded.
- Measures must be taken at the individual level to safeguard sustainment.

Each function of combat service support has considerations unique to mountainous, cold weather operations.

Transportation

The main logistical differences between mountain operations and other operations result from problems with transporting and securing material. Any proposed support structure must plan for a redundant ability to distribute supplies directly to units operating from predetermined supply routes. Some forms of transportation used to supply units are air (both fixed and rotary wing), motor vehicle, and animal packing.

Air Delivery. Fixed-wing aircraft can air drop supplies in rural areas where surface resupply may not be feasible. In the past decade, great strides have been made in the field of aerial delivery with technology advancing to the point that supplies weighing as much as 10,000 pounds can be delivered an average of 150 meters from its target from altitudes as high as 25,000 feet.

The most recent air delivery technology is called the joint precision airdrop system, which is a family of GPS-guided parachute systems. The parachutes can deliver loads of varying weights; the Marine Corps uses three different versions: 750 pounds; 2,000 pounds; and 10,000 pounds. Each system consists of the canopy and an airborne guidance unit. Prior to being deployed from the aircraft, a GPS coordinate is entered into the airborne guidance unit and guides the parachute in a planned trajectory.

Drop zones are few in mountainous environments and accuracy is low due to steep terrain. Drops are best made in relatively secure meadows or valley floors. Supplies delivered to units on ridgelines or mountain peaks have a low rate of recovery. Door bundles thrown out of helicopters are better suited for mountain peaks and ridgelines. Air delivery be planned as an emergency reserve that is employed when other options are not practical.

Helicopter Support Teams. Helicopters should be employed as much as possible to increase responsiveness. They have a decreased lift capability at upper altitudes and an increased capability in colder weather; however, colder temperatures cannot make up for the high-altitude deficiencies. Helicopter support teams must coordinate extensively concerning their need for trained personnel and regarding each helicopter's capabilities in the lift and drop LZs. Weather can also determine if helicopters can be employed. Redundant modes of transportation must always be planned when employing helicopters.

Motor Transportation. Most vehicles are not designed to perform at their optimal capability in extreme cold, at high altitudes, or in complex and compartmentalized terrain. Fuel consumption rates increase by up to 75 percent while carrying capacity is reduced by 20 to 25 percent. Factors that must be considered include the following:

- Plastic becomes brittle and belts snap if not warm.
- A starter should not be initiated for more than 15 seconds because it could burn out and drain the battery in one attempt.
- Vehicles should not be jumped or slaved head-to-head. If they "jump," they could kill people or damage the vehicles.
- Half water-half antifreeze mixture is stable down to -32 °F.
- At 0 °F, straight 20-weight oil is best because it does not gel and allows engines to start with less drag.
- Below -15 °F, vehicles should run constantly.
- Chains should be inspected before and during employment. Tire pressure must not be changed after chains have been applied and all hooks on the chains should face away from the tire. After the winter season, chains should be wire brushed clean, dipped in crankcase oil, drip dried, and then stored in a burlap or canvas bag.
- A covered vehicle usually sustains less damage. All doors, windows, and hatches should be closed, if possible.
- Vehicles should be gradually warmed or defrosted because windshields crack when shocked with a change of temperature.
- Snow and ice should be cleared from steering and tracks with a wooden stick, such as a broom handle or a shovel handle.
- Drivers should slow down because the environment necessitates an extended stopping range and vehicles in front kick up mud and snow.
- The vehicle going uphill has the right of way and vehicles parked on slopes need to be chocked with big anchors because they can gradually slide.
- No one must ever sleep in a running vehicle because the carbon monoxide buildup is fatal.
- The SUSV has the following considerations—
  - It must never be sent out without a radio.
  - In 0 to -15 °F, vehicles should run 15 minutes per hour.
  - When using vehicle-powered radios, vehicles should run 15 minutes per hour.
  - When stopping for prolonged periods, grills should be covered.

Animal Packing. The transportation of supplies using pack animals can greatly support units operating for extended periods, away from a ground MSR and particularly for units on ridgelines. The MCMWTC is the only Department of Defense school currently training personnel and units in the employment of pack animals. A pack animal can carry between 50 and 300 pounds, depending on the type of animal available. Using pack animals requires acquiring them within the area of operations. Refer to Army Techniques Publication 3-18.13, *Special Forces Use of Pack Animals*, for more information.

Convoy Operations

Hazards for convoy operations are visibility, weather, and terrain.

Visibility. Fog, rain, and blowing snow can lead to disorientation. Marines should note their exact position and plan their route to safety before visibility decreases. Cold combined with fog can cause a thin sheet of ice to form on rocks. Whiteout conditions can be extremely dangerous.

Weather. Weather conditions in the mountains vary from one location to another as few as 10 kilometers apart. Approaching storms may be hard to spot if masked by local peaks. A clear, sunny day in July could turn into a snowstorm in less than an hour. Emergency gear must always be available and conditions constantly evaluated. Under certain conditions, it may be advisable to re-evaluate unit capabilities. Pushing ahead with a closed mind could be disastrous for the mission and the unit. In winter months, mountain passes close due to heavy snowfall and avalanches and there is a loss of flight days due to cloud cover. In the summer months, the spring floods increase the chance of vehicles getting stuck or swept away by water.

Terrain. Route reconnaissance should determine likely ambush locations, which are predominately canalizing areas. Although valleys most often provide the easiest route, they may also prove to be the most dangerous since it is very difficult to engage an enemy that maintains the high ground. Route reconnaissance and mountain picketing should also focus on maintenance and recovery challenge areas, equipment collection points, locations where vehicle rollovers are likely, and the estimated maximum throughput of vehicles on a road network or bridge. Because of the increased travel times associated with moving in high altitude, combat trains should be positioned as close to the tactical unit as possible.

Supply

Because of the burden on transportation, supplies should be prioritized and limited to essentials. The individual Marine's load should be lightened as much as possible. Certain items, such as demolitions, would most likely have an increased demand. Supply sources and limitations from the environment and even the enemy must be considered as should resupply options. Supply route considerations include—

- Existing roads should be rapidly analyzed for bottlenecks (prime mine, explosive hazards, and ambush locations), deployment areas, passing places, and turn-around locations for various vehicles.
- Routes should be classified as one- or two-way and staggered schedules developed for the use of one-way routes.
- Signs should be placed for both day and night moves on difficult and dangerous routes.

- Whenever possible, separate routes should be designated for vehicular and dismounted movement. Additionally, separate routes should be designated for wheeled and tracked vehicles, particularly if the latter are likely to damage road surfaces.
- Mountain pickets and overwatch should be in place to observe likely ambush locations.
- If operating in an area with explosive hazards, counter-hazard SOPs must be employed for route clearance; however, mountain pickets are still needed for the safety of route clearance vehicles and personnel at likely ambush sites. Convoy operation SOPs should be rehearsed.

During operational pauses, Marines should stockpile and cache supplies to reduce future demands during combat operations. High altitude operations increase personnel energy requirements by as much as 50 percent and, coupled with cold temperatures and increased physical activity, may make Marines' missions a secondary thought to surviving. Four MREs per day should be carried to meet increased caloric requirements. Other options include the meal cold weather (MCW), modular operational rations enhancement, and First Strike Ration. Even with extra rations, weight loss is a characteristic of operations in high altitude.

Engineering

Engineering demands might require a combined effort of all engineering units, yet the requirement to attach engineers to all units also exists due to isolation and difficult terrain. Increased demolition training for Marines who are not engineers should be conducted. Unit pioneer kit augmentation, such as adding snow shovels, ice augers, and chain saws, is also advised.

Mobility and countermobility are typically the priority of the entire operation, but the earthmoving vehicles generally employed for these operations have difficulties in severe terrain.

Historically, mines have been employed in mountainous regions because of their ability to block entire geographical areas from foot and vehicle movement. Increased education on detection and clearing must be conducted and SOPs established. More detail can be found in Marine Corps Center for Lessons Learned reports from mountain warfare operations, such as Operation ENDURING FREEDOM, for SOP development.

Maintenance

Training on all levels concerning environmental factors on vehicles and equipment should be considered. When possible, maintainers should supervise preventive maintenance. Operators need to maintain—

- Tires. A minimum of one extra tire per vehicle should be completely assembled to save time during combat operations. If possible, feasible, and economical, aftermarket tires with greater ply in the sidewall are recommended because most tire failure is due to sidewall blowout.
- Batteries. The vehicles should be equipped with a maintenance free, gel-type battery vice standard batteries.
- Class IX Items. Table 11-1 shows a list of parts the battalion should bring in addition to its standard Class IX block.

Table 11-1. Additional Class IX Block Considerations for Mountain and Cold Weather Operations.

Item	Quantity
Power steering pumps	2 per 10 vehicles
Steering gear box	1 per 10 vehicles
Heavy duty springs and shocks (for rough terrain, if not already on vehicle for additional armor)	2 per vehicle
Tires	1 spare per vehicle
Pitman arms	1 per 5 vehicles
Idler arms	1 per 5 vehicles
Upper and lower ball joints	1 each per 2 vehicles
Inner and outer tie rod ends	1 each per 2 vehicles
Front and rear tie rods	1 each per 2 vehicles
Half shaft bolts	10 per vehicle
Front and rear half shaft	1 each per 10 vehicles
Inner and outer constant velocity boots	1 each per vehicle
Gear hub input and output seals	2 each per vehicle
Differential yokes	1 per 20 vehicles
Gear hub plate bolts	25–30 total in PEB
Brake pads	2 each per vehicle
Brake rotors	1 per 10 vehicles
Front and rear brake lines	1 of each per 5 vehicles
Alternator mount bolts	1 set each per 5 vehicles
Starter mount bolts	1 set each per 5 vehicles
Power steering pump mount bolts	1 set each per 5 vehicles
Water pump	1 per 10 vehicles
Serpentine belts	1 per 5 vehicles
Air filters	2 per vehicle
Gel-type batteries	2 per 5 vehicles
Hardback door hinges	4 per vehicle
Hardback rear hatch shocks	2 per vehicle
Glow plugs	1 set of 8 per 5 vehicles
Glow plug controller	1 per 5 vehicles
Protective tool box	1 per 10 vehicles
LEGEND PEB pre-expended bin	

Health Services

Medical evacuation, CASEVAC, and Class VIII medical supplies are health service considerations.

Medical Evacuation. Casualties are transported from a combat zone health care facility to a health care facility located outside the combat zone by vehicle or aircraft.

Casualty Evacuation. Units must have a CASEVAC plan, which establishes the process of moving casualties from a combat area to a health care facility. Transporting casualties on foot, on a pack animal, on a sled over snow, in a vehicle, or in a helicopter can all be employed in a mountainous, cold weather environment. Litter teams require more personnel to move the casualty in compartmentalized terrain or at high altitude.

Class VIII Medical Supplies. A mountainous, cold weather environment greatly increases the demands for medical supplies. The standard individual issue should be increased accordingly.

Services

Services, such as postal, administration, legal, and exchange, are difficult to support in a mountainous, cold weather environment. Efforts should be made to satisfy communication with others through a postal service, but most other services cannot be provided outside a base camp installation.

Force Protection

Force protection is not a function of combat service support, but it should be an organic capability in all environments. Force protection in a mountainous environment should be additionally emphasized because of the close terrain and because the enemy will most likely attempt to cut off or destroy logistic support from the combat arm's units. Dispersion of assets is a force protection and a flexibility issue.

Individual Sustainment

Self-sustainment measures must be employed at the individual level regarding Class I, Class II supplies, and Class V.

Class I: Water/Food. Ration requirements increase in severe terrain from 3,000 calories per day to approximately 4,500 calories per day for each Marine. A 180-Marine line company would need to be supplied with 315 cases (approximately 6.5 pallets) of MREs or MCWs to sustain a 3,000 calories per day diet for one week. Water requirements increase as well in a mountainous, cold weather environment and Marines should make every effort to get water from the environment using chemical purification, boiling, filtration, or other methods. The Marine air-ground task force (MAGTF) logistics combat element most likely has reverse osmosis water purification systems for bulk water purification; however, smaller maneuver elements can self-support, making their own water by melting snow with SUES during the winter and by using commercial filters or iodine tablets during summer.

Class II: Clothing and Personal Equipment. Personal equipment should be adequate for the environment and safeguarded by the individual because its loss could be life threatening, and replacement can take days or weeks. Equipment and clothing should be constantly inspected by the chain of command. Table 11-2 lists required and suggested gear.

Table 11-2. Unit and Individual Clothing and Equipment for Mountainous, Cold Weather Activities.

Individual Mountain and Cold Weather Equipment					
TAMCN	**Nomenclature**	**Quantity**	**TAMCN**	**Nomenclature**	**Quantity**
C56522F	APECS Parka	1 per	V00142F	ECW Booties*	1 per
C66322F	APECS Trousers	1 per	V00152F	ECW Parka*	1 per
C34212F	Modular Sleep System (3-season with bivvy cover)	1 per	V00162F	ECW Trousers*	1 per
C10552F	Cold Weather Cap	1 per	V00062F	Balaclava (FROG)	1 per
C02602F	Neck Gaiter	1 per	V000172F	Lightweight Exposure Suit Jacket	1 per
C01692F	Improved Sleeping Mat	1 per	V000182F	Lightweight Exposure Suit Trousers	1 per
C34002F	Tarpaulin	1 per	V00202F	ECW Sleeping Bag	1 per
C01702F	Line, Wet Poncho	1 per	V00252F	Intermediate Cold-Weather Glove	1 per
C54402F	Pack	1 per	V41262F	Fleece	1 per
C54402F	Main and Assault Pack Liners	1 set per	V41602F	Boot, Insulated Cold Weather (Vapor Barrier)	1 per
C10662F	Undershirt, Mesh Baselayer Cold Weather	1 per	V42042F	Glove Inserts, Cold Weather (Contact Gloves)	2 per
C00162F	Drawers, Mesh Baselayer Cold Weather	1 per	V43102F	Mitten Shells (Snow Camouflage)	1 per
C00292F	Drawers, Gridfleece	1 per	V43552E	Snowshoe, Assault	1 per
C00172F	Shirt, Gridfleece	1 per	V43562F	Socks: ECW, Mountaineer	
C01152F	Drawers, Silkweight	2 per	V44802F	Cover, Field Pack (Snow MARPAT)	1 per
C01162F	Undershirt, Silkweight	2 per	V42902F	Trousers, Camouflage Snow	1 per
C01182E	Chest Rig	1 per	V43202F	Parks, Camouflage Snow	1 per
C31502F	First Aid Kit, Individual	1 per	V43552E	Snowshoe, Assault	1 per
C01292E	Enhanced Combat Helmet	1 per	V44862F	Cover, Individual (Snow Camouflage)	1 per
C01542F	Helmet Cover, MARPAT Snow	As Required	V00282B	Ski Poles (Optional)	1 per
C01802F	Sub Belt	1 per	V00242B	Military Ski System	As required
V42902F	ECW Mitten	1 per	V00022E	Cold-Weather Hydration System	1 per
Unit Equipment Requirements					
TAMCN	**Nomenclature**	**Quantity**	**TAMCN**	**Nomenclature**	**Quantity**
V00132B	SUES (Stove)	1 per 2	V43402E	Cold-Weather Infantry Kit	1 per 4
K45232E	MACK (Climbing Kit)	1 per company	V00232B	Arctic Shelter, 15-Person	1 per 15
V4652	ECW Tent (4-Marine Tent)	1 per 4			

NOTE
*Also referred to as "happy" booties, parkas, and trousers

Class V: Ammunition. Certain types of ammunition, such as grenades and demolitions, can be employed much more in mountainous terrain.

MOUNTAIN WARFIGHTING LOAD REQUIREMENTS

Combat operations in a mountainous, cold-weather environment require Marines to use additional specialized gear to survive and negotiate terrain. This increased requirement increases each Marine's individual load. The three warfighting loads—assault, combat, and existence—assist unit leaders in determining appropriate levels of clothing and equipment for multiple situations. Applying these loads ensures the safety of each Marine and maximizes each Marine's tactical efficiency. In a mountainous, cold-weather environment, Marines must carry a survival kit and the six pocket items.

Assault Load

The assault load is defined as the additional equipment needed for short duration missions. These items must be carried when away from the patrol base or bivouac site:

- Extra insulating layer. This layer (usually called the "gridfleece") is in addition to what Marines are wearing with the basic uniform requirement.
- Cold-weather cap or balaclava.
- Extra socks and gloves.
- Protective layer (APECS parka and trousers).
- Marine Corps sub belt, including—
  - Two quarts of water.
  - First aid kit (complete).
  - Ammunition.
- Assault pack waterproof bag.
- Improved sleeping mat.
- Mission-essential gear.
- Helmet with camouflage cover and body armor (as designated). The higher the altitude, the less personal protective equipment is practical to enable alert maneuver.
- Field-stripped rations for use when away from the patrol base or bivouac site.
- Individual mountaineering equipment, as required. A standard set of individual mountaineering equipment consists of one sling rope (15 to 18 feet), two carabiners (one locking and one nonlocking aluminum), and one pair of rappelling gloves.
- Specialized mountaineering equipment is carried as required. Examples include—
  - Over-the-snow mobility equipment (i.e., snowshoes or skis).
  - Repair and replacement items.
  - Overwhites (parka, trouser, pack cover, helmet cover, and over mittens).
  - Probe poles (one per buddy team, from the MCCWIK).
  - Shovels (one per buddy team, from the MCCWIK).
  - Transceivers (one per Marine with extra batteries, if traveling in avalanche terrain as part of a small intelligence, surveillance, and reconnaissance team).
  - Marine assault climber's kit items, ropes, cable ladders, harnesses, crampons, and ice axes.

Combat Load

Combat load equipment is carried for longer-duration missions. At a minimum, a unit with assault loads has one Marine per squad with a combat load for safety. This equipment can be spread throughout the unit. The following items should be carried in addition to the items in the assault load:

- Sleeping bag system (see Chapter 13).
- Stove and fuel bottle (full). Each Marine carries one item or the other.
- Thermos (one per buddy team).
- Cook set (one per four-Marine tent team). The canteen cup can be used in place of a cook set.
- Field tarpaulin for weather, expedient shelters, or CASEVAC.
- Personal hygiene equipment.

Existence Load

Existence load items are carried for extended-duration missions that may require supplementing or replacing items, such as extra insulating layers, extra socks and gloves, and spare vapor transmission layer (see Chapter 13).

Pocket Items

As part of the basic uniform, each Marine should have the following six items in the pockets of their utility uniform:

- Knife (a multitool is best, but a pocketknife, bayonet, or K-bar can suffice).
- Lip balm and sunscreen.
- Sunglasses that are polarized and have 100 percent ultraviolet (UV) protection.
- Note-taking material.
- Emergency ration.
- Flashlight or headlamp.

Survival Kit

Each Marine should have, at a minimum, two of each of the following survival kit items:

- Signaling Device (Day and Night). Examples of signaling devices include whistles (without ball inside because the ball may freeze); mirrors; cyalume or chemical lights; pyrotechnics; flashlights; and air panels, which arecreated by turning an assault waterproof bag inside out to create a contrasts against the terrain.
- First Aid Kit. The issued first aid kit is the minimum requirement; personal blister kits are recommended for mountainous terrain as well as individual medication.
- Water Gathering and Purifying Equipment. Examples of water gathering items are zipper-type re-closable bags, canteens, canteen cup, thermos, and hydration system. Examples of water purifying equipment are water purification tablets, iodine, filter pump, and stove.
- Fire Starting Items. Examples of fire-starting items are a lighter, flint and steel, or waterproof or windproof matches. Examples of tinder for fire starting are cotton balls, tampons, gauze, or anything that is 100 percent cotton and saturated with petroleum jelly. Prepackaged tinder, such as hexamine fuel or gauze, can also be used.

- Shelter-Building Items. Examples of shelter building items are 10 meters of 550 cord, field tarpaulin and bivvy cover (carried in combat load), and a space blanket or bag.
- Food-Gathering Items. Examples of food gathering items are a fishing kit with bait, emergency ration, and snare wire.

Ideally, at least one of each item is carried in the pockets of the utility uniform. All other survival kit items should be packed use the layering system so that most items are on the body, some are in the assault load, and some are in the combat load.

Equipment Distribution Within a Unit

For safety, the following items should be distributed within the unit:

- One CASEVAC system per platoon, such as a MCCWIK sled or flexible litter.
- At least one combat load per squad (may be spread loaded).
- At least one shelter per squad, such as a tent fly.

Unit leaders need to ensure Marines have all this gear prior to leaving the forward operating base, ship, or home station. Unit leaders and mountain leaders should modify these loads based on METT-T, space, and logistics considerations, and common sense.

Packing Considerations

While packing for the mountains or cold weather, Marines should consider the following:

- The stove and fuel bottle should be kept in the outside pockets of the pack. They may leak and soak equipment with fuel if stored inside the pack.
- Keep skins (if equipped with skis that required them) warm inside the jacket next to the body, which helps the skin's glue adhere when mounting.
- When Marines are not wearing the protective layer or insulating layers, they should keep them at the top of the pack. When taking a break during a movement, Marines can quickly don a layer to prevent becoming chilled.
- Climbing rope should be kept in the rope bag to reduce the rope's exposure to petroleum products, UV light, cuts, and abrasions.
- When not wearing overwhites, they should be kept under the map flap of the pack for a quick camouflage change as the terrain requires.
- Snowshoes should be secured to the pack with straps, parachute cord, or bungee cord. The tails of the snowshoes should point up and the shovels should point inward, wrapping under the bottom of the pack.
- Skis should be carried on the pack by sliding the tails into the external side pockets on the bottom of the pack. The tips are then strapped together with a toe strap or cord.
- Marines should have snacks readily available (either in uniform pockets or in the exterior pockets of the pack), allowing them to refuel on short breaks during movements without the need to remove the pack.

HELICOPTER CONSIDERATIONS IN MOUNTAIN ENVIRONMENTS

The helicopter is the single best tactical mobility asset available to Marines during mountain, cold weather activities. Marine aviation can move farther and faster than other means of transportation and provide a quick response to logistical requirements. However, the capabilities of the helicopter must be tempered with a sound understanding of the limitations of air support, which include decreased performance at high altitudes, lack of dependability due to unpredictable weather, and the extreme difficulty of performing maintenance in the cold. Although helicopters represent the opportunity to move quickly and efficiently, the unit leader must always have an alternate movement plan to ensure mission accomplishment in the event air support is canceled or unavailable.

The following factors should be considered when deploying helicopters in a mountainous, cold weather environment:

- Reduction in Operational Tempo. It takes the mechanics longer to fix, fuel, and perform routine maintenance on the aircraft. The aircraft may also have more maintenance problems due to the cold weather.
- Vulnerability in the LZ. Delays in the LZ make helicopters particularly vulnerable to both direct and indirect fire. Helicopters often create large snow signatures when conducting landings and takeoffs in snow-covered terrain.
- Temperature and Altitude. As temperature and altitude increase, helicopter performance decreases, affecting not only payload capability, but also time on station, airspeed, and maneuverability. Decreased temperature does not offset the effects of increased altitude when operating in high mountains.
- Weight or Bulk Load. Fewer passengers can be carried because Marines equipped for cold weather operations take up more space in the aircraft. It generally takes one and a half the normal seating space for a Marine with a full cold weather combat load.
- Weather. Mountainous, cold-weather environments are often compartmentalized and subject to rapid and severe weather changes. Commanders should have alternate plans for insertion and extraction.
- Rotor Wash Identification and Visibility. On landings and takeoffs, helicopters recirculate large snow clouds that can be observed from considerable distances.

Safety Considerations

Marines must understand the following safety considerations that apply to operating aircraft to reduce the risk of injury during cold weather, high altitude activities:

- Frostbite. Frostbite is a constant danger because of the combination of increased wind-chill from rotor wash and cold temperatures. Marines subjected to high winds and rotor wash should cover all exposed skin. The APECS jacket hood should be up and fully zipped, and the buddy method should be used to check for possible signs of frostbite.
- Assembly Areas. Assembly areas should provide security, concealment, dispersion, and a windbreak for troops. Additionally, all other considerations for temperate environments apply. Any time Marines must wait longer than 40 minutes in freezing temperatures, they

should erect warming shelters. This period might be substantially shorter in extreme cold temperatures or under severe windchill conditions.

- Rotor Blade Hazards. In deep snow-covered LZs, the helicopter may sink into the snow, reducing the rotor-blades-to-surface clearance. Use of the ahkio huddle technique (organizing by tent and sled team) for loading and unloading reduces the danger of being struck by the rotor blades. In sloping LZs, the helicopter should not be approached from the upslope side as rotor-blades-to-surface clearance is further reduced. Extreme caution must be exercised when operating near the tail rotor. Refer to Figure 11-1 for rotor blade clearances.
- Cargo Ramp Hazards. In deep snow, the crew chief might not be able to completely lower the cargo ramp. Marines must be aware that this significantly reduces head clearance. Marines should be cautious when operating near the cargo ramp; it is hydraulically operated and can easily crush personnel. Hydraulic fluid or ice can also cause the ramp to be a slipping hazard for debarking Marines.
- Ice Shedding. Under various conditions, ice may accumulate on the rotor blades of a helicopter. When it sheds, it produces many flying projectiles. The safest place to be is on the ground with the face covered (ahkio huddle).
- Unprepared LZs. When landing in an unprepared LZ, the fuselage floats on the snow's surface. Landing points should be probed and tramped down to discover possible obstacles.
- Dynamic Rollover Damage. A helicopter typically settles through the snow surface. If the ground is uneven or there are obstacles beneath the surface of the snow, it could cause the helicopter to contact the ground at an angle. In this condition the helicopter would be in danger of dynamic rollover. Dynamic rollover is when the helicopter rolls over onto itself due to the landing gear or skids coming in contact with the surface while power is being applied to the aircraft. Time permitting, the landing spot should be probed for any obstacles. An avalanche probe pole from the MCCWIK or a ski pole without the basket can be used.

Helicopter Landing Zone Selection and Preparation

Landing Zone Selection. The size of the LZ is determined by the number and type of helicopters to be employed. An LZ that is 50 meters by 50 meters is generally sufficient to land any helicopter, but consideration should be given to the altitude at which operations are being conducted. As operating altitudes increase toward 10,000 feet, the size of the LZ should also increase. For example, at 8,000 feet the dimensions would be about 75 meters by 75 meters due to the performance loss that a helicopter experiences while operating at higher altitudes. At higher altitudes (above 10,000 feet), an LZ that measures approximately 100 meters by 100 meters provides the necessary clearance for a safe approach and departure. Size considerations should also be increased if the LZ in question has significant obstacles surrounding the zone or on the approach/departure path.

> NOTE: In all situations, a face-to-face brief with the pilots in the operating area can help planners determine the capabilities and limitations of the aircraft and what size zones they are be looking for. The air officer or FAC should be the leading authority on this matter.

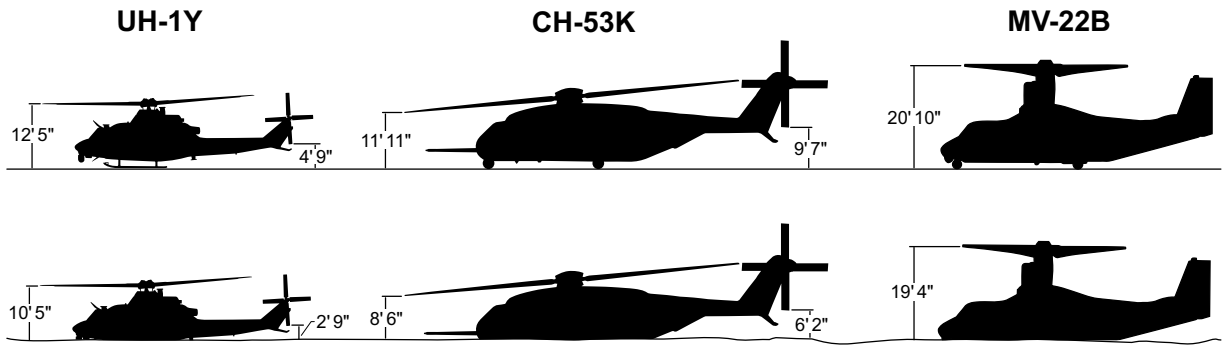


Figure 11-1. Rotor Clearance for Marine Corps Aircraft.

Other factors also that affect an LZ selection include—

- Wind Direction. The wind direction determines the approach and departure directions. Helicopters normally take off and land into the wind.
- Ground Surface. Debris, snow, and ice kicked up when a helicopter lands in the zone and most of the danger from this flying debris is to the Marines on the ground, so Marines should use caution when the aircraft is landing. Time permitting, Marines should pack down the area where the ahkio huddle is located to minimize the effects of blowing snow and ice.
- Ground Slope. Terrain with slopes of more than 8 degrees is usually considered too steep for helicopter landing due to the dynamic rollover characteristics of all helicopters. A briefing with the aircrew in the operating area clarifies the capabilities or limitations of the aircraft.
- Concealment. Areas should be selected that can conceal both the helicopter and the snow signature from direct enemy observation. The signature that develops from the rotor wash can be observed up to 30 kilometers away.
- Obstacles. The unit to be loaded should look for obstacles that may be hidden under snow as they can be potentially dangerous to the helicopter. The LZ should be probed to locate tree stumps or large rocks that could place the helicopter in a dynamic rollover situation or rupture the skin on the belly of the aircraft.
- Snow. Depth and consistency of snow can have a major impact on LZ operations. Hard or crusted snow can break up and become a hazard to Marines on the ground.
- Lakes and Rivers as LZs. Commanders should consider using frozen lakes and rivers as alternate LZs. Frozen lakes and rivers could make excellent LZs because they are typically level and have little loose snow due to the scouring winds.

LANDING ZONE PREPARATION

Marines should walk through the LZ to determine snow depth and appropriate locations for helicopter landing points.

They should consider the following:

- Packing the LZ. Packing the LZ makes it easier for a pilot to find the landing point and for Marines to move about, which is particularly important when conducting external operations. However, packing can create the probability of friendly forces being detected by the enemy. Time, conditions, and tactical situation permitting, the first area to be packed should be the area around the ahkio huddle. The next area that should be packed is the landing point, which should be approximately 50 meters square. Packing decreases the amount of snow that can be kicked up by the rotor wash. If an LZ is in a safe area and will be used frequently, a request for engineer support to pack the snow should be made. Over-the-snow vehicles are most effective for packing landing points quickly. For Marines on snowshoes, skis, or just boots, the packing method can still be used.
- Marking the LZ. Marking the LZ and the landing points is critical. The white, snow-covered zones can provide a difficult background for the pilots. Blowing snow can cause a whiteout condition and may cause the pilots to lose reference to the horizon. A reference point must be always visible.
- Air Panels. Air panels contrast in color with the snow. They must be secured to ensure that they are not blown away by rotor wash.
- Smoke Grenades. Smoke grenades should be used to mark the LZ only and not the landing points. When used in snow-covered LZs, a platform should be used to prevent the smoke grenade from sinking in the snow.
- Chemical Lights. Chemical lights provide good close-in lighting at night but are hard to see beyond one-half mile.
- Tree Boughs. Lay or stick tree boughs into the snow to provide a contrasting reference for the pilots' orientation.
- Sled Teams. Ahkio huddles are the primary method of marking landing points. The huddle should contrast in color to the background in the LZ. Individuals should remove overwhites, wear a protective facemask, have the hood up and zipped on the protective layer, and be sure that no bare skin is exposed to the rotor wash.

Landing Zone Brief

The following is the minimum required information for a LZ brief:

- Unit call sign.
- LZ location.
- LZ marking.
- Wind direction and velocity.
- LZ size.
- LZ elevation.
- Obstacles and snow conditions.
- Visibility.
- Approach/retirement direction (recommended).

Preparations for Embarkation

Helicopters often have reduced payloads when operating at higher altitudes. In addition, operating in high temperatures, high humidity, and high-density altitude degrade helicopter performance. Consequently, helicopter payloads may change significantly due to both the current and forecasted weather and LZ altitudes. Payload, personnel, equipment, and ahkio huddle procedures should be considered when preparing for embarkation.

Payload. Table 11-3 shows helicopter payload estimates, and it should be used only to demonstrate the reduction in capacity at elevation. Actual lift capacity can vary depending on fuel consumption, ordnance on board, time of flight, and weather. Reduced useful load is the total weight of fuel, cargo, and personnel an aircraft can lift at a given density altitude. Increasing density altitude reduces the useful load.

Table 11-3. Helicopter Payload Characteristics at Increasing Altitude.

Helicopter	Sea Level	5,000 ft MSL	10,000 ft MSL
UH-1Y	6 pax and gear	4 pax and gear	2 pax and gear
CH-53K	37 pax and gear	24 pax and gear	18 pax and gear
MV-22B	24 pax and gear	20 pax and gear	16 pax and gear

LEGEND

CH-53K	heavy-lift assault support helicopter	MV-22B	medium-lift assault support
ft	feet	pax	passengers
MSL	mean sea level	UH-1Y	utility helicopter

Personnel. A major hazard to personnel operating around helicopters in the cold weather is the windchill generated by the rotor wash. Exposed skin should be kept to a minimum. If a long wait is expected, warming tents should be erected.

Equipment. The team sled should be staged as near the landing point as possible. To prevent the team sled from being moved by rotor wash, the Marines embarking on the aircraft should lay on top of the sled (ahkio huddle).

Weapons should be in Condition 1 when embarking the aircraft. Muzzles should be pointed down on the CH-53K but pointed up or outward on the UH-1Y. No equipment, such as skis, poles, or radio antennas, should be allowed to protrude above the height of an individual so that no equipment goes into the rotor blades. Packs should not be worn aboard helicopters due to the restricted movement and the requirement to fasten seat belts before departure. Packs and team sleds should be staged at the center of the aisle on assault aircraft.

Ahkio Huddle Procedures. The ahkio huddle is designed to get Marines on and off a helicopter as quickly as possible with minimum exposure to windchill. Although typically used in a snow-covered environment, the huddle can be effectively used in any environment.

The ahkio huddle is established around the sled or tent equipment on the landing point. Packs are removed, and skis are bound together. Marines group together on top of the equipment, face down, to keep the equipment from blowing away. Overwhite camouflage is removed so that the

huddle contrasts the snow-covered background. All the tent team's equipment necessary for survival is loaded on the same aircraft as the personnel. The helicopter lands to place the sled team huddle under its rotor arc at the 2 o'clock position.

The ahkio huddle reduces the amount of time the helicopter must remain in zone by providing the pilots a reference point, reducing the distance Marines have to move through snow to the aircraft and reducing loading/unloading time.

Embarking the Helicopter

The ahkio team leader supervises the loading of the sled and any other equipment. See Figure 11-2 for embarkation and debarkation routes for specific aircraft.

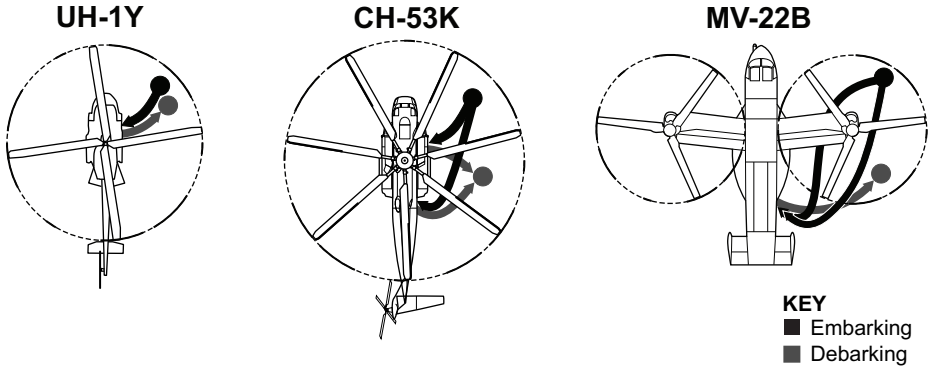


Figure 11-2. Embarking and Debarking by the Ahkio Huddle Method.

The leader and team have specific responsibilities when embarking and debarking the helicopter. The ahkio team leader is responsible for the following:

- Load first, move to the front of the helicopter, and secure gear by the left most forward seat.
- Immediately communicate with the pilot.
- Strap in for takeoff and landing.
- When in flight, observe from the cockpit between the pilots to maintain orientation.
- Designate Marines to load/unload equipment.
- Maintain accountability of the ahkio team.

The ahkio team members are responsible for the following:

- Load the helicopter only when directed by the crew chief, who directs the team to load through either the side or rear door.
- Enter the aircraft quickly and move to preassigned seats.
- Hand carry snowshoes on board. Once seated, team members hold their snowshoes and weapons between their legs.
- Bind skis and poles together in pairs. When loading or unloading, keep them parallel to the deck at waist level. Once loaded, place skis on the deck of the aircraft beneath the feet.

The assistant ahkio team leader is responsible for the following:

- Supervise the loading and unloading.
- Ensure that all gear and Marines have boarded.
- Board last and signal "thumbs up" to the crew chief.

Debarking the Helicopter

The offload generally follows the reverse order of the onload. The debarking sequence, supervised by the assistant team leader, is as follows:

- The sled and any other equipment are unloaded first.
- All remaining Marines exit in reverse order of embarking.
- The ahkio huddle is assumed just off the ramp or outside the door under the rotor arc.
- Only after the helicopter lifts off does the ahkio team tactically deploy.

CASUALTY EVACUATION

Considerations in Mountains and Cold Weather

The following CASEVAC considerations apply to helicopter operations:

- Helicopter operations in this environment can be unpredictable, so alternate CASEVAC means must be planned.
- Identifying CASEVAC LZs should be planned and a dedicated CASEVAC helicopter should be on alert.
- Marines must be cautious when loading a patient aboard a helicopter in deep snow due to the reduced rotor clearance.
- The patient should be protected from the rotor wash. Any exposed skin is subject to frostbite.
- A warming tent should be established for the patients and the loading teams.

CHAPTER 12.
MOUNTAIN SAFETY AND HEALTH CONSIDERATIONS

MOUNTAIN SAFETY PRINCIPLES

The following principles can help leaders conduct a safe and efficient operation in any mountainous environment. These 12 principles can be remembered using the mnemonic "BE SAFE MARINE":

- **B**–Be aware of the group's ability.
- **E**–Evaluate terrain and weather constantly.
- **S**–Stay as a group.
- **A**–Appreciate time requirements.
- **F**–Find shelter during storms, if required.
- **E**–Eat properly and drink plenty of fluids.
- **M**–Maintain proper clothing and equipment.
- **A**–Ask locals about conditions.
- **R**–Remember to stay calm and think.
- **I**–Insist on emergency rations and kits.
- **N**–Never forget accident procedures.
- **E**–Energy is saved when warm and dry.

Be Aware of the Group's Ability

Leaders should evaluate the individual abilities of their Marines and use this knowledge as the basis for planning. Leaders should evaluate the following:

- Physical Conditioning. Physical fitness is the foundation for all strenuous mountaineering activities. Leaders must be aware of their units' states of fitness and consider changes in altitude, climate, and the amount of time for acclimatization.
- Mental Attitude. Unit members need to be positive, realistic, and honest with themselves, and they should create a realistic appraisal of the situation and the unit's capability.
- Technical Skills. These skills include the ability to conduct a vertical assault, construct rope installations, maneuver over snow-covered terrain, and conduct avalanche search and rescue operations. A unit with these skills increases its ability to operate effectively in a mountainous, cold weather environment.
- Individual Skills. Leaders must choose those with the most proficiency at the individual skills required for the mission, such as navigation techniques, security, call for fire, track plans, bivouac site selection, and skijoring. Company leaders should help train individuals for specific skills.

Evaluate Terrain and Weather Constantly

During the planning stages of a mission, leaders should gather as much information as possible on the surrounding terrain and key terrain features involved in their area of operations. They should consider—

- The necessity of bringing items such as ropes, crampons, climbing gear, or skins.
- The caution needed when moving in particularly dangerous areas (e.g., loose rock and avalanche-prone slopes).
- Knowledge of the unit's position on the planned route.

Drastic weather changes can occur within a few hours, resulting in gale force winds, reduced visibility, heavy precipitation, and extreme temperature drops. In addition to obtaining current weather data, the leader must plan for the unexpected weather. For example, during a lightning storm leaders should ensure—

- All radios are off and staged with weapons away from personnel.
- Personnel are in a lower-lying area or around tall natural objects (not trees).

> NOTE: To calculate the approximate distance in miles from a lightening flash, the general estimate is to count the number of seconds from when the flash is seen to when thunder is heard and then divide by five.

Stay as a Group

Units should remain as a group, considering the following factors:

- Implement adequate rest halts based upon the terrain and elevation, physical condition of the unit, amount of combat load, and mission requirements.
- Use the buddy system regardless of rank.
- Maintain a steady pace, enabling all unit members to reach the objective area.

Appreciate Time Requirements

Leaders must estimate the time required for the operation based on terrain, weather, unit size, abilities, and the enemy situation. This estimate should also consider the possibility of unexpected emergencies due to severe conditions, such as injuries or unplanned bivouacs.

The TDF is designed to be a guideline and should not be considered as the exact amount of time required for the movement. The TDF is designed for acclimated troops on foot in the summertime or on skis with skins or snowshoes in the wintertime. The TDF varies based on unit size, physical conditioning, experience, load carried, angle of slope, snow conditions, and surface conditions.

A set of TDFs is used for planning as explained in the following examples:

- Mountain leaders or patrols with high altitude and cold weather experience—3 kilometers per hour plus 1 hour for every 300 meters ascent and 1 hour for every 600 meters descent.
- Assault climbers, scout skiers, or patrols—2 kilometers per hour plus 1 hour for every 300 meters ascent and 1 hour for every 600 meters descent.
- Company and battalion movements—1 kilometer per hour plus 1 hour for every 300 meters ascent and 1 hour for every 600 meters descent.

Route cards (see Chapter 4) are a tool for route planning and require a detailed map study. Overlays and route cards should contain the following information at minimum:

- Unit designation.
- Unit commander.
- Number of personnel.
- Inclusive dates and times of movement.
- Grid of each checkpoint and bivouac.
- Estimated time (log actual time on route).
- Map references.
- Magnetic azimuth and distances for each leg.
- Elevation gains and losses per leg.
- Description of the ground.

The route card is an essential tool during storms and reduced visibility for dead reckoning navigation. Before departure, the unit commander must submit a route card and route overlay to higher headquarters and keep a duplicate copy. Units should follow the preplanned route as closely as possible, changing course as necessary based on the tactical situation.

Find Shelter During Storms

If there is a drastic change in the weather, tents should be erected immediately. If tents are not available, the unit leader should locate natural shelter or build a shelter. The following principles can help an individual stay safe during inclement weather:

- Make Shelter. The basic requirement is protection from the wind and precipitation.
- Keep Warm. Retaining body heat is critical; avoid any action in which body heat is lost. Marines should—
  - Get adequate shelter.
  - Insulate themselves from the ground using branches, a sleeping mat, or their pack.
  - Wear extra clothing.
  - Use extra equipment for insulation.
  - Build a fire (if the situation permits) or use the stove while trying to conserve fuel.
  - Protect head, hands, and feet early, before getting cold.
- Keep Dry. Marines must remove wet clothing, towel dry skin, and try to avoid sweating in their clothing or sleep system. The body to lose heat 32 times faster when wet than when dry.

Adequate protection from the elements is critical to prevent the onset of hypothermia.

Eat Properly and Drink Plenty of Fluids

The human body can be compared to a furnace, which runs on food to produce energy (warmth). By planning the consumption of food to suit the specific situation, adequate nutrition and extra warmth can be supplied.

Adequate hydration is critical in a mountainous environment. Everything is more difficult when dehydrated, so leaders should ensure that they and their troops are drinking water. Drinking adequate amounts of water can maintain the body. Danger from dehydration is as high in

mountain regions as in hot, dry areas. Loss of liquids is easily seen and felt in hot climates, whereas, in the mountains, the loss of body fluids is much less noticeable. Water intake is at least 3 to 6 quarts per day (includes water in food) but may be as high as 6 to 8 quarts per day during intense physical activity to help prevent dehydration.

Maintain Proper Clothing and Equipment

The issued equipment is some of the best equipment available; however, it must be cared for properly, much like the Marine's rifle. As Marines care meticulously for their weapons because it keeps them alive in combat, they care for the clothing system in bad weather and the mountaineering or mobility gear in a mountainous environment. Maintenance must be meticulous because it might take a long time to get replacement items.

Ask Locals About Conditions

Local weather patterns, rockslide and avalanche areas, watering points, and normal routes are pieces of information that can be obtained by questioning the host-nation population. The unit leader must obtain current information regarding the conditions along the intended route.

Remember to Stay Calm and Think

Having recognized that there is an emergency, Marines should apply the following principles:

- Stay Calm and Do Not Panic. Marines must conserve body heat and energy.
- Think. When cold, tired, hungry, or frightened, individuals must organize their thoughts into a logical sequence.
- Self Help. The group must try to help itself by either finding the way back to safety or by preparing shelters and procuring food.
- Keep Unit Cohesion. Above all else, the group must act as a tight-knit unit. Individual dissension can cause a total loss of control and unit strength.

Before the mission, leaders should brief all personnel on the SOP for when a Marine becomes lost or separated from the group. In most situations, the safest method is to retrace the route to the Marine's last known point and continue from there, particularly when tracks are visible. Leaders should encourage group input. They should refer to the navigation log, check all recorded bearings and distances, and then recalculate the position. Marines should perform the following actions if they are lost—

- Check calculations with each other.
- Attempt resection.
- Move in a cloverleaf or box pattern until recognizing a terrain feature.
- Shoot an escape azimuth toward a known point or area.

If still lost after completing the above actions, the Marines should remain in place so the group can attempt to locate them.

Insist on Emergency Rations and Kits

Marines should have the following items with them in case of emergency:

- The emergency rations.
- Standard first aid kit, which may be augmented with blister items, such as mole skin or second skin, iodine, antibiotic ointment, and air-activated heat packs.
- Survival kit with fire starting, food gathering, first aid, water procurment, shelter, and signaling devices.
- Repair kit with tape, 550 cord, multitool, sewing awl, flex cuffs, and safety pins.

Never Forget Accident Procedures

The most frequent causes of accidents are—

- Overestimation of physical and technical abilities.
- Carelessness.
- General lack of observation of surroundings.
- Lack of knowledge and experience.
- Failure to act as a group.
- Underestimating the terrain and the time requirements to move through it.

Active involvement in training and education enables a leader to gain the knowledge and experience needed to effectively lead in a mountainous environment.

If an accident does occur, Marines should—

- Perform basic first aid.
- Protect the patient from the elements.
- Evacuate or send help as necessary.
- Never send a person for help alone, if possible. Those individuals should have the following information regarding the accident:
  - Time of accident.
  - Nature and location of accident.
  - Number injured.
  - Best approach route to accident scene.

If one person of a two-person team is injured, the injured person must be given all available aid before the other goes for help. An unconscious individual should be wrapped in all available clothing and sleeping gear and anchored (if on steep terrain). A note explaining the circumstances and reassuring them should be left in a conspicuous spot.

This note must also contain the following information:

- When the Marine expects to return.
- Where the Marine went.
- What the Marine did before leaving, such as medication given.

The international audio distress signal consists of six short blasts in one-minute intervals from the person requesting help. The return signal is three blasts in one-minute intervals from the respondent. Other methods of signaling include red pyrotechnics, SOS (…---…), and "mayday" by voice communications.

Energy is Saved When Warm and Dry

Marines can save heat and energy by—

- Dressing and sleeping to be comfortably cool. Avoid sweating by removing layers as needed to stay dry.
- Eating properly.
- Drinking properly.
- Ensuring shelter meets criteria.
- Producing external heat, such as with fires, stove, or extra clothing, to save body heat and energy for future use.
- Avoiding getting wet because this increases body heat loss.

MOUNTAIN HEALTH AWARENESS

Those who recognize and respect the forces of nature can manage challenges and use these forces to their advantage; however, those who disregard or underestimate these forces will encounter challenges and potential failure. If Marines fail to eat properly or do not get sufficient liquids, efficiency suffers. In turn, decreased efficiency increases the possibility of sustaining casualties by either environmental injury or enemy action, increasing risk of mission failure. The following subparagraphs provide information to help prevent, recognize, and treat various health problems common to mountainous, cold-weather environments.

Prevention

The body's ability to acclimate to an environment is greatly controlled by its physical condition, which is influenced primarily by fitness, nutrition, water intake, and hygiene.

Physical Fitness. Being physically fit is foundational to successfully performing in a mountainous environment. The more fit an individual is, the easier it is for that Marine to move in harsh terrain, carry heavy loads, and ultimately adapt to the stresses of combat operations in a mountainous, cold weather environment.

Nutrition. Marines must consume enough calories daily to maintain strength and conditioning. Typically, consuming four MREs or three MCWs each day provides sufficient vitamins and calories. At a high altitude, in the mountains, and particularly in the winter, Marines require at least 3,000 to 4,500 calories per day to replace what is depleted by increased physical activity and the cold.

In the mountains, increasing the intake of carbohydrates (e.g., sugar, bread, rice, or pasta) is recommended because they are more easily converted into heat energy by the body and aid in acclimatization.

Water Intake. The body loses liquid at an exceptional rate in mountainous, cold weather environments because of evaporation, exertion, and low humidity; however, Marines should adjust clothing and ventilation to prevent loss of liquid through perspiration. The heavy exertion of movement on foot and preparation of bivouacs and defenses exacts its toll in sweat and loss of moisture in the breath. Water intake requirement is at least 3 to 6 quarts per day (includes water in food) but may be as high as 6 to 8 quarts per day during intense physical activity to help prevent dehydration.

Hygiene. Poor personal hygiene coupled with extensive periods in any field environment can have fatal consequences due to skin and other infections and intestinal illnesses. In a mountainous, cold weather environment, maintaining personal hygiene is paramount for ensuring physical and mental wellbeing

Recognition and Treatment of Altitude and Cold Weather Injuries

The most prevalent injuries include—

- Dehydration.
- Heat cramps.
- Heat exhaustion.
- Heat stroke.
- Acute mountain sickness (AMS).
- High altitude cerebral edema (HACE).
- High altitude pulmonary edema (HAPE).
- Splenic syndrome.
- Hypothermia.
- Frostbite.
- Trench or immersion foot.
- Snow blindness.
- Carbon monoxide poisoning.

Dehydration. Dehydration is a deficit of total body water and is the most common illness seen, both in the winter and in the summer. Excessive fluid loss can be caused by—

- Urination. Urination increases as a response to the cold and high altitude.
- Cold, Dry Air. In most mountainous areas, the air is often cold and dry, so inhaled air must be humidified and warmed by the body, which takes water.
- Strenuous Activity. Marines in the mountains are typically involved in strenuous activity that leads to sweating, which is exacerbated by overdressing.
- Coffee and Tea. These are mild diuretics, which stimulate the kidneys to produce excess urine.

Inadequate fluid intake may occur from inaccessibility or using thirst as an indicator. Thirst is not a good indicator of the state of hydration, particularly in a high-altitude environment. If Marines are thirsty they are already dehydrated.

Symptoms of dehydration are—

- Headache.
- Nausea.
- Dizziness.
- Fainting.
- Constipation.
- Dry mouth.
- Weakness.
- Lethargy.
- Stomach cramps.
- Leg and arm cramps.

Signs of dehydration are—

- Swollen tongue.
- Dark urine.
- Low blood pressure.
- Rapid heart rate (greater than 100 beats per minute).

To treat dehydration in the field, leaders should give Marines at least 6 quarts of water per day. Severe cases may require intravenous fluids.

Heat Cramps. Heat cramps are painful spasms of skeletal muscle caused by the excessive loss of body salt. When a Marine conducts strenuous activity that leads to excessive sweating, a salt imbalance within the body can result. This salt imbalance can then lead to muscle cramps in the arms, legs, or abdomen.

To prevent heat cramps, Marines should—

- Avoid overheating by proper ventilation.
- Maintain a proper diet that provides the body with enough salt.
- Hydrate.

To manage heat cramps in the field, leaders should—

- Have the patient stop moving (rest).
- Massage the affected muscles, which may help relieve the spasm.
- Stretch out the muscle.
- Ensure the patient is adequately hydrated. Increase the patient's salt intake by adding either one salt tablet or one tablespoon of table salt (from an MRE accessory packet) to a quart of water. Have the patient sip the salted water over a period of a few hours.

Heat Exhaustion. Heat exhaustion is a severe form of dehydration combined with or because of strenuous physical activity. Blood mostly consists of water; when a large amount of water is lost in the form of sweat, the amount of blood volume in the body drops. When the blood volume drops low enough, heat exhaustion results. A sign of heat exhaustion is fainting. Some symptoms of heat exhaustion are—

- Headache.
- Nausea.
- Dizziness.
- Fatigue.

Preventing heat exhaustion is the same as for heat cramps: wear minimal layers and ensure adequate ventilation to avoid overheating. If heat exhaustion occurs, Marines should—

- Lay the patient down with the feet higher than the head.
- Insulate the patient from the cold ground with a sleeping mat.
- Ensure that the patient is well ventilated. Unzip the parka or take it off, until the patients feel cool. Make sure the patient does not get too cold.
- If the patient is awake and not vomiting, give fluids by mouth. Ensure the patient sips the fluids. Usually, 3 quarts at a minimum are required.

Heat Stroke. Also known as sunstroke, heat stroke occurs when the body's cooling mechanisms fail to rid the body of excessive heat buildup, such as when exercising in a hot, humid environment. Typically, the air in a mountainous environment is cool and dry; nonetheless, heat stroke can occur in the mountains, even in the winter. Heat stroke can occur when body temperature levels are greater than 103 °F.

In most cases, the onset of heat stroke is sudden; an individual becomes delirious or comatose before complaining of symptoms. Approximately 20 percent of individuals complain of—

- Headache.
- Nausea.
- Dizziness.
- Fatigue.

Some signs of heat stroke include—

- Altered mental status, including delirium or coma.
- Body temperatures of 103 °F or greater.
- Hot, flushed skin.
- Sweating. It is often taught that sweating is absent in heat stroke, but this is untrue. Sweating often is present in heat stroke, so responders should not assume a victim does not have heat stroke simply because they are sweating.

As with hypothermia, the only way to absolutely diagnose a victim as having heat stroke is with a rectal thermometer. Anybody with abnormal behavior, such as hallucinations, bizarre behavior, or confusion, and a temperature of 103 °F or higher should be treated for heat stroke.

To prevent heat stroke, the same principles apply as with heat exhaustion: drink 6 to 8 quarts of water per day and keep as well-ventilated as possible. When the temperature and humidity are high, however, units should reduce physical activity.

The longer the victim remains overheated, the more likely it will result in death. To treat heat stroke in the field, responders must—

- Reduce heat immediately by dousing the patient with large amounts of cool water and fanning. Responders can also apply wet, cool towels or cold water bottles to the neck, the groin, chest, and armpits, or use cold packs, if available.
- Maintain an open airway.
- Remove as much of the patient's clothing as possible.
- Give them nothing by mouth.

When the patient's temperature has dropped below 102 °F, the Marine may discontinue cooling the individual. Be sure to recheck the temperature every five minutes. If the patient's temperature rises to 103 °F or greater, begin recooling and CASEVAC immediately.

WARNING: Heat stroke is lethal in up to 40 percent of cases and most of those who do live suffer permanent brain damage.

Acute Mountain Sickness. An unacclimatized individual in high altitude can develop AMS, and anyone can develop it when ascending rapidly from sea level to over 7,000 feet. About 25 percent of individuals who ascend rapidly to 8,000 to 9,000 feet develop AMS; most unacclimatized individuals develop AMS when they rapidly ascend to 11,000 to 12,000 feet. Factors that increase the chance of developing AMS or making it worse are overexertion at altitude and dehydration. Lower barometric pressure and reduced oxygen found at high altitude leads to a state of hypoxia, which means low levels of oxygen in the blood. The body's response to hypoxia can lead to AMS or other altitude illnesses.

Symptoms, which typically occur 6 to 48 hours after reaching altitude, include—

- Headache, the most common symptom, which may be severe.
- Nausea, vomiting.
- Decreased appetite.
- Difficulty sleeping due to irregular breathing.
- Weakness, loss of coordination.
- Easily fatigued.
- Dizziness.
- Apathy.

The best prevention of AMS is a staged ascent. Table 12-1 provides ascent rates for personnel going to a high altitude from sea level.

Table 12-1. Rates of Ascent.

Altitude	Rate of Ascent
7,000 to 8,000 feet	Optimal altitude to begin acclimatization process from sea level; allow for two overnights before further ascent.
8,000 to 14,000 feet	Ascend at a rate of 3,000 feet per day
>14,000 feet	500 to 1,000 feet per day
NOTE For every 4,000 feet of elevation gain add an extra day of acclimatization	

Above 14,000 feet, Marines should ascend no faster than 500 to 1,000 feet per day. If no AMS symptoms occur after 48 hours at a given altitude, they can begin to ascend. Sustained human existence above 18,000 feet is not possible; therefore, only limited operations can be conducted above this elevation.

Certain medications can be used to treat or prevent AMS, but these medications can only be used under the direction of medical personnel. Treatment of AMS includes—

- Light duty (Marines with AMS should not ascend any higher as AMS can progress to HACE, a life-threatening condition).
- Adequate fluid intake. Because AMS is a fluid-retaining condition, Marines should be careful not to overhydrate.
- Other medications can be taken for the headache and steroid medication can be taken, as prescribed, for more serious symptoms.

Most cases of AMS should resolve with 2 to 3 days of treatment; however, if it does not, or if the symptoms are severe or worsening, then descending 1,000 to 3,000 feet should bring relief.

High Altitude Cerebral Edema. High altitude cerebral edema is a high altitude illness characterized by swelling of the brain. Severe AMS can progress to mild HACE, which can progress to severe HACE and death. Other signs of HACE include—

- Poor coordination. (Responders should test the victim's balance).
- Personality changes.
- Poor judgment.
- Bizarre behavior.

Symptoms of HACE include—

- Hallucinations.
- Confusion.
- Excessive fatigue.
- Coma in severe cases.

The preventive measures for HACE are the same as for AMS; however, immediate descent is mandatory. Drugs prescribed by medical personnel include steroids, acetazolamide, and oxygen, if available.

Possible treatments also include using a portable hyperbaric chamber. The HACE patient is placed in the bag and zipped up. Using a foot pedal operated pump, the pressure in the bag is increased, simulating a decrease in altitude. Altitude "decreases" of up to 6,000 feet can be achieved; however, this bag should only be reserved for emergencies when rapid descent is delayed. It is a very labor-intensive method and only a temporary measure.

WARNING: HACE is fatal if not treated.

High Altitude Pulmonary Edema. High altitude pulmonary edema is characterized by the lungs filling with fluid. Although similar to AMS and HACE, HAPE is rarely experienced below 10,000 feet.

Signs of HAPE include—

- Increased respiratory rate.
- Increased heart rate.
- Detection of fluid in the lungs. Typically, fluid can be heard in the lungs with a stethoscope, but in extreme cases it can be heard without it.
- Blue lips.
- Presence of pink, frothy sputum—indicates severe HAPE.

Symptoms of HAPE include—

- Decreased exercise performance and weakness that is worse than expected for the altitude.
- Cough.
- Chest tightness.
- Shortness of breath even while resting (the most significant symptom in diagnosing HAPE).

The same prevention methods as for AMS—a slow graded ascent—can be employed for HAPE. Should a Marine present HAPE symptoms, treatments include—

- Descending rapidly to as low as possible, preferably to sea level.
- Receiving 100 percent oxygen by mask.
- Taking certain medications, administed by a medical professional, such as nifedipine, acetazolamide, or albuterol inhalers.
- Using a hyperbaric chamber.
- Putting the individual on bed rest. If the patient's heart rate is elevated, the amount of fluid in their lungs increases, which worsens the condition—a fact that should be considered when planning the patient's CASEVAC. If the patient walks, their condition may worsen and, in some instances, death may result.

WARNING: HAPE is fatal if not treated.

Splenic Syndrome. Splenic syndrome is a condition that can occur when Marines with the sickle-cell trait deploy to a high altitude environment. When the red blood cells do not receive adequate oxygen, their shape changes and the blood starts to sludge. The spleen has narrow blood vessels that are prone to blood clots. In severe cases, sections of the spleen can die from lack of blood. This condition does not affect every Marine with the sickle-cell trait.

A symptom of splenic syndrome is the sudden onset of severe left upper abdominal pain, which usually occurs during heavy physical exertion. It is treated with aggressive hydration, using intravenous fluids, if available, and oxygen.

To prevent splenic syndrome, leaders should identify Marines with the sickle cell trait by screening medical records before deploying to high altitude environments. For deployments to moderate altitudes (7,000 to 10,000 feet), sickle-cell-trait Marines need appropriate hydration and 2 to 3 days to acclimate before heavy exertion. For deployments to higher altitudes, medical professionals should be consulted before deploying Marines with the sickle-cell trait.

Hypothermia. Hypothermia is the state in which the body's core temperature is 95 °F or less.

NOTE: Exposure should not be used to describe hypothermia.

Most hypothermia cases occur when the temperature is between 30 and 50 °F. This temperature range is quite common in the fall, winter, and spring months. Hypothermia occurs when heat loss from the body exceeds the body's ability to produce heat. Contributing factors include—

- Ambient temperature, which is the outside air temperature.
- Windchill, which affects improperly clothed individuals.
- Wet clothing caused by precipitation and sweat from overdressing.
- Cold water immersion.
- Improper clothing.
- Exhaustion.
- Starvation.
- Dehydration.
- Alcohol, nicotine, and drugs, such as barbiturates and tranquilizers.
- Injuries that cause immobility, major bleeding, major burns, or head trauma.

Severe hypothermia is life threatening. In a field setting, any mild hypothermia casualty who is shivering, able to speak and make sense, and has normal heart and breathing rates (even if it is fast) can eventually recover with minimal intervention in the field. Severe hypothermia patients, however, must be evacuated as soon as possible.

Signs of severe hypothermia include the following:

- Severely altered mental status—the brain is literally getting cold. Signs might include confusion, slurred speech, strange behavior, irritability, impaired judgment, hallucinations, or a decreased level of consciousness. The individual ceases to care about personal safety and loses concern for rescue. As hypothermia worsens, victims will lose consciousness and eventually slip into a coma.

- Core temperature of less than 95 °F. Body temperature is most accurately taken with a rectal thermometer. If the rectal thermometer is cold, such as if it had been left in a pack, then it will assume the ambient air temperature and will take a longer period to indicate the individual's core temperature. If the rectal thermometer is not left in long enough, then it can give a false impression of severe hypothermia.

  NOTE: A core temperature is the temperature at the center of the body, and it is most accurate when measured rectally. If the conditions do not allow for a rectal temperature to be taken or if a thermometer is not available, then a field expedient method is to place an ungloved hand on the torso of the patient. If the torso is cold to the touch, then it is safe to assume hypothermia, but a rectal temperature should be taken as soon as possible.
- Low vital signs. The heart and breathing rates slow.
- Shivering. The body shivers to try and warm itself as it first begins to get cold. Shivering stops either because the body has warmed back up to a normal temperature range or the body has continued to cool. Once the core temperature goes below about 90 °F, shivering ceases completely. A sign of severe hypothermia is when an individual has stopped shivering yet continues to cool. If an individual stops shivering, one must determine whether that is because they have warmed up or continued to cool.

To prevent hypothermia, Marines should—

- Wear and care for cold weather clothing properly.
- Keep clothing as dry as possible.
- Wear a hat —up to 80 percent of the body's heat can escape from the head.
- Dress to be comfortably cool, particularly before any activity. Overdressing causes sweating.
- Avoid dehydration by drinking 6 to 8 quarts of water per day.
- Eat at least 4,500 calories per day.
- Avoid fatigue and exhaustion. A person in a state of physical exhaustion is at increased risk for hypothermia.
- Increase levels of activity as the temperature drops. Marines should not remain stationary when the temperature is very low. If the tactical situation does not permit moving about, perform isometric exercises of successive muscles. Beware of long periods of inactivity in contact with the snow, such as laying in the prone position in an ambush or when a casualty is lying on the ground. Make use of the sleeping mat to decrease conductive heat loss.
- Use the buddy system to check each other for signs and symptoms of hypothermia.

Hypothermia is treated in the following ways:

- A casualty who is severely hypothermic must be handled gently because their heart will be sensitive to movement and very prone to abnormal rhythms that can lead to sudden death.
- The patient should be removed from the environment and brought into the battalion aid station, a tent, or a snow cave to prevent further heat loss. As soon as possible, cold, wet clothes should be removed carefully—if necessary, cut the clothes off.

- The patient should be wrapped in a vapor-barrier liner for insulation. A vapor-barrier liner prevents heat loss due to evaporation and slows down heat loss due to convection. The easiest way to insulate a patient in the field is by wrapping them in plastic trash bags and then placing them in a sleeping bag.
- The easiest way to rewarm the patient in the field is to zip two sleeping bags together and place them in the zipped-up bags with two stripped volunteers. While many Marines may be hesitant to perform this rewarming method, it could save the patient's life. In addition to the volunteers, place warmed materials on either side of the patient's neck, in their armpits, and their groin. Warmed rocks, bags of warm water, or heat packs can be used. The warmed materials should not be hot, and the volunteers should be in contact with the items as well. A hypothermia victim may not be able to tell if their skin is burning but the volunteers will.
- Evacuate the victim. A CASEVAC may not be possible due to the tactical situation, weather, or other factors; however, the sooner a victim can be evacuated, the better. Severe hypothermia is a medical emergency.

In addition, Marines should consider the following—

- Fluids may be given to the victim if they are mildly hypothermic. Otherwise, they should take nothing by mouth.
- Excessive movement of the victim should be avoided as their heart may stop beating if it is jarred.
- First aid should be applied to major wounds first (particularly extremity wounds) before attempting to rewarm the victim.
- Alcohol should never be given to hypothermia victims.

Even after the rewarming process has begun, the victim must be constantly monitored. Someone with severe hypothermia may appear to be dead (not breathing or without a pulse); however, people who have been found this way have been successfully revived with no permanent damage.

Frostbite. Frostbite is the actual freezing of tissue. The high-risk areas for frostbite are fingers, toes, nose, cheeks, and ears. Three major risk factors are—

- Improper clothing or improper care of clothing. Small-unit leaders must ensure that their Marines are adequately clothed and that the clothing is adequately maintained. Examples of improper clothing and maintenance include—
  - Wearing gloves when mittens should be worn.
  - Failure to dry gloves or liners after they have become wet.
  - Wearing wet clothing of any kind.
  - Wearing improper footwear.
  - Failing to remove boots at night, sleeping with boots on, or failing to dry boots when they become wet.
  - Wearing boots and gloves that are too tight. Also, the pack straps should not be secured too tightly as this may decrease circulation to the arms.
- Dehydration. Marines who are well hydrated are much better equipped to fight off frostbite.
- Poor diet or starvation.

Other factors that contribute to the likelihood of developing frostbite include the following:

- Outside temperature—the colder it is, the greater the risks.
- Snow or ground temperature (snow temperature can be 30 to 40 °F colder than air temperature).
- Windchill; however, this should not affect Marines who are properly dressed.
- Cold metals, which should never be touched with bare flesh. Only touch cold metals if wearing contact gloves.
- Petroleum products like white gas or gasoline, which freeze at a much lower temperature than water, can cause immediate, severe frostbite if spilled on bare skin.
- Exhaustion, which affects the body's natural defense mechanisms and lowers immunity.
- Hypothermia.
- A person's race or place of birth.
- Tobacco (nicotine) use, which decreases the amount of blood flowing to the hands and feet.
- Prolonged immobility (as when sitting in an ambush position or a casualty lying on the snow).
- Rotor wash from helicopters, which increases windchill.
- Previous cold injury.

Signs of frostbite include—

- Change in skin tone or texture.
- Skin that feels waxy or firm.
- Joints that are stiff or immobile.
- The affected part may feel like a block of wood or even ice.
- Pulses in the affected areas may or may not be present.

Symptoms of frostbite are—

- Decreased sensation.
- Tingling.
- Aching cold.
- Sharp pain, usually after rewarming.
- Increased warmth.
- Burning, usually after rewarming.
- Numbness. The victim may describe the affected part as clumsy, lifeless, bulky, or club like.

Like burns, frostbite is categorized in into first, second, third, and fourth degrees; however, it is also referred to three stages: frostnip, superficial frostbite, and deep frostbite:

- Frostnip has developed when some part of the body (usually the toes, fingers, or nose) becomes painfully cold but does not freeze. It is a harmless condition and the affected part returns to normal with rewarming.

- Superficial frostbite occurs when the skin freezes, but not the tissue beneath it, such as muscle, nerves, and bone. Skin with superficial frostbite takes on the following characteristics:
  - Skin appears pale, white, gray, or even blue and has a waxy feel to it. After the tissue has been rewarmed it may become red.
  - Pulse in the affected area will be present but can be weak.
  - The sensation of pain and light touch may be absent but the ability to discern deeper sensations, such as pressure, will be intact.
  - The joints will be mobile but stiff.
  - Movement of the frostbitten part by the victim will be possible although it may be difficult.
  - Blisters filled with a clear fluid may form.
- Deep frostbite affects patients in the following ways:
  - Initially, the skin may appear the same as with superficial frostbite.
  - Pulses will not be present.
  - Blisters form and may be filled with blood.
  - The skin will feel wood-like, firm, or even rock hard.
  - Tissues below will feel doughy or hard.
  - All sensation will be absent.
  - Skin will not move easily or at all.
  - Joints will be stiff or immobile.
  - Movement of the affected part will be difficult or impossible.

It is often difficult to say exactly how severe a case of frostbite is until several weeks have passed; therefore, it is wise to assume the worst.

> NOTE: Frostbite may be present in different degrees in the same affected part. For example, a frostbitten hand may have deep frostbite at the fingers, superficial frostbite at the palm, and frostnip at the wrist.

Frostbite is a preventable injury. The best way to prevent frostbite is to prevent the three major risk factors (improper clothing or improper care of clothing, dehydration, and starvation) and by ensuring that Marines—

- Dress in Layers. Marines should keep comfortably cool by adding or removing layers. If the wind is blowing, Marines should wear the correct protective layer and always have a balaclava or watch cap available and wear it if it is cold. If the fingers are getting cold in gloves, they should wear mittens.
- Keep Clothes Dry. If boots, socks, or gloves get wet, they must be dried. Marines may have to change socks up to four to five times a day (especially with vapor barrier boots). If gloves or liners are wet, they should be warmed and dried. Marines should not wear wet clothing.
- Avoid Dehydration. When Marines become dehydrated, the amount of blood available to warm the fingers and toes goes down, greatly increasing the risk of frostbite.
- Avoid Starvation. Food is fuel and the body uses that fuel to make heat. When Marines are low on fuel, they will be low on heat.

If Marines notice their fingers or toes getting cold, even after having tried to warm them, they should let their leaders know. Ignoring the problem will only make the problem worse. Small-unit leaders must ensure preventive measures are taken.

Only frostnip should be treated in the field; immediately evacuate all other patients with more severe frostbite. If unsure of the frostbite's severity, responders should evacuate. Frostnipped skin will revert to normal holding the affected area skin-to-skin for 15 minutes; if the affected area does not return to normal, responders should assume a frostbite injury has occurred and report it up the chain. Marines should remember the following points when treating frostnip:

- Rewarm face, nose, ears with hands.
- Rewarm hands in armpits, groin, or belly.
- Rewarm feet with mountain buddy's armpits or belly.
- Do not rub any cold injury with snow.
- Do not massage the affected part.
- Do not apply direct heat to the skin because a burn injury may result.
- Loosen constricting clothing.
- Have the victim rapidly move their arms because the centrifugal forces will force blood into the fingers.

Any frostbite injury, (other than frostnip) is treated the same—by rewarming and evacuating the patient. Rewarming should only be done in the field when evacuation is not possible. A freeze, thaw, refreeze injury occurs when a frostbitten extremity is thawed out, then, before it can heal (which may take weeks or months), it freezes again. This cycle worsens the initial injury. In an extreme emergency, it is better to walk on a frost-bitten foot than to warm it up and then have it freeze again. Marines should follow these tenets:

- Treat frozen extremities as fractures—carefully pad and splint.
- Treat frozen feet as litter cases.
- Prevent further freezing injury.
- Do not forget about hypothermia. Keep the victim warm and dry.

Once in the rear, a frostbitten extremity is rewarmed in a water bath, with the temperature strictly maintained between 99 and 102 °F. This procedure can be extremely painful.

Immersion Foot. Immersion foot (also known as trench foot) is a cold or wet injury to the feet or hands from prolonged (generally 7 to 10 hours) exposure to water at temperatures above freezing. The major symptom is extreme pain and the condition is classified from mild to severe. Immersion foot and frostbite are often very difficult to visually distinguish. Often, both may be present, but signs of immersion foot include—

- Red and purple mottled skin.
- Patches of white skin.
- Very wrinkled skin.
- Severe cases may leave gangrene and blisters.

- Swelling.
- Lowered or even absent pulse.

To prevent immersion foot, Marines should—

- Keep feet warm and dry.
- Change socks at least once a day and as required; dry the removed socks and gloves. Let the feet dry during the change and wipe out the inside of the boot. Do not wear vapor barrier or intense cold weather boots to bed.
- Constantly exercise the feet and hands whenever the body is otherwise immobile to keep blood flowing.

Immersion foot is treated in the following ways:

- Immersion foot cases must be evacuated and cannot be treated effectively in the field.
- While awaiting evacuation, the feet should be dried, warmed, and elevated.
- The pain is often severe, even though the injury may appear mild; it may require medication, such as morphine.

Immersion foot usually takes at least two months to heal but may take up to a year. Severe cases may require amputation.

Snow Blindness. Snow blindness is sunburn of the cornea. Marines in cold weather, mountainous environment are at increased risk for snow blindness because of the high altitude and snow. At high altitudes, fewer UV rays, which cause snow blindness and sunburn, are filtered out of the air, so more UV rays are available to cause damage. The white color of snow reflects more UV rays off the ground and back into the face.

Symptoms of snow blindness are —

- Painful eyes.
- Hot, sticky, or gritty sensation in the eyes, like sand in the eyes.
- Blurred vision.
- Headache, which may be severe.
- Eye muscle spasm.

Signs of snow blindness include—

- Excessive tearing.
- Bloodshot eyes.

To prevent snow blindness, Marines should always wear sunglasses with UV protection. If sunglasses are not available, field expedient sunglasses can be made from a strip of cardboard with horizontal slits. Charcoal can also be applied under the eyes to cut down on reflection of the sun off the snow.

Snow blindness is treated in the following ways:

- Evacuate, when possible.
- Patch the eyes to prevent any more light reaching them.
- Apply wet compresses, if it is not too cold, to help relieve some of the discomfort.

Healing usually takes two days for mild cases or up to a week for more severe cases.

Carbon Monoxide Poisoning. Carbon monoxide is a heavy, odorless, colorless, tasteless gas resulting from incomplete combustion of fossil fuels. It kills through asphyxia, even in the presence of adequate oxygen, because oxygen-transporting hemoglobin has a 210 times greater affinity for carbon monoxide than for oxygen, which means carbon monoxide takes the place of the oxygen in the body and causes poisoning.

The signs and symptoms of carbon monoxide poisoning vary with the amount the victim has inhaled. In mild cases, the victim may have only dizziness, headache, and confusion. Severe cases can cause a deep coma or sudden respiratory arrest. The classic sign of carbon monoxide poisoning is cherry-red lip color, but this is usually a very late and severe sign; the skin is typically pale or blue. Whenever a person in a poorly ventilated area collapses, carbon monoxide poisoning should be suspected. Recognizing this condition may be difficult when all members of the party are affected.

The first step in treating carbon monoxide poisoning is to remove the victim from the contaminated area. Victims with mild poisoning who have not lost consciousness need fresh air, light duty for a minimum of four hours, and oxygen, if available. More severely affected victims may require rescue breathing. Fortunately, the lungs excrete carbon monoxide within a few hours.

Prevention is the key, so a high index of suspicion is required. Marines should—

- Cook in the vestibule of the tent except in ECW conditions. If conditions warrant cooking inside the tent, no one should be asleep where there is a stove in use without a mountain buddy present.
- Be familiar with the signs and symptoms of carbon monoxide poisoning. A mountain buddy team member is awake if a stove is on inside a tent.
- Ensure that there is adequate ventilation when operating vehicle engines and stoves in closed spaces (tents).
- Be vigilant when cooking over open flames.

Unit leaders need to check their Marines' tents periodically to ensure stoves are not operating while Marines are sleeping.

GENERAL TIPS FOR A COLD-WEATHER ENVIRONMENT

Marines should wear clothing in layers, stay hydrated, and drink plenty of hot liquids throughout the day. Using vasodilators, such as garlic or hot sauce, helps circulation; conversely, vasoconstrictors, such as any nicotine and caffeine, should be avoided. Because the body requires extra fuel to stay warm in the cold, Marines should eat plenty of hot food.

Hands

To keep hands healthy, Marines should—

- Move the fingers and hands to stimulate and force warm blood to the extremities.
- Switch to mittens as required to keep hands and fingers warm.
- Ensure gloves fit loosely; tight gloves restrict blood flow.
- Change wet gloves or mittens as soon as possible.
- Never wear just the glove's insulating inserts. Use the shells to keep the inserts dry.
- Remove gloves or mittens if fingers lose their sensitivity. Skin on skin contact is essential.
- Avoid using a vapor barrier on the hands, such as neoprene gloves. These do not breathe and may easily expose wet hands to cold temperatures and wind when the barriers are removed, which may result in a cold weather injury.

Feet

To keep feet healthy, Marines should—

- Avoid standing in one place for too long. Try to move around as much as possible.
- Change socks regularly.
- Put more insulation between boots and the ground when standing arctic sentry, such as standing on a sleeping mat or other insulating material.
- Wear vapor barrier socks in extreme cold temperatures.

Sleeping

The following techniques can be used to ensure restful sleep:

- Eat a hot meal and drink a hot wet before going to sleep at night. Putting warm fluids and food into the body keeps it warm longer.
- Place extra insulation between the sleeping bag and the ground. Extra mats, empty packs, or pine boughs add extra insulation.
- Ensure that all Marines are warm. The more crowded a tent, the warmer it is.
- Wear a wicking layer when sleeping; this can minimize skin oils from getting into the sleeping bag, which degrades the bag's insulating ability.
- Wear extra insulating layers when sleeping, as needed. No wet clothing or APECS layers should be worn.
- Wear a balaclava or a hat when sleeping.
- Use canteens filled with warm water and placed in the sleeping bag as hot water bottles to preheat the bag. This also prevents the water from freezing overnight.

Other Considerations

Marines should consider the following:

- Whenever there is a stove or flame source inside a tent, maintain a fire watch.
- Keep all battery-operated equipment, such as flashlights or handheld radios, inside the sleeping bag, if feasible. Leaving this gear on the tent floor overnight drains the batteries.
- Have a sponge or rags handy to mop up spills or excess condensation.
- When melting snow, fill a bag with clean snow and stage it at the tent.

- Marines should consider the following techniques to keep battle ready:
- Always keep gear neat, orderly, and packed in the event Marines must displace suddenly.
- Take care of personal hygiene needs, such as shaving or washing, before going to sleep to allow the body to replenish natural skin oils that help prevent cold weather injuries, such as windburn, sunburn, and frostbite.
- The 5-gallon water jug should be stored upside down to prevent the freezing of water at the pouring point. In extreme conditions, they should be buried in the snow, as snow is a natural insulating material.
- Handle all fuel outside the tent and always use contact gloves. Never handle fuel near a lighted stove. In extreme cold temperatures, fuel spilled on unprotected skin can freeze the skin tissue almost immediately.
- Fill the thermos with hot water every night before going to sleep to provide something hot to sip during the night or in the event Marines must make an unplanned move in the night.

CHAPTER 13.
COLD-WEATHER CLOTHING AND EQUIPMENT

COLD-WEATHER CLOTHING

Marines must understand the insulating levels of their cold-weather clothing to maximize their utility. The individual articles of clothing that comprise the system are complementary and offer Marines options to suit their current activity or individual preferences. Cold-weather clothing is designed to be flexible enough to both ventilate excess heat and insulate against the cold.

Principles of Use

The basic principles for properly wearing cold-weather clothing can be remembered using the mnemonic "COLD:"

- **C**lean—Keep clothing clean. Clothing keeps a Marine warm by trapping warm air against their body and in the fabric of the clothing. If the fabric is filled with dirt, sweat, or other grime, it cannot do its job as efficiently. For example, soap left on wet-weather clothing and equipment degrades its water repellency and vapor transmission rate.
- **O**verheating—Avoid overheating. The appropriate amount of clothing should be worn such that, when combined with body heat and the environment, Marines stay cool enough to prevent overheating that can result in injuries.
- **L**oose and layered—Clothes should be comfortably loose. If it is too tight, it will constrict the flow of blood to the extremities and cause limbs to get cold. Warm air can be trapped between the body and the clothes; it is this warm air that keeps Marines warm, not the clothes. The more layers, the more they will trap warm. Several thin layers working together will work better than one thick layer working alone. Layers should be removed at the first sensation of sweating.
- **D**ry—Keep clothing dry. Wet clothing is less effective than dry clothing, so it is important to put on a shell or protective layer during wet conditions or when walking through wet snow.

Principles of Design

The cold weather clothing system was designed with three layers, which can be remembered using the mnemonic "VIP":

- **V**apor Transmission Layer. This layer is also known as a "sweat transfer layer" and draws moisture away from the skin to keep the wearer dry and warm.
- **I**nsulating Layer. This layer can be one or several layers that hold the warm air around the body. Preferably, it is lightweight, very compressible, and fast drying.
- **P**rotective Layer. This layer protects the insulating layer(s) from becoming wet or dirty. It should be made of a windproof, waterproof, or windproof and waterproof material.

To fit the specific needs of aviation and maintenance personnel, the Marine Corps uses the cold-weather layering system and specialty clothing. For more information, refer to NAVAIR Manual 13-1-6.7-2, *Aviation-Crew Systems Aircrew Personal Protective Equipment [Aircrew/ Passenger Equipment]*).

Cold Weather Layering System

The cold weather layering system provides lightweight, compressible, fast-drying clothing suited for the modern cold weather battlefield. It uses synthetic materials to manage moisture and transfer perspiration away from the skin, keeping the user warm and dry. It is a layered insulating system and is adjustable to personal preference, metabolism, and prevailing weather conditions. It is designed to maintain adequate environmental protection between 40 °F and -25 °F and survivability beyond the extreme cold category (with moderate movement). The system consists of the following six primary layers and accessories:

- Level 1 (the next-to-skin layer): flame-resistant lightweight (silk-weight) underwear set or cold weather mesh baselayer (undershirt and drawer).
- Level 2: flame-resistant midweight (grid fleece) underwear set.
- Level 3: wind resistant synthetic fleece jacket.
- Level 4: Marine Corps combat utility uniform (MCCUU), flame-resistant combat ensemble, or enhanced flame-resistant combat ensemble.
- Level 5: APECS, lightweight exposure suit, or inclement weather combat shirt
- Level 6: extreme cold weather parka, trousers, and booties
- Accessories: handwear, footwear, and headgear.

The cold weather clothing layering system can be broken down into eight categories:

- Vapor transmission layer.
- Insulating layer.
- Protective layer.
- Snow camouflage (overwhites).
- Head gear.
- Hand gear.
- Foot gear.
- Suspenders.

The vapor transmission layer is worn next to the skin. Insulating layers are adjusted according to preference, metabolism, and weather conditions to avoid overheating when on the move or to avoid cold weather injuries when stopped. Marines should take off insulating layers during movement to keep them dry and put on dry, insulating layers upon halting. Protective layers are worn as necessary to prevent the insulating layers from becoming wet and protect the individual from wind and precipitation.

Overwhites are not protective outer garments; they are worn only as a camouflage outer layer. The unit leader should dictate either the outer camouflage layer or all layers for inexperienced troops since inexperienced troops usually overdress for movements. Experienced troops, on the other hand, should be allowed to add the inner layers for individual comfort and work efficiency.

Clothing Maintenance. Marines must examine the clothing items regularly for tears, punctures, bubbling (delaminating), or damage to the material. Punctures on the outer layer produce leaks and eventually ruin the material if clothing is not properly maintained. Repairs should be made as soon as possible.

Dirty clothes wear out quicker because dirt cuts textile fibers, mats down insulating fibers, becomes saturated due to inhibiting water repellency, and retains moisture on the inside from perspiration. Therefore, clothing items should be cleaned regularly when in use. Before laundering and drying clothing, tie all the draw cords together, zip up all zippers, and fasten all snaps and hooks. Securing these items results in a better-laundered garment.

Vapor Transmission Layer. The vapor transmission layer can include flame resistant lightweight, cold weather mesh baselayer, and flame-resistant midweight long underwear sets of long-sleeved undershirts and drawers.

These layers are designed to draw moisture away from the skin and transfer it to the outer layers of the clothing system. Improved moisture management improves clothing system performance and comfort. Cotton undershirts and underwear should not be worn when using this clothing because it negates the wicking action of the material by causing moisture to be trapped against the skin.

Mesh Baselayer. The mesh baselayer is designed for increased comfort due to air pockets providing enhanced moisture management and thermal insulation. The undershirt has jersey knit shoulder panels and underarm gussets, with a rib knit collar and sleeve cuffs. The drawers have jersey knit inner thigh gussets and reinforced knee patches, a tapered two-ply functional fly, elastic waistband with integrated draw-cord and rib knit ankle cuffs. The mesh baselayer may be worn with the MCCUU, flame-resistant combat ensemble, or as part of the cold weather layering system as an undergarment while in a field environment or in garrison. Cotton undergarments should not be worn under this set.

Flame-Resistant Lightweight Underwear. The flame-resistant lightweight underwear set is designed to wick perspiration away from the skin. The undershirt has long sleeves and a mock turtleneck. The drawers have a front fly, elastic waist, and ankle cuffs. Two sets per Marine are issued. The flame resistant lightweight underwear may be worn as part of the cold weather layering system as an undergarment while in a field environment or in garrison. Cotton undergarments should not be worn under this set.

Flame-Resistant Midweight Underwear. The flame-resistant midweight underwear layer provides improved moisture management and insulation in cold weather environments. It can be worn next to the skin or worn over Level 1 as an additional insulating layer. The pullover shirt has long sleeves with thumb holes, a half-zip mock turtleneck and a kangaroo pocket. The drawers have a front fly, elastic waist, and hemmed ankle. The flame-resistant midweight underwear may be worn with the MCCUU, flame-resistant organizational gea, or as part of the cold weather layering system as an undergarment

Insulating Layer. The fleece jacket is an insulation layer that provides improved wind resistance and breathability when worn in intermediate to cold weather environments. The jacket is a full zip mock turtleneck with stretch fleece side and underarm panels for increased mobility and breathability. The sleeves have an adjustable hook and loop cuff closure.

The fleece should be worn under the MCCUU, combat desert jacket, or combat woodland jacket. It can also be worn over the MCCUU as a liner to the APECS parka. The fleece jacket is not approved for wear as an outer garment as it does not include a rank tab.

Protective Layer. The APECS should be worn as a protective layer and layered with other levels for increased insulation against cold weather. The APECS, available in woodland pattern, is a protective layer with a waterproof breathable membrane. The parka has covered zippers, hook and loop wrist closures, upper arm sleeve pockets, front and chest pockets, zippered underarm vents, and a stowable hood. The trousers have cargo pockets and a knee-to-cuff zipper to aid in donning and doffing footwear.

The APECS parka has two hand-warming cargo pockets, two side access breast pockets, two upper sleeve pockets, and a hood that rolls and stows in the collar. It also features water shedding slide fasteners and zippered armpit vents. It has a two-way, full-front zipper to provide full-face protection, leaving only the eyes uncovered. There is an elastic draw cord at the hem and waist, hook and loop wrist fasteners, and a rank tab at center chest.

The APECS trousers feature suspender attachments, belt loops, two side-leg cargo pockets, and knee-high zippers. The trousers have seat and knee reinforced patches and pass-through pockets. The parka and trousers serve as the windproof and water repellent outer protective layer. The garment can block water while allowing perspiration (water vapor) to be expelled.

> NOTE: Residual detergent decreases water repellency.

Marines should check water repellency of APECS parkas and trousers upon receipt, before each mission, and after laundering by placing a few droplets of water on the material. If water repellency properties are sufficient, water should bead up into droplets and not be absorbed into the fabric. If water is absorbed into the fabric, item should be returned to the Individual Issue Facility to be surveyed and replaced, if warranted.

> NOTE: Using after-market durable water repellent products could adversely affect this item.

The lightweight exposure suit available in desert pattern, is a lightweight, water vapor permeable protective layer for low volume rain and snow protection. The jacket has pass-through breast pockets, upper arm sleeve pockets, zippered underarm vents, and a stowable hood. The trousers have pass-through pockets and a knee-to-cuff zipper for donning and doffing footwear. It should be worn as a protective layer and layered with other levels for increased insulation against cold weather.

The inclement weather combat shirt is a flame-resistant, half-zip, water-resistant pullover that provides protection against inclement weather. The shirt features upper arm pockets, reinforced elbows, and elastic cuffed sleeves, and is available in both woodland and desert pattern.

It is designated for deployment issue. It can be worn with the flame-resistant combat ensemble and enhanced flame-resistant combat ensemble to provide protection from precipitation.

Snow Camouflage (Snow Overwhites). The snow camouflage parka, trousers and pack cover are over-garments designed to prevent detection in snow covered terrain. There are two variants of the snow camouflage parka and trousers: the military variant and commercial variant.

Military Variant. The military variant features a button front closure, a drawstring adjustable hood and waist, front pass-through hip pockets, and an internal pocket into which the parka can be packed. The trousers feature loops for suspenders, a drawstring waist with button front fly closure, elastic ankle, and an internal pocket for packing. The Type I pack cover has an elastic opening and is designed to fit over the pack. The Type II is a larger version that also includes a webbing strap with buckle used to secure the cover to the main bag and frame. It includes a storage pocket to contain the pack cover when not in use.

Commercial Variant. The snow camouflage parka features a zipper front closure, zippered front pass-through pockets, a drawcord waist and a stowable drawcord adjustable hood. The trousers have loops for suspenders, a crotch gusset, an elastic waist with an embedded drawcord and barrel lock, zippered front hip pass-through pockets, and zipper openings beginning at the ankle and extending approximately halfway up the length of the outseam.

The snow camouflage parka and trousers are not insulating layers and are not substitutes for outer garments. The parka and trousers should be worn with insulating and protective layers. The hood, when used, should be worn over all headgear including the helmet. Suspender hooks should be attached to suspender loops. Trousers and pack covers should be adjusted using draw cords.

Head Gear. The various head gear available to Marines includes—

- The hard face microfleece cap, which provides thermal insulation for the individual Marine in cold weather environments. It is wind resistant and water resistant.
- The cold weather cap, which provides increased protection for the individual Marine in cold-weather environments. It consists of two material layers, a water-resistant nylon outer shell, and a fleece inner lining. The design includes a visor with earflaps that can secured with hook and loop.
- The neck gaiter, which is made of thin polypropylene and can be worn six ways.
- Lightweight and midweight balaclavas, which are made from flame-resistant materials. The balaclavas have a hinged face guard that allows wearer to expose their face without having to remove helmet and balaclava. The balaclavas are worn when flame or flash threat are present. For cold weather wear, the two balaclavas can be layered together for added warmth. The balaclavas can be worn under the helmet.
- Extended cold weather balaclava, which is a pull over the head style with an adjustable face opening, allowing it to be worn up over the nose, or down under the chin. The finished edges around the face opening and bottom edge are lined with binding tape.

These items are designed to provide protection to the neck, head, and face in cold weather.

Hand Gear. Hand gear available to Marines includes—

- Contact gloves, also known as liner gloves. These gloves may be worn under the protective shells of the heavier gloves to ensure the gloves stay dry. These gloves are local supply items and two pairs per Marine are issued. Contact gloves are designed to handle cold metal objects, such as weapons or hand tools and are not heavy-duty work gloves. They can be used as a lightweight liner for either protective glove or mitten shells. Contact gloves are not to be worn inside either the glove or mitten when the liners are inserted; this could lead to frostbite because they would be too tight.
- The intermediate cold weather glove, which provides protection in cold wet weather. The glove comprises a water repellent (nylon, leather) outer shell, a waterproof insert, and insulated layer against the hand. The glove is a curved finger design with a gauntlet that fits over the sleeve of the extreme cold weather parka and has a wrist closure design to prevent the entry of cold air or snow. It is designed to be worn in cold weather environments to protect the user from snow, wind, and ice with a threshold temperature range from 40°F to 0°F.
- The extreme cold weather mitten system comprises an insulated mitten shell with a removable insulated mitten liner and a flame-resistant light duty glove insert. The mitten shell is waterproof with a water repellent outer shell (nylon with leather palm), an elastic wristband and a long gauntlet with an adjustable cord and barrel lock. The removable insulated liner is water repellent, has a no slip grip, and attaches to the inside of the shell by hook and loop tabs. The glove insert is flame resistant, water repellent treated and has grip dots covering the fingers and palm. The layered mitten system is for wear in extreme weather environments (deployments) to guard against cold weather threats from 0 °F to -40 °F.

Foot Gear. Foot gear consists of socks, boots, and gaiters. These items are designed to provide protection to the feet from cold temperatures, wind, and moisture. Thick wool socks used to keep feet warm in extreme cold-weather conditions.

The intense cold weather boot provides protection in an extreme cold weather environment. Used in conjunction with the military ski system. It is a full-grain black leather boot with 400 grams of insulation and is waterproof. The intense cold weather boots provide protection in intense cold weather conditions and when temperatures are 24 °F to -25 °F. During cold weather wear, users should remove boots, when possible, to air dry feet and change socks, as necessary.

Vapor barrier boots are worn in a cold, dry environment and protect the feet down to -50 °F. The vapor barrier boots, shown in Figure 13-1, consist of a nonremovable inner and an outer boot made of rubber and filled with either wool fleece, felt, or closed cell foam (neoprene) insulation. They keep moisture out, while allowing heat to transfer quickly by moisture in the air. Whenever possible, the boots should be removed to air-dry feet throughout the day. Socks should be changed according to instructions. The valve on the side of the boot should always be closed to keep moisture out, except during air transport to equalize pressure in the insulating cells. They are usually sized 1 to 1.5 sizes smaller than a street shoe size. One pair per Marine is issued. This boot is recommended for static work, such as bivouac routine.

Figure 13-1. Vapor Barrier Boots.

Gaiters are leggings worn in conjunction with the boots to provide protection from snow or debris entering the boot. When wearing a cotton trousers, Marines should wear the gaiter on the outside of the trousers. When it is snowing heavily or Marines are wearing APECS trousers, the gaiters should go under the trousers.

Three-quarter gaiters can be worn with any boot. They have an adjustable bottom strap, which is placed under the boot instep, and an adjustable top draw cord.

Care and cleaning of foot gear varies by the specific item:

- Polypropylene inner socks are washed in the same manner as the polypropylene long underwear. Wool socks should be washed in cold water with a mild detergent and should not be machine dried.
- For boots, a stiff brush and water is used to remove dirt and snow. Soaking the inside of the boots should be avoided because lined boots take days to dry. The boots should air dry whenever possible, being careful not to use open flames or any method that dries the boot too quickly. Keeping the boot dry prevents freezing.
- Gaiters can be washed in cold water with powder detergent and dried on medium/low heat. If the rubber parts start to dry out, they can be coated with a silicone spray. Full gaiters should not be left on boots to dry because leather boots would be damaged, or the rubber band might wear out faster. The toe of the gaiter should be pulled off the toe box to avoid boot toe curl.

Personal Equipment

A Marine's personal equipment includes a sleeping system and load-carrying equipment.

Sleeping System. There are two sleep systems from which Marines can choose according to the temperature protection that best matches the operational environment—the three-season sleep system, and the extreme cold weather sleeping bag. These are local supply items and one per Marine is issued, depending on the climate to which traveling. A sleep system consists of—

- A bivvy cover that protects the individual from rain and wind as the outer most layer.
- A sleeping bag that provides warmth from cold temperatures inside the bivvy or tent.
- A foam improved sleeping mat that provides warmth and padding from the cold ground under the bivvy and sleeping bag.
- A compression sack that reduces the sleeping bag and bivvy bulk and keeps it dry during load carriage.

Three-Season Sleep System. Three-season sleep system consists of the following four components:

- One sleeping bag, regular, color coyote.
- One bivvy cover, color coyote.
- One compression stuff sack, color coyote.
- One mesh storage bag, color black.

The three-season sleep system is issued from the individual issue facility for spring, summer, and fall conditions above 20 degrees. Table 13-1 identifies the clothing layers used with this system to achieve six hours of protection at different temperatures. Fewer layers are required for less than four hours of protection while more layers are required for protection exceeding six hours.

The three-season sleeping bag component is available in two sizes; Marines shorter than 6 feet use size regular and Marines 6 feet and taller use a size long bag. The long sleeping bag is identified by its olive green interior. The bivvy and stuff sack are one size.

To use the compression sack—

- Firmly and completely fill the bottom few inches of the sack with the sleeping bag and bivvy as a firm base to achieve maximum volume reduction when cinched.
- Stuff the rest of the components in the sack to fill it.

Push down the contents so that the top of the sack can be folded between the black straps, rolled down, and the two side compression straps buckled. Trapped air escapes through the purge valve as the compression straps are cinched to reduce length.

In garrison, the sleeping bag, bivvy cover, and compression sack are cleaned, dried, and stored in the mesh storage bag with little compression to maintain their warmth and waterproof properties for the next field use. The three-season bag should never be packed in the compression sack. The sleeping bag and bivvy should be washed separately in home laundry with cold water and tumble dried on a low temperature. Laundry detergent not rinsed out destroys water protection. The compression sack is wiped clean and then air dried. Machine washing and drying destroys the waterproof coating.

Table 13-1. Three-Season Sleep System Temperature Prediction and Physical Properties (15 °F and Warmer).

Protective Layers Used with 3-Season Sleeping Bag, Bivvy, and Improved Sleeping Mat	Minimum Temperature for 6 Hours (°F)
Protective level 1: skivvies	30
Protective level 2: silkweights	20
Protective level 3: warming fleece layers; top and drawers, and cold weather cap	15
Protective level 4: ECW parka, trousers, booties, and balaclava	10
Add tactical tent shelter to selected protective level	Subtract 5 °F for lower temperature usage given more protection
Remove bivvy cover from selected protective level	Add 5 °F for higher temperature usage given less protection
Remove improved mat insulation from selected protective level	Add 10 °F for higher temperature usage given less protection
Physical Properties for Load Management	**Weights (pounds)**
Sleeping bag; size regular/size long	2.4 regular/2.8 long
Bivvy cover	1.8
Compression stuff sack	0.5
Combined system weight	4.7 regular/5.1 long
Packed Volume	**Volume (cubic inches)**
Size, regular	800 (fits in bottom of main pack)
Size, long	840 (fits in bottom of main pack)

Extreme Cold Weather Sleeping Bag. The extreme cold weather sleeping bag is issued for winter conditions from 15 to -12 °F for 6 hours of protection. It has three core components:

- Outer sleeping bag, extreme cold weather.
- Compression stuff sack, extreme cold weather
- Visual user guide, extreme cold weather.

Table 13-2 lists the clothing layers used to achieve six hours of protection for different temperatures. Fewer layers are required for less than four hours protection while more layers are required for protection duration exceeding six hours.

To use the compression sack—

- Firmly and completely fill the bottom few inches of the sack with the sleeping bag and bivvy to reduce volume when cinched.
- Stuff the rest of the components to fill the sac.
- Spread the top flap over the sleep system and cinch the top of the bag closed.
- Compress the sleep system by evenly cinching the six length-wise straps and the three width-wise straps for load carriage.

Table 13-2. Extreme Cold Weather Bag Temperature Prediction and Physical Properties (15°F and colder).

Protective Layers Used with 3-Season Sleeping Bag, Extreme Cold Weather Bags, Bivvy, and Improved Sleeping Mat	Minimum Temperature for 6 Hours (°F)
Protective level 1: skivvies (ECW bag)	15
Protective level 2: silkweights (ECW bag)	5
Protective level 3: warming fleece layers; top and drawers, and cold weather cap (3-Season bag and ECW bag)	0
Protective level 4: cold weather parka, trousers, booties, and balaclava (3-Season and ECW bag)	-13
Add tactical tent shelter to selected protective level	Subtract 5 °F for lower temperature usage given more protection
Remove bivvy cover from selected protective level	Add 5 °F for higher temperature usage given less protection
Remove improved mat insulation from selected protective level	Add 10 °F for higher temperature usage given less protection
Physical Properties for Load Management	**Weight (pounds)**
Sleeping bag; black inner bag	4.0
Bivvy cover	2.2
Compression stuff sack	0.9
System weight	9.4
Packed Volume	**Volume (cubic inches)**
Complete two-bag system	1780

Care and cleaning for the ECW bag is the same as for the three-season sleep system. A closed cell foam mat weighs 1.2 pounds and provides warmth, padding, and protection from the cold, rough ground. The mat is used between the ground and the individual for sitting, sleeping, or when personnel lie prone for long periods, such as during ambushes. The Marine will be warmer if the mat is placed inside the bivvy cover under the sleeping bag. The improved sleeping mat is a local supply item from the individual issue facility and one per Marine is issued.

To achieve the maximum protection from their sleep systems—

- Read visual user guides available to understand adjustment features.
- Keep the sleep system dry; moisture reduces warmth.
- Never add moisture to sleeping bag from sweat, wearing wet or damp clothing, or breathing inside the bag. Remove wet clothing and dry between bag and bivvy. Wear the minimum number of dry clothing layers in the sleep bag to sleep cool and add layers during the night if needed. Always wear the watch cap and dry socks in cooler temps.
- Cinch hood around face keeping mouth and nose exposed. Wear a balaclava for face protection in cold temperatures.
- Place sleeping bag inside bivvy when sleeping outdoors without shelter to keep dry. For maximum rain protection, adjust the two bivvy wire standoffs to stand upright over the face for maximum rain runoff and close the bivvy window. When weather permits, open the bivvy window partially or fully for ventilation or fold down the top of the bivvy on the chest to prevent condensation inside the bivvy.

- Use the bivvy as a blanket on top of the sleeping bag when sleeping inside a tent. This quickly releases any moisture from body heat.
- Never drag the sleep system across the ground to prevent holes, punctures, and tears.
- Air dry all sleep system components whenever practical before packing the sleep system in the protective stuff sack. Fluff the sleeping bag before it is stuffed into the sack so that moisture within is driven out when air is purged from the stuff sack.
- Fluff the sleeping bag (trapped air is the best insulator) to increase warmth before getting in to sleep and refluff during the night when cold; kick feet at bottom and grab top with hands and shake up and down.
- Follow cleaning instructions and store in the mesh bag while in garrison to keep the sleeping bag fluffy for maximum warmth and to keep materials waterproof.

Load-Carrying Equipment. The following items are used to carry loads:

- The USMC pack consists of multiple bags and interchangeable pouches configurable to individual load carriage requirements (refer to TM 4451-20/1, *Operator and Field Maintenance Manual for Consolidated Storage Program Serviceability Standard for Infantry Combat Equipment*).
- The main pack liner is an SL-3 component of the USMC pack. It fits inside the main area of the USMC pack, which is waterproof. Air can be purged in the main pack area; air can also be purged from the main pack liner allowing maximum storage and watertight closure, maximizing the usable volume of the USMC main pack.
- The USMC sub-belt integrates with all family of improved load bearing equipment components without causing interference and allow individual equipment items to be securely attached without the use of tools.
- The cold weather hydration system consists of two wide mouth 32-ounce bottles with lids, two water bottle parkas with strap, and one cup.

MARINE CORPS COLD WEATHER INFANTRY KIT

The MCCWIK enables forward-deployed Marines, separated from their logistic train, a means of sustaining themselves. The MCCWIK enables a 4-person fire team to operate in a cold weather environment for an extended period, and it is used with the 4-person ECW tent and two 2-person stoves. The MCCWIK consists of the fire team sled with transport bag and the following items (which fit inside the transport bag):

- One avalanche probe with stuff sack.
- Two snow shovels.
- Two 1-quart thermoses with spare stopper.
- Two 32-ounce fuel bottles.
- Two funnels.
- One cook set.
- Ski wax kit with stuff sacks.

  NOTE: Not used with military ski system due to its scales.

- Climbing skins with stuff sacks.
- One hatchet.
- One whisk broom.
- One snow saw with sheath.
- One snow pit analysis kit.

Fire Team Sled

The fire team sled is designed to hold the entire group's stores contained in the MCCWIK system plus one fire team tent and two fire team small-unit expeditionary stoves. Each sled protects the equipment from the elements and offers a method to transport the equipment more efficiently over snow.

The fire team sled comprises the following parts:

- Hull. The hull is made of high-impact plastic with three runners designed to keep the sled upright during movement. It has two clevises located in the front of the sled for attaching poles. The sled is also designed with a flanged top for securing the transport bag. There are three large metal D-rings located outside the hull. These D-rings are designed to assist movement of the sled by attaching traces. There are six, small metal D-rings located on the sides of the hull for securing the transport bag to the hull.
- Transport Bag. This bag is made of nylon corduroy and has a cinch cord on its rear corners and two plastic buckles on its front corners. It also has three adjustable compression straps with plastic buckles, two carrying handles, and a double zipper for top loading.
- Aluminum Pull Poles. There are four aluminum pull poles: two are "hooked" to attach to the clevis of the hull and have a small hole on the opposite end; the remaining two poles have a snap button for attachment to the "hooked" poles and a small hole on the opposite end for assembly to the pull harness.
- Waist Harness. There are two different waist harnesses: the pull harness and the assist harness. The pull harness is equipped with a harness block, pin, and lanyard with carabiner and is the primary harness used to pull the sled. The assist harness is used when more than one Marine is needed to pull the sled. Both harnesses are constructed of nylon and have a plastic snap buckle.

Marines should conduct the following service checks to the fire team sled:

- Hull. The hull should be checked for cracks or holes. Two clevises should be present and inspected for cracks or fracture lines. All metal D-rings should be present and not fractured.
- Transport Bag. The transport bag should be free of rips or holes and the zipper functional. All three compression straps should be present and all plastic buckles inspected for cracks or breakage.
- Aluminum Poles. The poles should be straight, not cracked or bent. All snap buttons should be functional.
- Waist Harnesses. The harnesses should be inspected for possible rips or tears and the plastic buckles for cracks or breakage. The pull harness should be inspected to ensure both harness blocks, lanyards, carabiners, and pins are present and not cracked, ripped, or fractured.

To assemble the fire team sled (see Figure 13-2)—

- Place the transport bag into the sled hull with zipper and handles up and buckles toward the bow of the sled hull. Position the cinch cord under the flange located around the top edge of the sled hull. Stretch flap with the female buckle end over the front of sled. Couple each set of buckles under their adjacent clevis.
- Place the "hooked" end of the pole through the hole on the clevis while depressing the snap button and ensuring the bend is toward the outside of the sled. Assemble pole halves by depressing snap button into the larger sleeve, aligning the snap button with the hole.
- Adjust the waist harnesses in the front and rear, keeping pull points directly at the sides of the hip. Insert webbing loops through slot in harness block. Place carabiner through the protruding web loop to the outside of the harness block. Insert pole into the harness block and secure into place with pin.

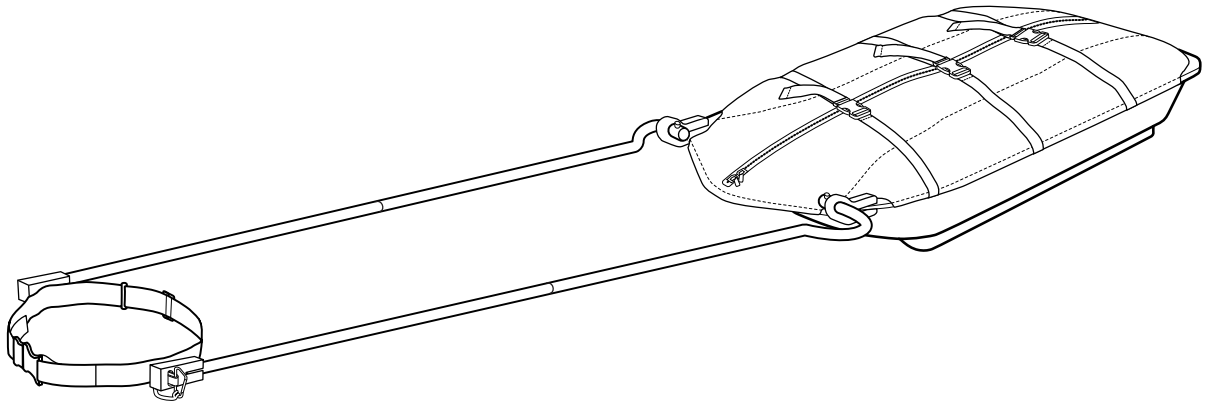


Figure 13-2. Fire Team Sled.

Extreme Cold Weather Tent

The ECW tent is lightweight and portable, weighing 17 pounds. The tent is a self-standing, dome-shaped, four-season design capable of holding four Marines within its approximately 68 square feet of floor space (see Figures 13-3).

The ECW tent is composed of the following parts:

- Tent Body. The tent body is made of urethane coated taffeta nylon weighing 3 ounces per yard. Inside the top of the tent is a mesh drying rack and around the bottom are several mesh pockets for commonly used items. The entrance has a mesh panel designed to keep bugs out.
- Flysheet. The tent comes with two different flysheets: a woodland camouflage cover for forested areas and a white cover for snow-covered terrain. These sheets are also made of nylon with a heavy black urethane coating for light discipline.
- Poles. The pole configuration used with this tent allows maximum use of floor space. The poles consist of nine sections of 7075 aluminum that are held together by shock cords, which aid in connecting them when pitching the tent.
- Accessory Kit. Each tent comes with an accessory kit containing—
  - 2 pole repair sleeves.
  - 24 aluminum stakes.

- 12 nylon tiedown cords.
- 12 line tighteners.
- A black foam spacer.
- Woodland colored repair tape 3 inches by 36 inches.

Figure 13-3. Extreme Cold Weather Tent.

Pitching the Tent. Marines take the following steps when pitching the ECW tent:

- Clear an area. Ensure that there is sufficient room for the tent (approximately a 12- by 12-foot area) by spreading it over the ground and pulling the floor section tight. Once the circle is marked, it should be dug down 4 to 6 feet. Depending on the tactical situation and time

limitations, Marines can pack down the snow to achieve some cover and concealment initially and then improve the position later by building up a surrounding snow wall.

- Insert poles into sleeves. Six of the poles go into the sleeves on the tent, with three being kept aside for the fly. The poles that form the triangle at the top of the tent should go in first, followed by the poles around the side. There are several grommets in each strap to adjust the tension of the tent.
- Attach the foam spacer. The foam spacer is attached to the snap located on the rear of the tent. The foam spacer is used to prevent the fly sheet from coming into contact with the tent, keeping water away from the tent and adding an additional insulating layer.
- Hook the flysheet. The flysheet is hooked onto the back of the tent and brought over the top, ensuring that the entrances on both are aligned. The remaining poles go into the sleeves and are adjusted for tension. The front of the fly is pulled out away from the tent for maximum tension. Inside the fly are two straps that attach to the triangular buckles on each side of the entrance. These straps are used to adjust tension and prevent the fly from blowing away. The fly may be used alone when the weight and load considerations override tent functionality, such as for a long reconnaissance patrol.
- Secure the tent. Use the tent stakes and guidelines provided to secure the tent. These tents, as with all tents, are vulnerable to wind damage. Therefore, it may be necessary to secure the corners before inserting the poles during pitching in high wind conditions. When pitching the tent in deep snow, it may be preferable to use a "deadman" (any weighted object available, preferably something natural that can be cut away and left) to hold the tent down. All tiedown points available should be used, depending on wind and tactical conditions.

Although the tent is designed with light retention material, it is not lightproof, but it may be possible to build a snow wall that shields light emissions and camouflages and protects the tent from snow. In deep snow, it is best to dig down into the snow-pack and keep a low silhouette; the tent can be camouflaged further with netting.

Striking and Packing the Tent. To strike the tent, the pitching instructions are performed in reverse order. The tent fly should be folded lengthwise into thirds and rolled tightly around the folded tent pole sections, squeezing trapped air out in the process, before placing it in the stuff sacks.

> NOTE: When breaking down the tent poles, Marines may find the poles frozen together from the freezing of condensation. They must warm the pole enough to break down the tent and can do this by generating friction on the poles with a gloved hand.

Tent Maintenance. The ECW tent requires the following maintenance:

- Cleaning. After each use, loose debris should be shaken from the tent and all dust and track marks sponged clean. If the fabric requires deeper cleaning, the tent should be hand washed in mild soap and warm water and air dried out of direct sunlight, ensuring the fabric is completely dry. The tent should never be stored wet to prevent mildew and damage to the tent fabric.
- Tent Pole Care. From time to time, a thin layer of silicon lubricant should be applied to all parts of the poles. This lubricant is excellent protection against corrosion, prevents the poles from freezing together when they are very cold, and makes the joints work more smoothly in any weather.

- Seam Sealing. To ensure the tent floor and fly-sheet are waterproof, the seams must be thoroughly sealed.
- Zippers. Zippers should be lubricated with a silicone spray to keep them running smoothly and to prevent freezing.

Safety Considerations. The following measures should be taken to ensure safety within the tent:

- Ventilation. The door should be kept open slightly to ventilate and prevent condensation from forming inside the tent. Such condensation would cause humid air and prevent the proper functioning of the drying rack.
- Stoves. Cooking or melting snow for water should be done in the vestibule because cooking inside the tent can lead to fires or spills that can harm Marines or gear. A lit stove placed inside the tent in the stove hole heats the inside of the tent quickly for rewarming and drying clothing, but it also consumes all the oxygen in a sealed tent, which may result in asphyxiation from carbon monoxide poisoning. Since carbon monoxide is heavier than air and settles at the tent bottom, the tent should be vented as low as possible to the ground, leaving the zipper open 6 to 8 inches.

Small-Unit Expeditionary Stove. The SUES (see Figure 13-4) is a multifuel stove that can burn JP-8 jet fuel or diesel fuel.

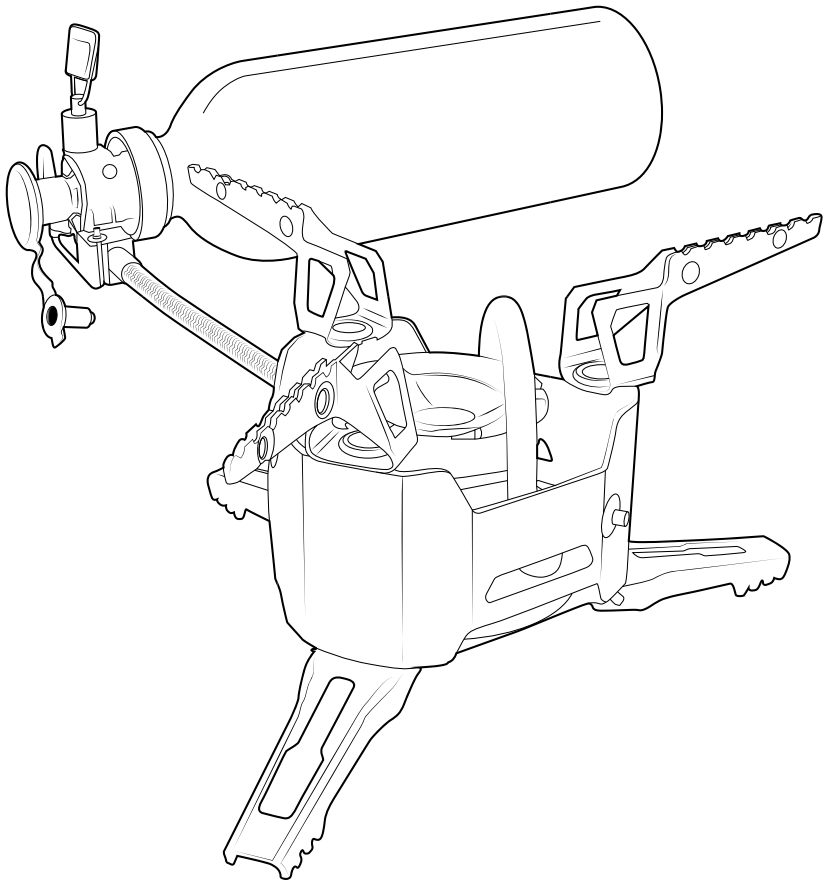


Figure 13-4. Small Unit Expeditionary Stove.

Stove Use. To use the stove—

- Fill fuel bottle only to fill line because air space is necessary for fuel pressurization.
- Insert pump into the fuel bottle and firmly tighten.
- Close the control valve and then stroke plunger. Less fuel requires more strokes/pressure.
- Set up the stove by rotating the stove legs and pot supports and placing the stove on the center of the heat reflector on a level surface. DO NOT TIP THE STOVE.
- Connect the stove and pump by inserting the fuel line into pump with the fuel bottle on its side and the control valve pointing up. Secure the catch arm on fuel pump groove. Keep fuel line straight for safety.
- Ensure that the control knob is in the OFF position.
- Open the pump knob one turn counterclockwise.
- Place the thumb over the hole in the pump knob and pump air into the fuel tank. DO NOT OVER PRESSURIZE THE FUEL TANK. If little or no resistance is felt, lubricate, or replace the pump cup.
- Preheat the stove by releasing only one-half tablespoon of fuel. Open control valve one turn and let fuel flow for three seconds. Close control valve. Look for fuel in burner cup and on priming pad. Light the fuel. Initial flash can singe eyebrows if the face is too close to stove because the flash can be 8 to 10 inches in size.

To turn the stove on—

- Wait for preheat flame to reduce in size.
- Open one-half turn and wait for steady blue flame.
- Slowly open control valve.

To cook—

- Set up the windscreen to improve performance in all conditions, leaving a 1-inch gap between windscreen and pot for optimal performance.
- It may be necessary to repump the stove occasionally during use for full heat output, adding 10 strokes every 10 minutes is a rule of thumb.
- Turn the control knob between HI and LOW to regulate the heat.

To turn the stove off—

- Close control valve. Because of residual fuel in the line, the stove continues to burn with a small flame.
- Wait 5 minutes for stove to cool after flames are out.
- Unlock catch arm and remove fuel line from pump.
- Depressurize bottle and repack stove. Hold the fuel bottle upright, away from the face and any sources of heat or ignition. Slowly unscrew pump to depressurize bottle.

To transport or store the fuel bottle, the pump may be left inside a depressurized fuel bottle. The pump can also be removed and replaced with the fuel bottle cap.

Group Stores

Group stores are those items required to operate for a prolonged period in a cold weather environment. The fire team sled should not be used to haul individual gear, which should be carried in the individual's pack. The following items can be placed in the sled:

- Extra fuel for the team stoves.
- One case of extra MREs or MCWs.
- Candles or lantern.
- Trash bags.
- Crew-served weapons.
- Ammunition.

Packing the Sled

When packing the sled, the most important principle is to keep the center of gravity low, balanced side to side, and to the rear half of the sled. Packing the sled in this way will facilitates movement of the sled and help prevent it from tipping over or nosediving into the snow when being pulled. The heaviest items should be loaded first. Seldom used items, such as extra fuel, candles, and trash bags, should also be on the bottom, front half of the sled. The ECW tent should be in its stuff sack and placed inside the sled. Shovels and pioneer gear should be packed on top of all other components so that Marines can get to them easily during a movement or when first establishing a bivouac. Once all group stores are inside the sled, the canvas cover is zipped, and all compression straps tightened to hold the gear securely in place.

15-Man Arctic Shelter

The 15-Man Arctic Shelter is an advanced lightweight, rapid deploying expeditionary frame shelter. The shelter has a unique hybrid dome design that optimizes snow load, snow shed, and wind load while providing optimal usable space and interior height. The Arctic Shelter articulating frame is constructed of aircraft grade aluminum for unsurpassed strength and durability in extreme cold weather environments. The unique design provides a robust, easy to use system. The shelter features a dual layer construction that provides a completely weatherproof, yet breathable enclosure providing for ample ventilation to prevent moisture and condensation buildup on the interior shelter surfaces. The shelter has venting, stove-pipe, and heater accommodations as well as inherent insulative properties, afforded by the dual-layer design. All fabrics used in the shelter are resistant to the deteriorating effects of rot, fungus, mildew, and corrosion in both operational and storage conditions. The materials allow tent striking with minimum drying time to prevent mildew. The liner provides 310 square feet of environmentally protected, usable space. The unique liner material offers several high-performing features in a very lightweight, low cube fabric that features flame resistance, mildew resistance, and blackout capability. The shelter features two lightweight, yet durable fabric flies that can be easily attached to the shelter to provide camouflage in both woodland and snow-covered environments. The 15-man arctic shelter's specifications are as follows:

- Dimension (deployed):
  - Diameter: 21ft
  - Height: 7ft. 10 in.

- Weights:
  - Frame bag: 50 lbs.
  - Liner Bag: 98 lbs.
  - Total Weight: 148 lbs.

For more information on the 15-Man Arctic Shelter, refer to Stock List (SL)-3-12419A, *Component List for Arctic Shelter, 15-Man*.

Site Selection

Marines should consider the following criteria when selecting a tent site:

- Forested areas in the mountains offer the best site.
- Forested areas provide cover and concealment for the Marines, and the trees can provide protection from the wind.
- Wooded areas also provide firewood and other materials for constructing defensive positions.
- If fires are built, the trees overhead can help disperse the smoke.

Pitching the 15-Man Arctic Shelter

To erect the 15-Man Arctic Shelter, a level area must be created. If the snow is deep, it can be shoveled out or packed down with snowshoes. The diameter of the tent can be measured by using a ski pole held at arm's length. Two Marines are needed, each to hold one end of the ski pole. One person stands in the center of the prospective tent site; the other person walks a complete circle around them to determine the diameter needed.

To erect the 15-man arctic shelter tent—

1. Remove the frame and all components from transport bags. Position the frame where shelter is to be erected and stand it vertically.
2. Position four people around the frame and grasp it at the positions indicated by white "GRIP HERE TO EXPAND/FOLD FRAME" labels.
3. Lift the frame off ground and slowly walk backwards to expand the frame. Once the frame is expanded, place it on ground.
4. Insert legs of peak assembly into webbing pockets located at inner top hubs of the frame and secure with attached hook and loop fasteners. The peak assembly must extend vertically away from the frame.
5. Select the appropriate fly and partially unfold to locate door and stove pipe openings. Orient the fly door openings to face desired directions. Lay the fly across the peak assembly, making sure that interior of the fly faces the frame. Locate the center of the fly as indicated by the grommet with a yellow patch. Install the center post of the peak assembly into the grommet with the yellow patch.
6. Continue to unfold the fly, stopping when it reaches the inner hub pairs of the frame.
7. Position two people opposite each other and grasp the frame near inner hubs at "GRIP HERE TO EXPAND/FOLD FRAME" labels and slowly lift the frame, peak assembly, and fly, allowing the frame to completely expand and take dome shape.

8. While two people continue to hold expanded frame, have two additional people secure perimeter straps, which are attached at the base of the frame. With all perimeter straps secure, the two people holding the frame can let go.
9. Pull stake loops located at all lower hub pairs parallel to perimeter straps and secure with stakes.

Install Liner and Floor

To install the liner and floor—

1. Have two people move the liner with attached floor into center of frame. Partially unfold the liner to locate door and stove pipe openings. Orient door and stove pipe openings to match the door and stove pipe openings of fly.
2. Locate three clips that are attached to the outside of the liner, near the stove pipe opening. Attach the clips to black diagonal cables located at the center of the expanded frame.
3. Locate paired inner hanging straps of liner as indicated by yellow discs and inner hub pairs of frame. Secure liner by wrapping one strap around hub pair and install strap grommet onto post at top of hub. Wrap second strap around opposite side of hub pair and install strap grommet onto post at top of hub. Repeat for all four straps and hub pairs.
4. Continue to unfold the fly, stopping when it reaches the outer hub pairs of the frame.
5. Locate the paired outer hanging straps of the liner and the outer hub pairs of the frame. Secure the liner in the same manner as detailed in Step 3. Repeat for all eight straps or hub pairs.
6. Locate the paired lower hanging straps of the liner and lower hub pairs of the frame. Pass one strap under the frame. Secure liner in the same manner as detailed in Step 3. Repeat for all eight straps and hub pairs.
7. Pull the floor of the liner taut and drive stakes through the stake loops located in floor. Two stake loops are located at each door panel. One stake loop is in the duct inlet panel and one stake loop is in the opposite panel.
8. Pull the mudflaps of the liner over the frame and perimeter straps.
9. Locate the outer ring of the grommets on the fly and the outer hub pairs of the frame. Install the grommets onto posts at the top of the hubs. Completely unfold the fly to lower the hub pairs of the frame.
10. Locate the ground ring of the grommets on the fly and lower the hub pairs of the frame. Install the grommets onto the posts at the exterior of the hubs.
11. Locate the retainer brackets of the frame. Slip the retainer brackets onto the posts at the exterior of the hubs.

Anchor the Shelter

To anchor the shelter—

1. Stake windlines approximately 18 inches directly in front of each lower hub pair. Tension the windlines by adjusting the tent-slip until the windline is taut. For additional security, wrap hook and loop fastener around each windline and tent-slip.
2. Place sandbags, snow, or ice onto mudflaps of liner and fly. If sandbags are used, place two at the door panel, two at the duct inlet panel, and two at the panel opposite the duct inlet panel. Place one at four remaining panels.

For more information refer to TM 12419A-OR/1, *Crew/Operational Manual for Arctic Shelter, 15 Man*.

SPACE HEATERS

Space Heater, Arctic

The SHA stove was the primary heater for larger tents prior to fielding of SHC-60 heaters. The SHA stove is a multifuel stove however use of the SHA in liquid fuel mode is prohibited with shelters. Technical Manual 10-4520-261-12&P, *Operator's and Organizational Maintenance Manual (Including Repair Parts and Special Parts Tools Lists) Space Heater Arctic*, provides details on operator instructions.

The SHA is a lightweight (41 lbs), portable, multi-fueled, non-powered heater that provides a maximum heat output of 25,000 BTU with a high/low adjustment capability. The SHA accessories include the stack, flue cap, gravity feed adapter, fuel can stand and hoses. All accessory components, including the pre-assembled, telescoping stove pipe, can be stored within the heater making it highly mobile and easy to assemble.

Marines can use the heater inside (solid fuel only) the tent to provide heating in the 15-man tents. The SHA is operational in temperatures ranging from -60°F to 50°F and can be stored in temperatures ranging from -60°F to 160°F.

Space Heater, Convective

The Space Heater, Convective is the primary heater for larger tents. For operator instructions, refer to TM 10-4520-264-12&P, *Operator's and Unit Maintenance Manual Including Repair Parts and Special Tools Lists (RPSTL) for Space Heater, Convective 60K BTU (SHC-60K)*.

The SHC 60K is a 60,000 BTU lightweight (98 lbs), portable, multi-fueled heater that requires no external generator. Electrical power to operate the SHC 60K is generated internally, and without any moving parts or noise, using thermoelectric modules, located in the combustion chamber, that convert waste heat into electrical energy. The electricity generated is used to power the blowers, pumps, ignition system, safety system, control devices, and to recharge the battery. The heater provides single switch startup and operation is completely automatic due to built-in diagnostics, safety and temperature controls. Accessories include a remote temperature control box, cable, insulated air ducts, fuel hoses, gravity feed adapter, fuel can stand and spare parts.

It provides service members operating in cold and extreme cold environments with a safe, portable, heater for shelters having up to 600 square feet of floor space. The SHC 60K operates outside the shelter and provides forced air heating, which supplies better heat distribution than radiant type heaters and frees up floor space.

Safety

Marines should use the following precautions to safely operate stoves and heaters:

- Never leave a stove or heater running unattended.
- Turn the stove off if leaving, even for a short time.
- Make sure all fittings on the stove fit tightly.
- Always keep the stove level to spread an even flame on the burner plate by placing a piece of wood or an MRE sleeve under the stove legs and first stove pipe.
- 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 can damage the threads and render the stove inoperable.
- Check the rate of fuel flow at regular intervals. The drop in fuel changes the burn rate in the burner plate.
- If the stove goes out, wait for the stove to cool down before relighting.
- Store all fuel supplies outside the tent to prevent an explosion.
- A piece of plywood covered with aluminum foil and slightly larger than the base of the stove should be carried as part of the tent equipment. The plywood provides a firm base for the stove, preventing it from melting into the snow.

CHAPTER 14.
DEFENSIVE POSITIONS AND FIELD FORTIFICATIONS

Defensive positions are inherently linked to patrol bases or bivouac sites; therefore, leaders must organize their unit's assigned sector and design the strongest fighting positions that time and materiel allow.

SITE SELECTION

When selecting sites for defensive positions in the mountains, Marines should consider the following factors:

- Establishing the fighting positions on the high ground makes it nearly impossible for the enemy to conduct an attack over icy slopes or when wading through knee- to waist-high snow uphill.
- It should cover likely avenues of approach, such as frozen streams, lakes, ravines, or tree lines, and cover natural obstacles, such as avalanches, windfall (downed trees, limbs, debris, etc.), and water obstacles.
- Incorporating natural strengthening features, such as rocks, trees, fallen timber, small knolls, or depressions offers natural cover and concealment.
- Using shaded areas provides concealment and prevents the sun from melting snow and ice protection.
- The site should provide cover from prevailing winds to give Marines the advantage of seeing more clearly and further while forcing the enemy to look into the wind.

SITE CHARACTERISTICS

As with any fighting position, a low profile is desired. If the snow is shallow, a regular fighting position should be dug into the ground, taking care not to scatter the dirt across the snow, as this may give away the position.

The fighting position should be built to match nearby snowbanks; for example, if the surrounding area has powdered snow, so should the fighting position. The position should not sharply contrast with the terrain. See Figure 14-1 for an example of a individual firing position.

The bottom of the fighting position should be kept camouflaged; Marines should not dig down to the dirt and then leave the dirt exposed. Insulation can be used at the bottom of the position for camouflage and to keep Marines warmer.

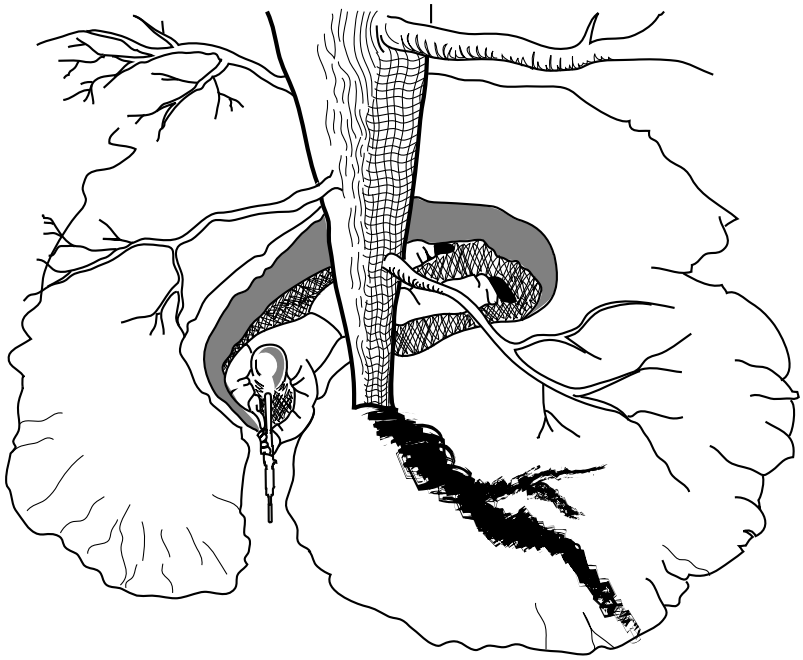


Figure 14-1. Individual Firing Position.

Marines should build the fighting position just before snowfall as fresh snow helps conceal construction efforts. Never walk directly in front of a friendly position. See Figure 14-2 for an example of a two-Marine defensive position.

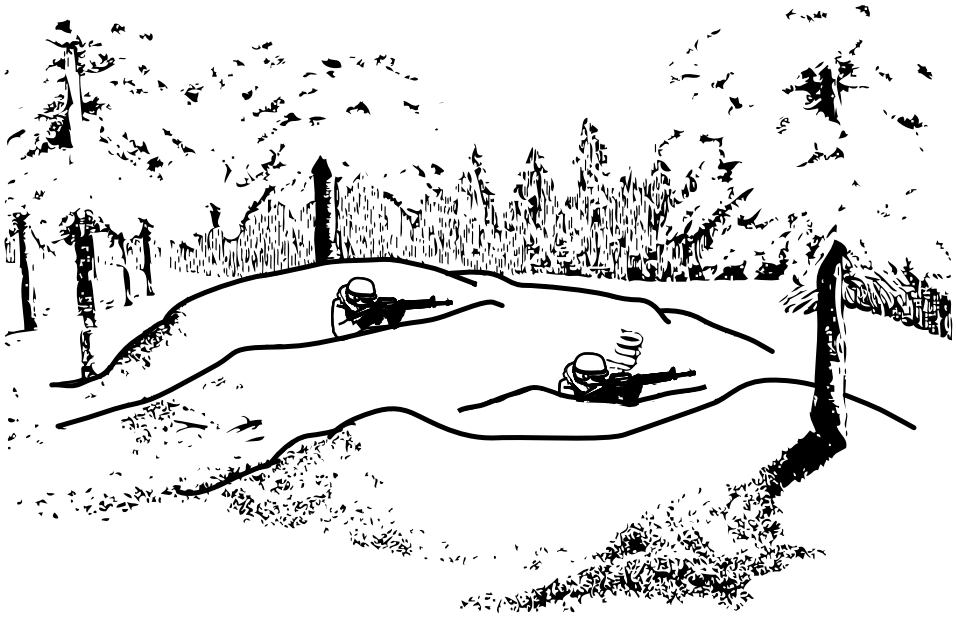


Figure 14-2. Two-Marine Defensive Position.

Building a log roof and burying it under dirt and snow provides overhead cover, as shown in Figure 14-3.

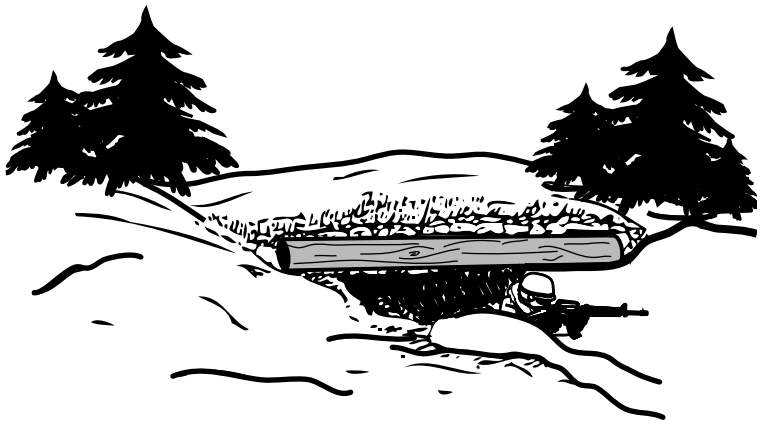


Figure 14-3. Defensive Position with Overhead Cover.

BUILDING MATERIALS

Several materials of a mountainous and cold weather environment that Marines can use to build fighting positions. Each of these materials has varying degrees of effectiveness in providing cover from enemy fire. The following data provides minimum construction specifications required to provide cover from small arms:

- Newly fallen snow:
  - Minimum thickness is 13 feet.
  - Construct by cutting into the back of a large snowbank or pile.
- Packed snow:
  - Minimum thickness is 7 feet.
  - Construct by stomping down snow in MRE boxes to form blocks.
- Snow-Crete:
  - Minimum thickness is 4 feet.
  - Construct by pouring water onto packed snow and allow it to freeze.
- Ice:
  - Minimum thickness is 3.5 feet.
  - Construct by making ice blocks in empty ammunition cans or MRE boxes lined with trash bags and filled with water. Marines could also cut ice blocks out of lakes and streams, which not only builds the position, but also denies an avenue of approach.

- Ice-Crete (blocks of ice water and ice that aggregate to form blocks of ice, which can be used to build structures):
  - Minimum thickness is 1 foot.
  - Construct by mixing soil, branches, and water in empty ammunition cans or lined MRE boxes and allowing them to freeze. Marines could also build log forms, fill with dirt, and then pour water into the forms and allow them to freeze.
- Rocks:
  - Many mountains only have rocks available as a construction material, as digging down would be impossible. This type of position is called a sangar, or sanger, from the British wars in Afghanistan in the late 1800s.
  - Construct by building up with rocks at least two layers thick to offset and cover spaces between the rocks. Embrasures are formed by angling rocks with the wide part of the "V" inside and the narrow part of the "V" on the outside to prevent ricochets being angled in through the embrasure.

FIELD FORTIFICATIONS

A Marine can enhance their defensive position by incorporating materials, such as rocks, logs, dirt, or sandbags, into the fighting position.

Rocks, Logs, and Dirt

If the situation permits, positions dug directly into the ground with overhead cover provides the best protection. Eight inches of logs or dirt are required to stop mortar and artillery fragments.

Sandbags

Sandbags filled with snow, dirt, or rocks and then soaked so they freeze, provide increased protection from bullet penetration and are an expedient way to make packed snow (see Figure 14-4).

> NOTE: Each of these positions is designed for two Marines. Each Marine fires from the outside edges of the position.

Figure 14-4. Fighting Position Using Sandbags.

Wooden Logs

Marines can use logs to build fighting positions (see Figure 14-5). There are three basic types of log walls: natural tree wall, artificial anchor wall, and tripod wall.

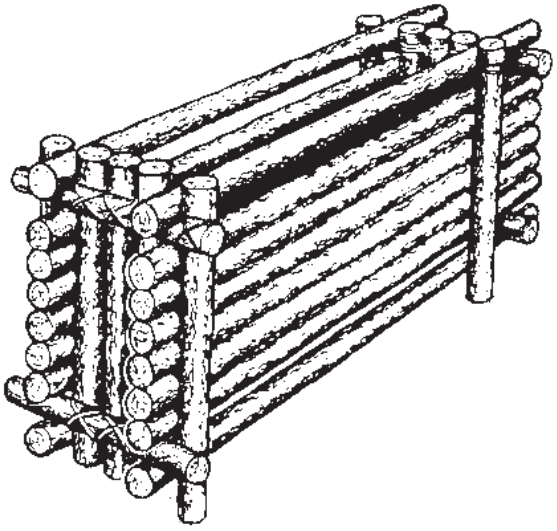


Figure 14-5. Example Log Form.

Natural Tree Wall. To create a natural tree wall, stack logs on the enemy side against any two sturdy trees (approximately 8 feet apart) until they stand approximately chest high. Pile snow, rocks, and branches against these logs to hold them against the trees (see Figure 14-6) or build a wall on both sides of the trees (see Figure 14-7).

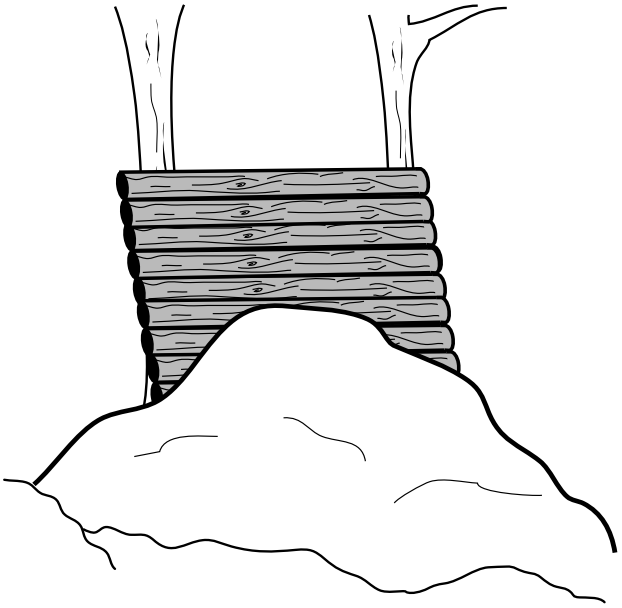


Figure 14-6. Tree Supported Wall.

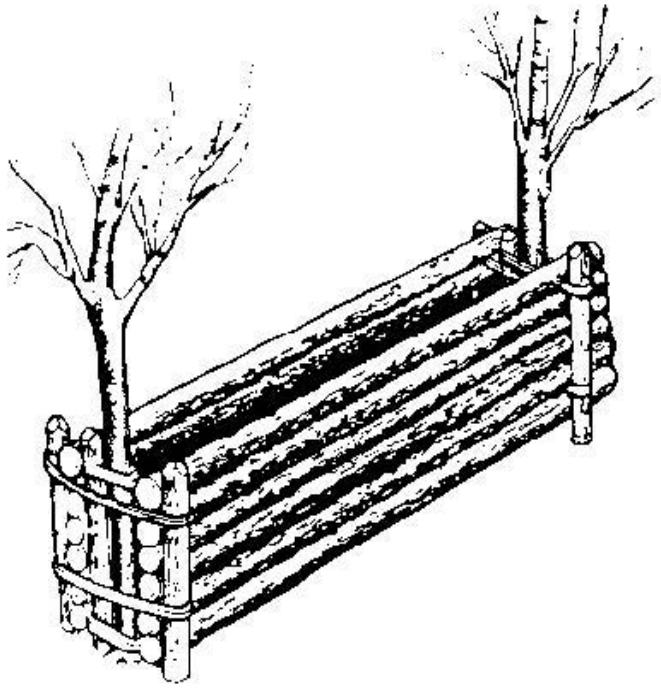


Figure 14-7. Tree Wall on Both Sides of Trees.

Artificial Anchor Wall. It might be necessary to construct an artificial anchor wall when there are no suitable anchors to hold the wall up. To construct an artificial anchor wall, Marines—

- Drive two logs into the ground approximately 8 feet apart and 3 feet deep.
- Dig a trench on the enemy side of the two logs about 1 foot deep and 8 feet long.
- Lay a log in this trench to act as a deadman.
- Connect cordage from the ends of the deadman to the top and bottom of the two original logs (see Figure 14-8).
- Stack logs on the enemy side of the two original logs and pile snow, rocks, and branches on the enemy side of the stacked logs to hold these logs in place and to make the position appear to be a snow bank (see Figure 14-9).

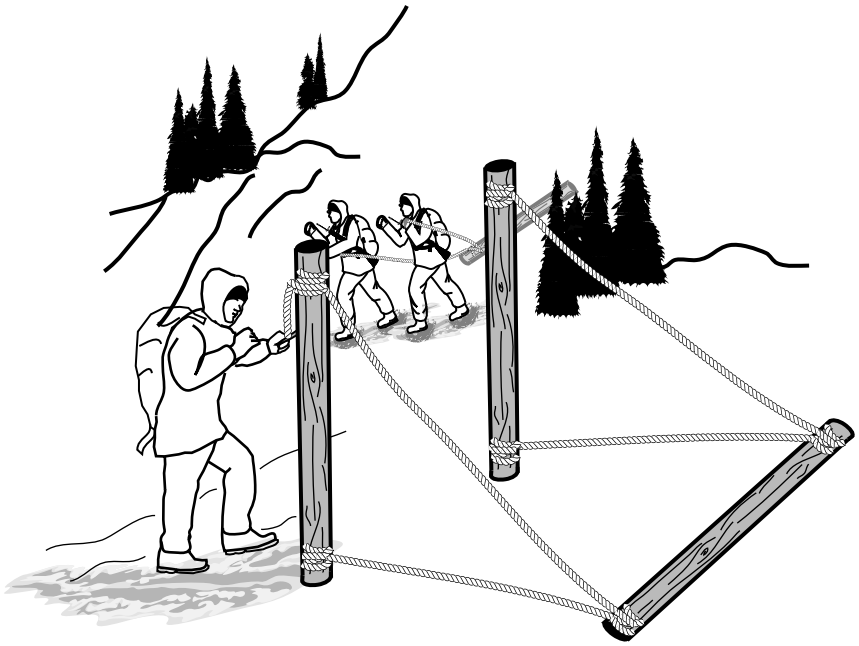


Figure 14-8. Artificial Anchor Wall Construction.

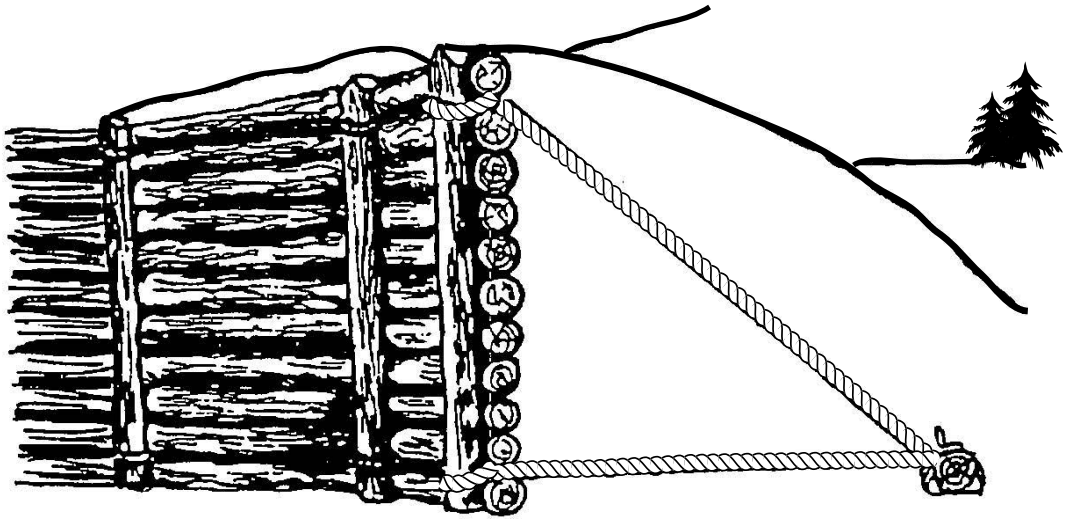


Figure 14-9. Anchor Supported Wall.

Tripod Wall. Marines construct a tripod wall by lashing three logs together with cordage to form a tripod (see Figure 14-10). The tripod legs are positioned so that two of the legs are facing the enemy; logs are stacked up on the enemy side of the tripod legs; and snow, rocks, and branches are piled up against the stacked legs to hold them in place and to make the position look like a snowbank. Marines should camouflage the tripod's apex.

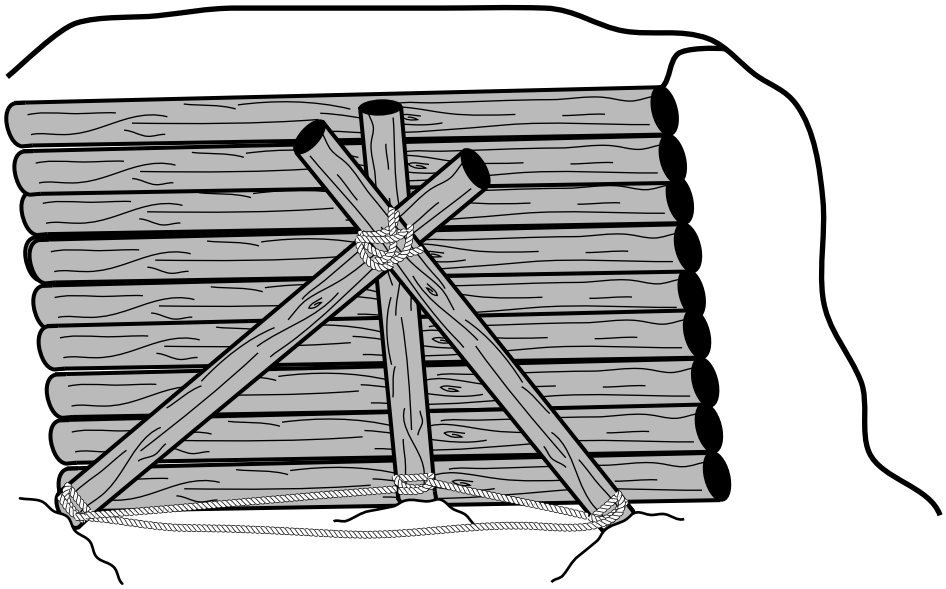


Figure 14-10. Tripod Supported Wall.

EMPLACEMENT OF OBSTACLES

When emplacing obstacles, extreme care must be taken to minimize tracks that would reveal the obstacles or jeopardize positions. Obstacles can be either natural or manmade. For details about planning and constructing manmade obstacles, see MCTP 3-34B, *Combined Arms Countermobility*.

Natural Obstacles

Reconnaissance of the area for natural obstacles dictates where to set up the principal direction of fires and final protective fires.

Manmade Obstacles

Manmade obstacles, integrated with existing natural obstacles, can be used to channel enemy forces into designated engagement areas.

Barbed Wire and Concertina Wire. Barbed wire makes an effective obstacle in soft, shallow snow. Triple concertina wire is especially effective since it is easy to install and difficult to cross (see Figure 14-11). However, as the snow gets deeper and more compact, a point is reached where it is possible to cross the barbed wire on top of the snow.

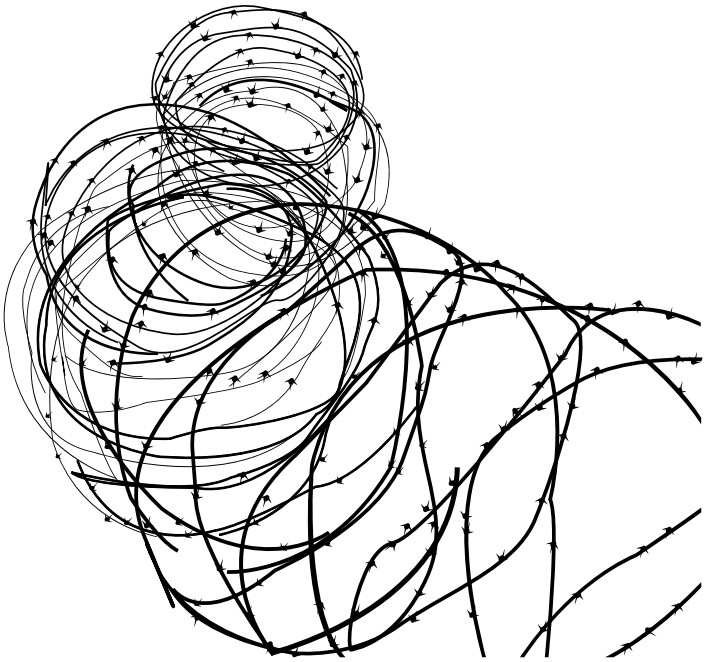


Figure 14-11. Concertina Wire.

Tanglefoot. Tanglefoot is one of the most common types of obstacles. It is constructed by driving poles or logs into the snow with approximately 1 foot showing above the snow and zig-zagging barbed wire from pole to pole (see Figure 14-12). The disadvantage of tanglefoot is that if a large snowfall covers it up, it becomes ineffective.

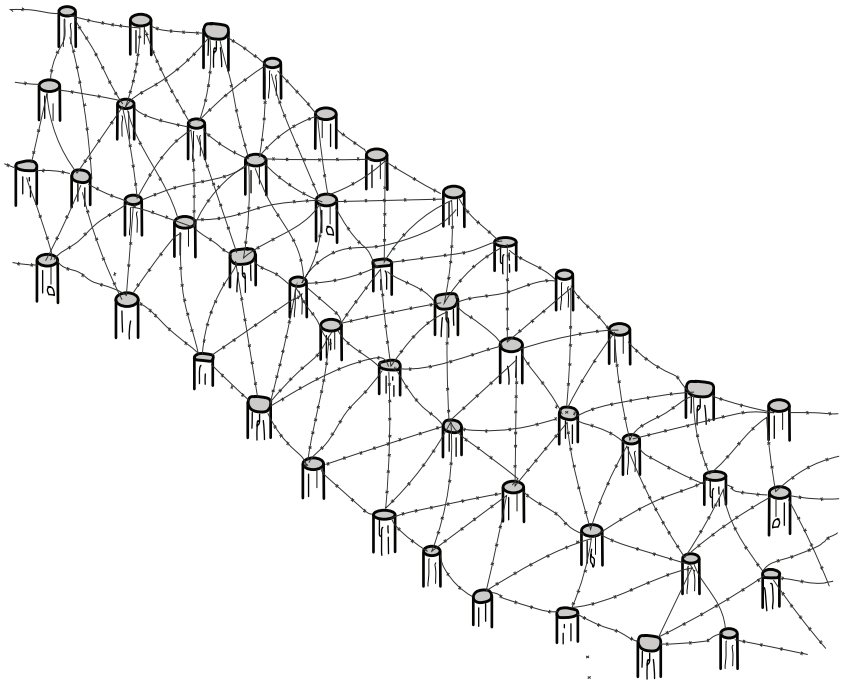


Figure 14-12. Tanglefoot.

Lapland Fence. The lapland fence uses a floating type of anchor point or one that is not sunk into the ground. Poles are used to form a tripod. The tripod is mounted on a triangular base of wood. Six strands of barbed wire are strung on the enemy side of the fence, four strands along the friendly side, and four strands along the bottom (see Figure 14-13). As the snow becomes deeper, the tripods are raised out of the snow to rest the obstacle on top of the newly fallen snow. The bottom of the tripod and the base wires give enough flotation to prevent the fence from sinking into the snow.

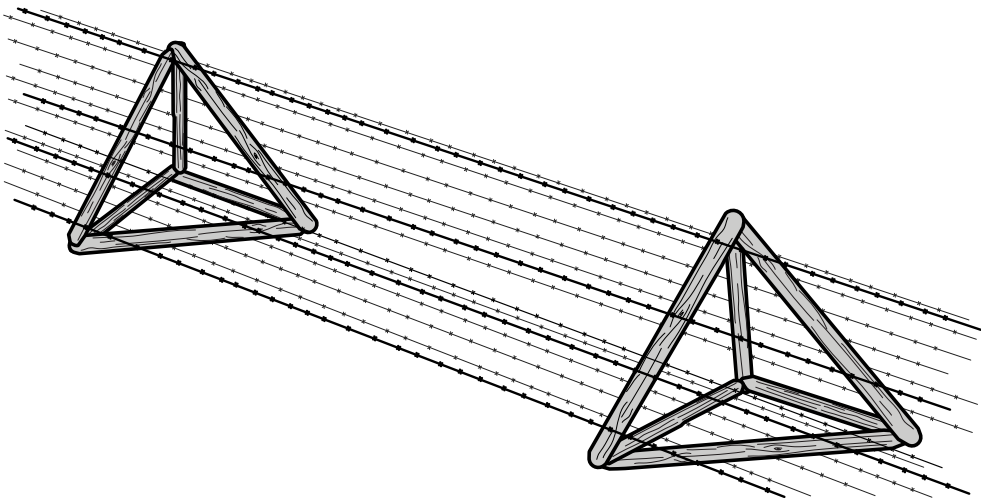


Figure 14-13. Lapland Fence.

Knife Rests. Knife rests are portable, barbed wire fences, which can supplement obstacles partially covered by snowfall. They are constructed by tying two wood poles at their center, each approximately 4 feet long. The "Xs" are then lashed to a 10- to 12-foot pole, which forms a framework to which barbed wire is fastened on all four sides (see Figure 14-14). This obstacle can be stored until needed and then easily transported to the next desired location. It can also be lifted and set on top of fresh snowfall.

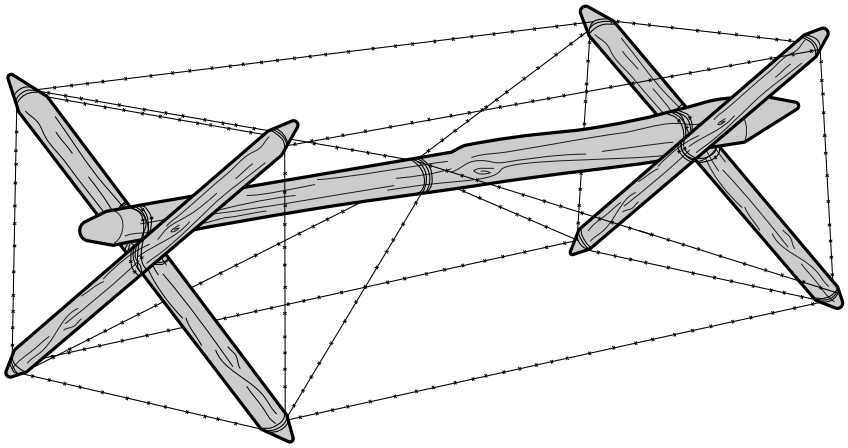


Figure 14-14. Knife Rest.

Ski Pit. A ski pit (Figure 14-15) is a hasty and effective means of slowing down enemy skiborne troops. They are constructed by cutting (digging) a wedge out of a slope approximately 24 to 30 inches deep.

The wedge points toward the friendly forces. Marines should camouflage the snow that comes out of the pit—usually the snow is thrown on the downhill side. The object of the pit is to have skiers ski into the pit, catch their tips in the point of the wedge, flipping them over. Ski pits are most effective where the enemy is moving downhill.

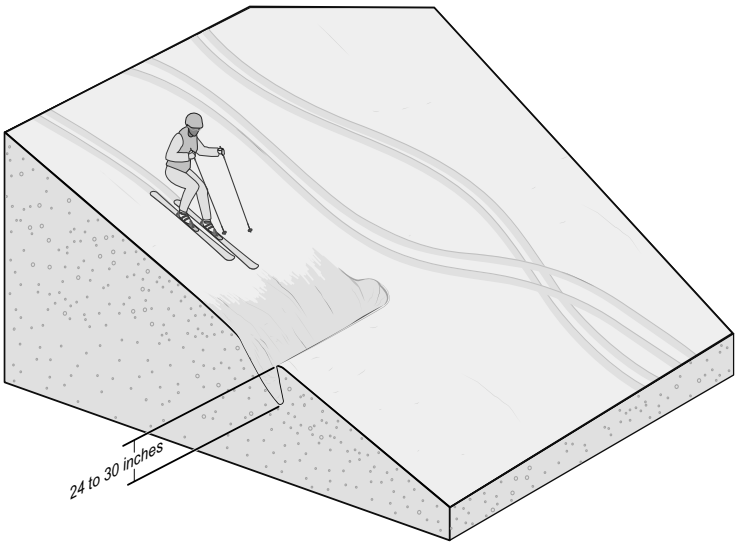


Figure 14-15. Ski Pit.

Abatis. An abatis is similar to trees downed by wind. Trees are felled at an angle of 45 degrees to the enemy's direction of approach. The trees should be left attached to their stumps (see Figure 14-16) to prevent the enemy from removing them along trails, roads, and slopes. An abatis can stop or inflict damage to wheeled or tracked vehicles, including tanks.

Trip Wire. A trip wire is a hasty obstacle that is effective in forested areas on skiborne troops. Trip wire works best on a downhill slope. It is constructed by stretching wire from tree to tree about throat level or ankle level. Stakes help reinforce the ankle-level trip wire.

Figure 14-16. Abatis.

CHAPTER 15.
PATROL BASES IN A SNOW-COVERED ENVIRONMENT

Establishing a patrol base or bivouac site is fundamental and critical to success in mountainous, cold weather warfighting. See Appendix E for the patrol base site selection checklist.

SITE SELECTION

Patrol bases should be—

- On the leeward sides of mountains. There is less wind and deeper snow for defensive positions and water supply.
- Off the valley floor. Cold air settles during windless periods.
- Clear of any suspected avalanche sites or run-out zones.
- A good defensive position.
- Large enough to contain the entire unit.
- In a forested area. Forested areas provide—
  - Natural cover and concealment under the trees for tents, vehicles, and tracks and protection from the wind.
  - Firewood and defensive position construction material.
  - Branches, which provide concealment and disperse smoke.

    NOTE: If a forested area is not available, then Marines should select a depression or knoll and dig down.
- Near an adequate water supply. Snow can be melted, but this is both a time- and fuel-consuming process and it may not be as clean as a running stream.

ESTABLISHING A PATROL BASE

When establishing a winter patrol base, units should adhere to the following sequence: security, track plan, defensive positions, living areas, and specific use areas.

Security

Security should be appropriate to the threat level.

Track Plan

Marines should establish a track plan in snow during the unit leader's reconnaissance. Track discipline is essential to maintaining a secure and patrol base. The primary elements of a track plan are the(see Figure 15-1)—

- Jump-Off Point. The intersection of the main trail and the trail leading to the bivouac is called the jump-off point. The jump-off point must be well concealed, using large trees, a river, boulders, or other natural obstacles. Generally, when selecting the jump-off point, the main trail is left at a right angle or, for best deception, heading back toward the original direction of march. The jump-off point should be covered by fire from the defensive position.
- Deceptive Track. A deceptive track is a trail that extends past the jump-off point on the main trail. The main trail should extend well beyond the track plan to an area suitable for use as a deceptive track plan. When returning to the jump-off point, Marines should ensure that the unit does not leaving marks indicating that they were returning on this track.
- Dummy Position. A dummy position is a false track plan located at the end of the deceptive track. This dummy position is a secondary deceptive plan. The primary defense of a track plan is concealment. Use caution when establishing the dummy position to ensure it does not draw attention to the unit's general location.

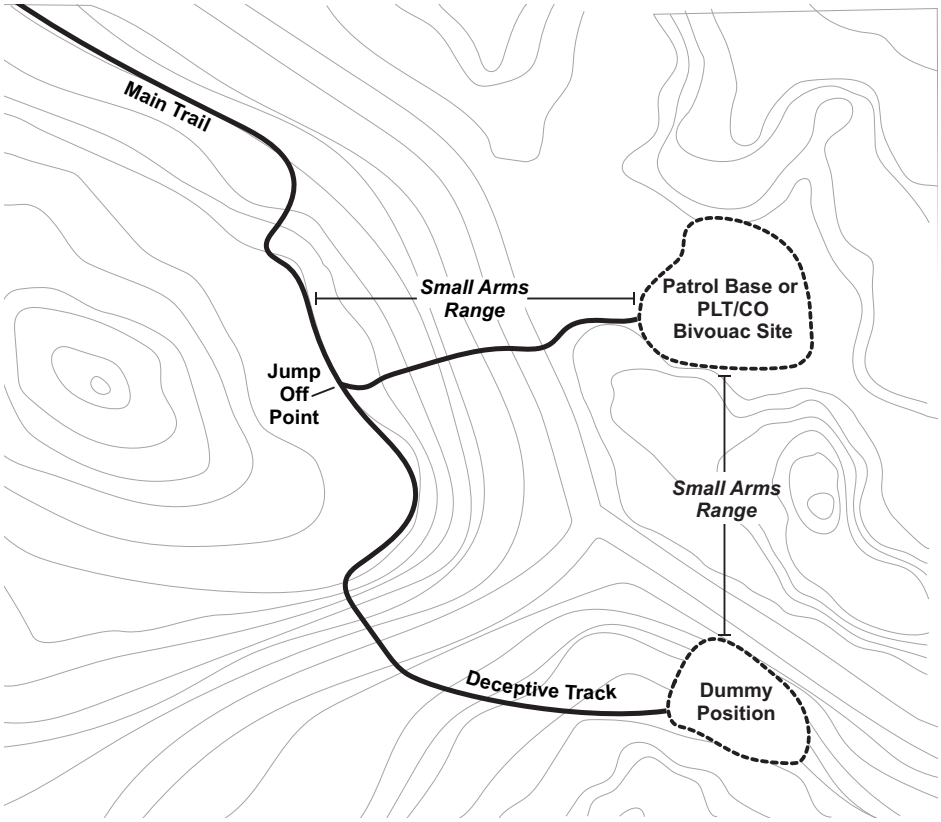


Figure 15-1. Platoon and Company Track Plan.

Each area in the patrol base should be designated in the track plan, including each team's tent site, defensive positions, and specific-use areas. Marines should avoid making tracks in straight lines and should maximize use of tress to provide cover.

Defensive Positions

The tactical situation and terrain dictates the type of defense established (see Figure 15-2). Individual positions should be constructed as discussed in Chapter 14. Marines should consider the following factors:

- Position automatic weapons to cover the jump-off point, dummy position, and likely avenues of approach.
- Establish defensive positions outside of the perimeter (approximately 30 meters) just beyond the range of the noises generated from inside the perimeter to avoid hindering the sentry's ability to listen for potential threats.
- Connect all positions—such as fighting holes, tents, and heads—by communication trenches.
- Construct the trench walls at an angle and round the edges so that they do not cast shadows.
- Construct trenches that are chest to shoulder deep to provide protection from incoming fire and to provide camouflage and concealment.
- Construct trenches in a zig-zag pattern to avoid receiving fire down the long axis.
- At a minimum, two Marines per squad should be on arctic sentry duty. Arctic sentry duty consists of a double-staggered watch to ensure that the sentries are always alert. For example: two Marines are in fighting positions at 0200 hours; one of these Marines came on post at 0130 and the other at 0200. The first Marine is relieved at 0230 and the second Marine is relieved at 0300.

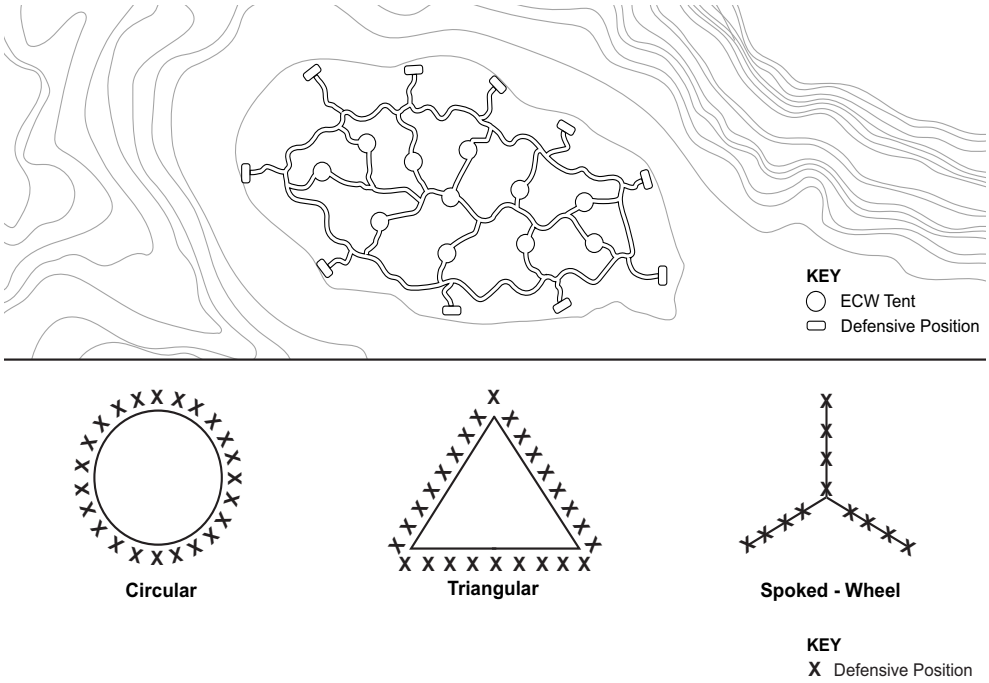


Figure 15-2. Defensive Position Types.

In extreme cold temperatures or during storms, a fire watch might also be needed to—

- Maintain communication with the sentries through wire or other means.
- Prepare hot water for the sentries upon their return from post.

- Alert the others in case of danger.
- Prevent the tents from collapsing from the weight of snow.

Living Areas

Once defensive positions are identified and staffed, Marines should begin constructing living areas. Living areas must be clearly marked during the leader's reconnaissance and connected to all other positions by communication trenches.

Establishing the Living Area. To maintain unit efficiency, unit leaders should ensure that tent sites are appropriately established and organized. The tent's exterior, interior, and vestibule each have specific considerations as does the tent's placement.

Organizing the Tent Site. The tent site should be located under overhanging tree limbs or near bushes, providing anchor points for protection from the wind and concealment from enemy observation. It should be located at least 10 meters off the main communication trench so that Marines can perform necessary functions, such as equipment maintenance, without blocking access to the main trench line and so that they can enforce light discipline.

When digging the tent site, Marines must create a smooth, firm floor by packing down the snow. The site for the pit should be big enough to allow room to walk around the exterior of the tent, allowing for the removal of snow buildup on the roof during snowstorms.

The tent should be positioned in the pit with the entrance at the downwind side to reduce the wind blowing inside the tent when the door is opened. A snow wall should be built around the perimeter of the tent with the snow that was removed from the pit (see Figure 15-4). This snow wall can help protect the tent from the wind, conceal it from enemy observation, and limit the amount of light that escapes from the tent when entering/exiting at night. The tent trench should be dug with a sharp bend to prevent the possibility of the enemy shooting down the trench's axis and into the tent.

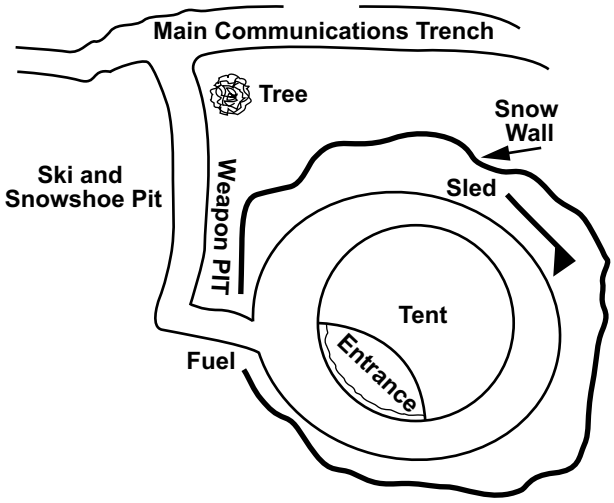


Figure 15-3. Tent Site.

Organizing the Exterior of the Tent. Marine units carry extra gear and equipment with them in a cold-weather environment. Because of the size of the ECW tent, most of this gear must be left outside of the tent. To ensure accountability of gear when displacing the patrol base during periods of reduced visibility, a unit should have a SOP regarding where and how gear is stored.

The following are key storage area considerations:

- Ski or Snowshoe Pit. Build a snowshoe or ski pit on one side of the entrance track. This pit should be long enough to accommodate the snowshoes or skis while lying flat on the surface and wide enough to accommodate all the tent team's snowshoes or skis and poles. It only needs to be deep enough to allow the snowshoes or skis to be stored below the surface of the snowpack. Place pine boughs or branches on the floor of the pit to prevent snowshoes and skis freezing to the snow.
- Weapons Pit. Opposite of the snowshoe or ski pit, units should build a pit for the team's weapons (personal and crew-served) and extra ammunition. This pit is constructed in the same manner as the snowshoe or ski pit, but all weapons and ammunition are covered with a field tarpaulin to protect them from the elements. If weapons are kept inside a tent, strict attention must be paid to the effects of condensation as discussed in Chapter 11.
- Fuel Storage Area. A fuel bottle storage area should be designated at least 1 meter from the tent. This storage area should be marked to facilitate locating the fuel in the event of heavy snowfall. To prevent a tent fire, Marines should refuel stoves and lanterns at the fuel storage area.
- Latrine Area. A tree or mound of snow should be designated as the tent team's urination area. This tree should be about 5 meters or so from the entrance of the tent.
- Shovels. Shovels should be kept near the door of the tent so Marines can keep the trenches free of new snowfall.
- Team Sled. All unused gear and equipment should be stored inside the sled with the cover secured and the sled on its side against the back of the tent. A "cave" may also be dug into the trench to store the sled.

Organizing the Vestibule Area of the Tent. When using ECW tents, the vestibule area should contain the following:

- Cold Hole. A rectangular shaped hole about 1 to 2 feet deep should be dug between the vestibule door and the tent door. The cold hole serves two purposes: it traps cold air and prevents it from drafting into the tent, and it provides a place to cook and melt snow for water.
- Packs. The team's packs should be left outside the main tent and stored in the vestibule, creating more room inside the tent, and prevent bringing in excess snow. All personal gear that is not being immediately used by the tent occupants should be stored inside their packs.
- Whisk Broom. A whisk broom should be inside the vestibule to brush snow off of occupants before they enter the tent.
- Trash bag. A trash bag should be placed inside the vestibule.
- Stoves and Cooking. Great care should be taken when lighting the stove inside the vestibule because a flare up could result in igniting the tent fly or tent body. A squad stove can heat the vestibule and tent quickly; however, it can also consume all the oxygen in a sealed tent, resulting in asphyxiation. Carbon monoxide poisoning (see Chapter 12) is also a risk without ventilation, so the bottom of the door should be unzipped with about 8 to 12 inches left open.

Organizing the Interior of the Tent. Marines should consider the following when organizing the tent's interior:

- Sleeping Arrangements. In the 15-Marine arctic tent, the occupants' sleeping bags and mats should be laid out in a wagon wheel fashion with their feet toward the center of tent. In the ECW tent, the occupants should sleep head to toe.
- Individual Gear. All individual gear that is not stored in the individual's pack should be staged in the individual's sleeping area.
- Drying Wet Gear. Both ECW tents and 15-Marine arctic tents have means to dry wet clothing. The ECW tent has a mesh drying rack in the roof of the tent. All wet gear should be placed on the rack to dry. However, too much gear on the rack can hinder the flow of air, slowing down the drying process. The 15-Marine arctic tents have several drying lines that are suspended from the tent liner. These lines are along the circumference of the tent and are used to hang wet clothing.
- Lighting. Flashlights or cyalume lights should be hung from either the drying rack buckles or drying lines. Candles or lanterns are not recommended for use inside the tent due to the fire hazard they create. It's critical to ensure that light does not show through the tent or fly.
- Ventilation. Open all doors and escape hatches regularly. To prevent carbon monoxide poisoning or asphyxiation, the doors should be unzipped several inches at the bottom to facilitate the flow of fresh air. Because carbon monoxide is heavier than air and settles, tents should be ventilated at the bottom of the door.
- Temperature. Temperatures inside the tent should be kept cool, which helps to conserve fuel and keep personnel acclimatized to cold weather.

Specific-Use Areas

The final step in establishing the bivouac site is to designate and establish specific-use areas, as depicted in Figure 15-3.

Head Area. The head area is centrally located, but below the living areas. It should neither be so close to the living areas that Marines may get sick, nor so far away to dissuade Marines from using the head area in bad weather. If the tents are dispersed over a large area, more than one head area may be built. The head area should be erected in a relatively sheltered area out of the wind; otherwise, field tarpaulins and tarps should be erected as wind shields.

If establishing a long-term bivouac, a toilet can be made by lashing a sturdy pole in between two trees at about knee level. A second pole can be lashed to the backside of the trees to provide a backrest.

Measures should be taken to avoid urinating anywhere besides the designated urination area. For additional information about field heads and waste management, see MCRP 3-40B.7, *Waste Management for Deployed Forces*,

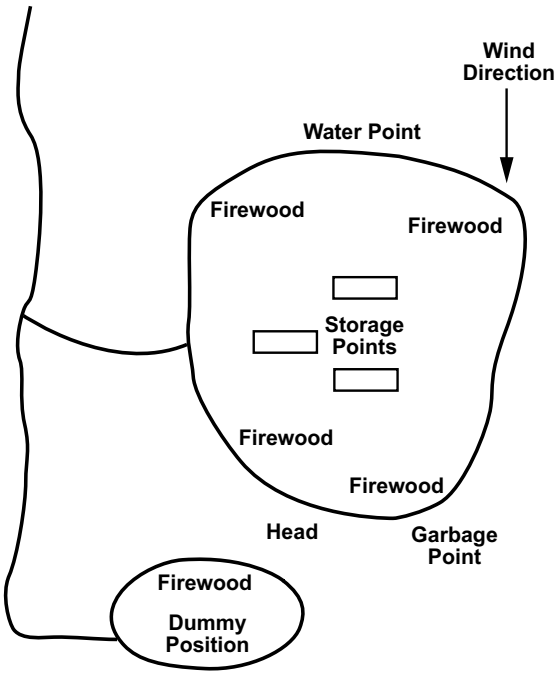


Figure 15-4. Specific-Use Areas.

Water Point. If near flowing water, as in the case of a stream or river, establish the water point as far upstream as possible. When a stream, lake, spring, pond, or well is not available in a cold-weather environment, a large, clean sheltered snowbank can be used. It should be located upwind and as far from the head area as possible. If chemical or biological agents have been used at any time in the past, the whole snowbank must be tested for contamination before use.

Garbage Point. The garbage point should be located next to the head area. During combat operations, garbage is usually buried. The dummy position can be used for this. The operation order provides guidance on the collection, storage, and disposal of hazardous waste.

Storage Points. Storage points are located inside the perimeter and fall under the control of the company gunnery sergeant or police sergeant. These areas are for the unit's excess gear and equipment, such as vehicles, rations, fuel, ammunition, communications equipment, and extra skis. Key factors to consider include the following:

- Protect all gear from the elements to maintain serviceability.
- Observe standard safety SOPs. For example, fuel should be stored at least 25 meters from any flame or explosives and ammunition.
- Properly camouflage and conceal all gear and equipment.

Scavenging Area. The scavenging area is the designated area for gathering firewood and building materials. Key factors to consider include the following:

- Avoid defiling a single area and giving the position away.
- Do any necessary cutting during daylight hours so natural noises can assist in concealing the activities.
- Consider cutting and gathering the wood from the dummy position.

PULL POLE PROCEDURES

When planning a pull pole, as much advance warning as possible—such as a specific time, staging area, direction of movement, order of movement, camouflage pattern, and over-the-snow mobility type—should be given so Marines can plan their schedules and ensure rest and readiness. Units should maintain security when conducting pull pole procedures.

NOTE: Pull pole produces can help ensure Marines avoid prolonged exposure to cold.

At 30 minutes prior to the pull pole time—

- All personnel should have gear packed and ready, including all water containers topped off and skins on the sled pullers' skis (if skiing).
- Any trenches dug to fighting positions should already be filled.
- Marines assigned to security duty should operate in buddy teams, equipped with combat loads and over-the-snow mobility equipment (snowshoes or skis), while Marines in the tents don appropriate layers for the movement
- Marines should be sitting on sleeping mats or packs with a stove burning waiting for the pull pole time.

At 15 minutes prior to the pull pole time—

- The stove should be turned off and packs and sleds staged outside of the tent site.
- Sleeping mats should remain in the tent until the last moment in the event of postponement.
- All snow and ice should be removed from the tent and tiedown lines.
- Anchors should be dug out of the snow or ice.

At 5 minutes prior to the pull pole time—

- Sleeping mats should be stowed.
- All equipment pits should be filled in and personnel should staff their designated pull pole positions, including the personnel assigned to strike and stow the tents and stoves (if any) and personnel who will fill in the tent site.

On order (pull pole), the tents are dropped simultaneously and, upon completion, staged at the designated spot in the order of movement. Security is brought in, and the unit moves.

CHAPTER 16.
CAMOUFLAGE, COVER, AND CONCEALMENT

In snow-covered terrain, the stark contrast between light and dark emphasizes any item that does not blend with its surroundings. Furthermore, every movement by vehicles or dismounted troops leaves readily identifiable tracks in the snow, which can provide detailed intelligence to an enemy. Before any movement, whether by foot or vehicle, track planning (balancing a minimal track pattern with a track deception plan) must be instituted with high priority.

Snowy terrain in wooded regions, when viewed from the air, has a high proportion of dark areas, which may influence the camouflage plan. Thermal signatures are easier to detect because of the background contrast.

Firing weapons, as well as vehicle exhausts, stove vents, and breathing in extreme cold all cause local ice fog or vapor clouds that can be readily observed, even if the weapons, vehicle, tent, or Marines are well concealed. Smoke from fires may hang immediately above a position if there is no wind. It may be necessary to move weapons frequently, shut off vehicle engines, or keep vehicles in the rear area to reduce these signs. Conversely, deception or concealment may be enhanced by deliberately creating vapor clouds or smoke clouds.

INDIVIDUAL CONCEALMENT

Individual concealment (see Figure 16-1) requires individuals to be familiar with the various terrain over which they will pass.

Figure 16-1. Camouflaged Marine.

Clothing Combinations

By using a combination of outerwear, four different color combinations can be attained—all green, all white, white over green, and green over white. The four camouflage combinations are considered the basics the individual Marine can build on in the following types of terrain:

- Thickly Wooded Areas. These areas consist mainly of secondary growth coniferous or deciduous trees with thick underbrush. An all green clothing combination is typically recommended for these conditions.
- Low Brush or Light Scrub Areas. These areas are often found at and above the tree line or in hilly areas with poor soil. In most cases, an open snow background predominates and a combination of white over green is recommended.
- Forested Areas. These areas are covered with primary growth, coniferous and deciduous, of varying density and with little underbrush. The normal clothing combination in these instances is green over white.
- Above Tree Line. Except in very mountainous regions where rock faces and large areas of talus may interrupt the whiteness, areas above the tree line tend to be snow covered. Different textures can be seen in the snow where it has been compressed by the wind or smoothed by the sun and, of greater tactical significance, by shadow. Marines should wear white clothing and ensure that weapons and other equipment items are similarly camouflaged. Even the straps of a pack, if not camouflaged, can stand out clearly at great distances. Marines should consider the following:
  - On bright days, a person may be more difficult to spot when they have the sky as a background, because the sky, in these conditions, are usually darker than the terrain.
  - Backgrounds of unbroken snow should be avoided as snow-covered ground reflects many times more light than bare ground and any deficiencies in camouflage would be exaggerated.
- Mixed Surroundings. In mixed surroundings frequent changes of camouflage may become necessary. Camouflage changes must be enacted unit-wide to aid in identifying friendly or enemy personnel. Overwhites must be quickly available to change as the terrain changes.

Weapons and Equipment Concealment

Small equipment items are relatively easy to camouflage using matte white paint or white tape. Although white tape is useful for camouflaging webbing equipment, some types of tape tend to crack and peel at low temperatures. When camouflaging weapons, ensure that the material used does not interfere with the working parts or the cooling system. Ice fog must be considered for all long-range weapons. Secondary and even tertiary positions may be used to shoot and move.

TENTS AND VEHICLES BELOW THE TREE LINE

The specific camouflaging methods used typically depend on the type of the tree cover and the materials available. If the region is thickly wooded, the tent (or vehicles) can be camouflaged by thickening the area around it with branches. Avoid disturbing the snow cover or the removing vegetation. In other instances, in which white predominates, the main object is to break up the

shape of the tent and the easily recognized shape of a vehicle by digging the tent or vehicle into the snow, which provides both cover and concealment, and then by draping white camouflage netting, clothing, or other materials over the tent.

TENTS AND VEHICLES ABOVE THE TREE LINE

If above the tree line, tents can be concealed by—

- Digging them into snowdrifts and smoothing the excavated snow to erase the change in texture and making it conform to the surrounding drift.
- Using white camouflage netting and white parachutes as tent and vehicle camouflage sheets.

In addition, Marines should consider the following when camouflaging vehicles:

- Prepare vehicles by painting them, as required (refer to TM 4750-15/1A, *Painting, Coating, Underbody and Registration Marking for Marine Corps Combat and Tactical Equipment*).
- Equip each vehicle with an all-season camouflage netting, as needed.
- Whenever possible, park vehicles so that its shadow falls on a bush, which interrupts the straight lines of its shadow.
- In wooded areas, lean-tos or snow shelters can be built to provide cover and concealment for vehicles.
- In cold conditions, vehicle exhaust can form ice fog or vapor clouds that can be easily detected by enemy forces.

CAMOUFLAGE MATERIALS

During snowy conditions, Marines can—

- Use improvised camouflage clothes made from sheeting, tape, whitewash sacking, or painted canvas.
- Cover objects with snow.
- Paint weapons, vehicles, skis, and sleds with white, matte or flat paint.
- Create white smoke, accounting for wind conditions.
- Apply camouflage face paint—white and loam color combination—to exposed areas of the face and hands to blend effectively with the snow cover.

WARNING: Frostbite signs may be covered by individual camouflage paint.

- Apply white zinc oxide ointment in place of camouflage sticks. It is easier to apply and remove to account for changing conditions, and it is easier to perform buddy checks for frostbite without causing additional damage to a frostbitten face.
- Use camouflage nets and parachutes to conceal tents and vehicles.
- Use natural vegetation, which is recommended. However, vegetation must be changed before it begins to wilt, and individuals should selectively gather vegetation so that they do not make their positions obvious because of stripped areas or indiscriminate tracks.

CONCEALMENT OF POSITIONS

All defensive positions must be camouflaged, whether they are dug into the ground or snow or are built above the snow level. They should be connected with well-camouflaged communication trenches and should be located under the brush or tree line when possible. When building and camouflaging defensive positions in the snow, consider the following:

- The sides and ends of all trenches should have pronounced slopes and rounded edges to reduce shadows, as in Figure 16-2.
- Carefully clear fields of fire, concealing any obvious tracks.
- If there is sufficient snow cover, do not dig trenches to ground level as grass, leaves, and dirt would mix with the excavated snow, making these areas easily detectable, particularly from air observation.

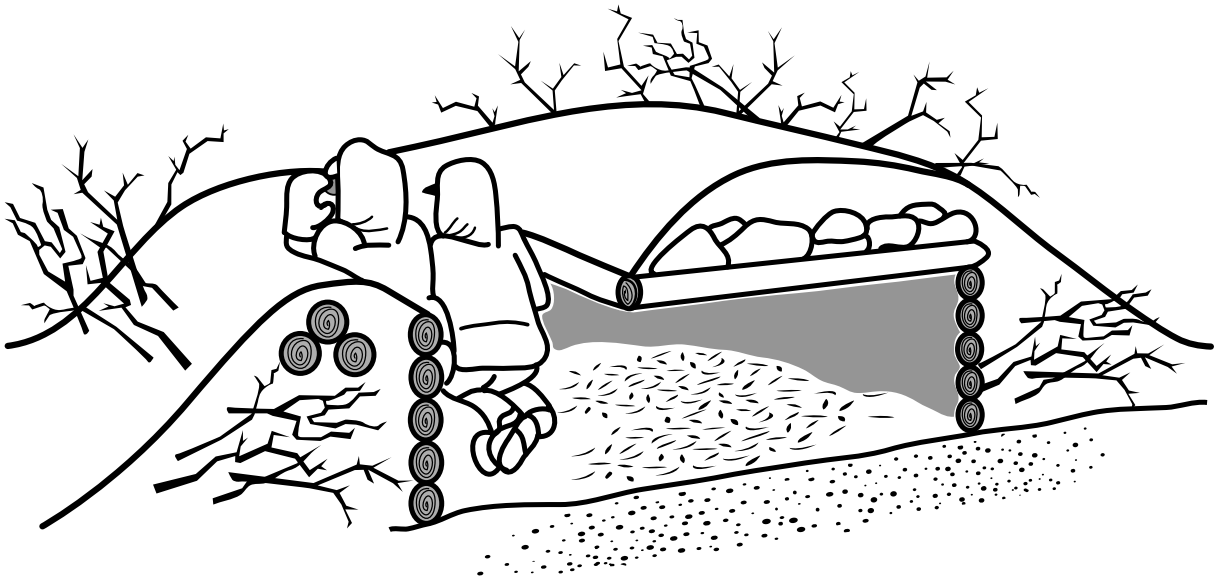


Figure 16-2. Camouflaged Position.

- Constantly using trails and trenches glazes and dirties these avenues. Frequently adding new snow improves the camouflage.
- The snow excavated from positions should be smoothed out and not left in humps and uneven piles that cast obvious shadows (see Figure 16-3).

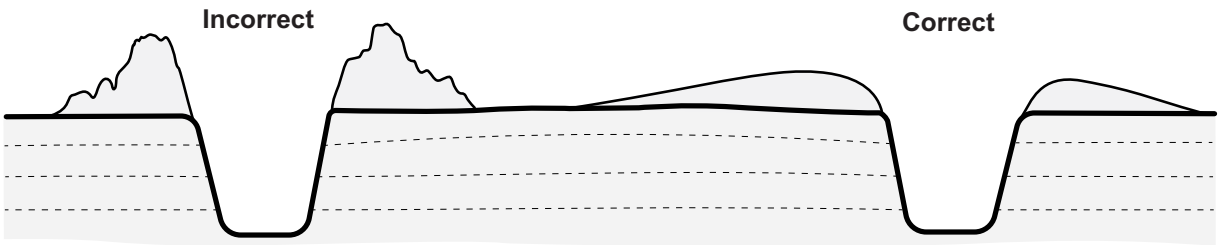


Figure 16-3. Snow Removed from a Trench.

- Select positions that need the least amount of modification to the natural surroundings, as in Figure 16-4.
- Conceal approaches to positions under trees or bushes, behind snowdrifts or slopes, and in shaded areas. They should also lead through the position to one or more dummy positions. Trails should never end at a camouflaged position.
- Consider the background. Appropriate inspection and camouflaging are necessary. The individual must consider the attackers perspective.

Figure 16-4. Camouflaged Shelter and Observation Post.

SIGNATURE MANAGEMENT: LIGHT AND NOISE DISCIPLINE

Light and noise travel great distances in cold temperatures. Snow acts as a natural insulator, which bounces sound waves off its surface. Since snow is crystallized water, it reflects light, particularly at night.

Light

Various tasks and duties carried out during the bivouac routine in a patrol base can produce lots of light in the winter environment.

Signature management considerations for light discipline include the following:

- There is a flash of light when lighting a stove. If the stove is lit after dark, light the stove with the tent flaps closed.
- Place tents and shelters in defilade so that light escaping from doors and vents is less visible to the enemy. When entering or leaving an ECW tent, Marines should exit the tent's main body and step into the vestibule, ensuring to close the flap behind oneself before opening the flap to the vestibule. If not using the fly, place a field tarpaulin over the doorway as a second flap.
- Snow should be packed around the base of the ECW tent, particularly around the vestibule area, to keep light from stoves, flashlights, and lanterns from being visible to the enemy. Snow walls must be built with an offset entry.
- To keep light discipline in a survival shelter, Marines must double up a field tarpaulin to create a double flap.
- Flashlights, even with red or blue lenses, and cyalume lights can be seen from a great distance. Their use should be restricted to emergencies. Night vision goggles or infrared cyalume lights can be used in the track plan to reduce the possibility of compromising the position.
- Personnel around the tent or on sentry routine should not have a lit cigarette.

Noise

Sound travels far in cold, thin air or across rocky terrain; therefore, Marines should—

- Slowly open and close the tent's zipper.
- Keep their voice low or stay silent.
- Minimize noise when preparing chow.
- Radio operators must ensure handsets are turned down or are in whisper mode.
- Loosen caps on fuel cans to equalize pressure.

APPENDIX A.
MOUNTAIN WARFARE SKILL SETS, CAPABILITIES, AND TRAINING REQUIREMENTS

Graduates of both the summer and winter mountain leader courses receive the free military occupational specialty, summer/winter mountain leader. Those that graduate either the summer or winter mountain leader's course receive the free military occupational specialty, winter mountain leader or summer mountain leader, respectively. Additionally, there are several courses that provide specific mountain warfare instruction to individuals. For more information on military occupational specialties, refer to Navy/Marine Corps Departmental Publications (NAVMC) 1200.1K, *Military Occupational Specialties Manual*; for more information on mountain warfare training events, refer to NAVMC 3500.70B, *Mountain Warfare Operations Training and Readiness Manual*.

MOUNTAIN LEADERS COURSE

Mountain Leader (Company Grade Officers and Staff Noncommissioned Officers)

The mountain leaders' training is divided by season. A mountain leader should attended both the summer and winter mountain leader courses. The summer trained mountain leader is a qualified in rope techniques and an assault climber. Mountain leaders are skilled in all aspects of warfighting in a mountainous and cold-weather environment. The primary role of the mountain leader is to train, advise, and plan company- and platoon-level dispersed operations in those parts of complex, compartmentalized mountainous terrain.

> NOTE: It is recommended to have two mountain leaders per infantry company, two per scout platoon, three per reconnaissance company for a reconnaissance battalion, and two per team for United States Marine Corps Forces, Special Operations Command.

The mountain leaders curricula 35 training days per course, where students will face challenges in planning, operating, and sustaining units in complex, compartmentalized terrain as well as tactical unit employment. Students are taught tactics, techniques, and procedures across warfighting functions so that they can serve as leaders and train others in these considerations. This course is designed to provide company-grade officers, SNCOs and sergeants with academic instruction and field application in the use of specialized mountaineering and cold-weather equipment, mountain warfare TTP.

Commanders should use their mountain leaders to help—

- Prepare route, movement, bivouac, and risk management.
- Recognize and evaluate peculiar terrain, weather, and hazards.

- Perform avalanche hazard evaluation and mitigation.
- Organize and lead avalanche rescue operations.
- Conduct ski instruction.
- Plan and conduct ski-borne patrols in level I and II terrain (level I is bottoms of valleys and main lines of communication, level II is ridges, slopes, and passes that overlook valleys; equipment dependent). See MCTP 12-10A for more information.
- Conduct multipitch climbing.
- Lead units over technically difficult, hazardous, or exposed terrain.
- Advise commanders and staff during planning on mountain warfare considerations across warfighting functions.

A Marine who has been through both mountain leader courses has the knowledge and skills to operate in all types of mountainous terrain and weather conditions. It is recommended that the most experienced mountain leader be attached to the S-3 to provide subject matter expertness when planning operations in mountainous terrain.

Winter Mountain Leaders Course. The Winter Mountain Leader course (M24M7B1) develops subject matter experts on the care and use of mountain and cold weather equipment, environmental and mobility skills, and small unit tactics to enable them to train company-sized units.

Summer Mountain Leaders Course. The Summer Mountain Leader course (M24M7A1) develops subject matter experts on the care and use of mountain and cold weather equipment, environmental and mobility skills (e.g., horizontal and vertical obstacle negotiation), and small unit tactics to enable them to train company-sized units.

ASSAULT CLIMBER COURSE

The Assault Climber Course (M24MEA1) is a 23-day course that familiarizes students with tactical rope suspension techniques, climbing techniques, and techniques to increase mobility. The course focuses on teaching students to use tactical rope suspension techniques to negotiate land and water obstacles unique to these environments. This course provides students with a working knowledge of the tactics, techniques, and procedures used to overcome near vertical-to-vertical obstacles.

SCOUT SKIER COURSE

The Scout Skier Course (M24HB41) familiarizes students with over-the-snow mobility, and cold-weather tactics, techniques, and procedures. This is a 19-day training course, designed to train individual personnel as subject matter experts on the care and use of cold-weather equipment, environmental and mobility skills, and small-unit tactics.

ANIMAL PACKING COURSE

Animal Packing (M24MN61) is a 16-day course that provides MAGTF units with Marines who understand and can extend their units culminating point in a mountainous environment by covering the following warfighting functions: maneuver, logistics, force protection, and command and control. Maneuver is oriented on transporting crew served weapons in support of combat operations. Transporting supplies and equipment enables sustainment efforts. The command and control warfighting function is oriented on planning, organizing, conducting animal packing, and providing advice to senior commanders and staffs. Force protection is focused on casualty evacuation techniques, animal first aid, and bivouac considerations while employing pack animals.

Over the 16 days, students move more than 70 kilometers while employing a pack string. This course is designed to aid Marine Corps units in alternative methods for transporting crew-served weapons, equipment and supplies, and wounded personnel to and from areas inaccessible to mechanized and air mobile transportation. The course subjects include introduction to animal packing, planning, anatomy of pack animals, animal packing techniques, casualty evacuation techniques, animal first aid, and bivouac considerations.

HORSEMANSHIP AND ANIMAL PACKING COURSE

Horsemanship and Animal Packing (M24MMM1) is a 16-day course that provides units with personnel capable of working with host-nation personnel operating with riding and packing animals in a mountainous environment. This course covers the following warfighting functions: maneuver, logistics, and force protection. Maneuver covers horsemanship and riding techniques; packing and transporting crew served weapons, equipment and supplies to enable sustainment; and transportation of wounded personnel to enable force protection. Students conduct multiple pack string and mounted horse-borne activities covering more than 115 kilometers. This course is designed to train small units in operating with indigenous personnel who ride and pack animals. This includes riding horses and packing animals for supporting combat operations (infiltration, exfiltration, CASEVAC, and moving weapons systems and equipment). The course subjects include animal care, anatomy of working animals, animal packing techniques, casualty evacuation techniques, animal first aid, bivouac and harbor site considerations, and horsemanship techniques. Students are taught the necessary skills to enable them to ride horses, load pack animals, and maintain animals in support of military operations.

MOUNTAIN COMMUNICATIONS COURSE

The Mountain Communications Course (M24CXJ1) provides instruction in the unique aspects and challenges of communications in a mountainous environment. Additionally, the course familiarizes students with command and control challenges, environmental considerations, and mobility in support of MAGTF operations. This is a 15-day course provides instruction on how to use specific radios in a mountainous environment, antenna types and construction in the

mountains, radio wave theory, and retransmission site selection and operations considerations. This course is recommended for units conducting the mountain exercise portion of the MAGTF warfighting Service-level training exercise.

MOUNTAIN MEDICINE COURSE

The Mountain Medicine Course (M24KAR1) familiarizes students with those technical and medical considerations unique to mountainous environments. The course covers the diagnosis, treatment, prevention of high altitude and cold weather-related illnesses and injuries, technical casualty evacuation techniques, movement, bivouac, and leadership skills in austere environments. This is a 20-day course involving both classroom and field instruction including high-risk training in rappelling, hoist operations, and high-angle rescue techniques. The classroom phase lasts one week and focuses on expanding medical understanding of wilderness and environmental medicine topics as well as providing pre-environmental training on techniques and procedures necessary for mountainous operations. The field phase covers the next two weeks and focuses on instructing and employing mountainous, compartmentalized, and high-angle casualty rescue and movement techniques as well as applying the medical knowledge from the classroom phase in a field setting. The course culminates with a final field exercise where students demonstrate the application of knowledge from both the classroom and field phases in various scenarios.

COLD-WEATHER MEDICINE COURSE

The Cold-Weather Medicine course (M24WAC1) familiarities students with those technical and medical considerations unique to mountainous and cold-weather environments. The course covers the diagnosis, treatment, and prevention of high altitude and cold weather-related illnesses and injuries, technical casualty evacuation techniques, movement, bivouac, and leadership skills in high altitude, compartmentalized, and snow-covered terrain. The focus of classroom instruction and field mentoring is placed on enhancing the students' medical knowledge base, clinical competence, self-confidence, and individual resourcefulness. This is a 20-day course involving both classroom and field instruction including high-risk training in cold water immersion, hoist operations, and steep earth patient movement techniques. The classroom phase lasts one week and focuses on expanding medical understanding of wilderness and environmental medicine topics with a focus on cold weather injuries and illnesses. The classroom phase also covers pre-environmental training on field techniques and procedures necessary for cold weather operations. The field phase (two weeks) focuses on instructing, sustainment, movement, casualty care and transport in a high altitude, snow-covered environment as well as applying the medical knowledge from the classroom phase in a field setting. The course culminates with a final field exercise where students demonstrate the application of knowledge from both the classroom and field phases.

BASIC COLD WEATHER ADVISOR COURSE

The Basic Cold Weather Advisor course (M2403W1) is a 12-day learning program that provides MAGTF units with Marines capable of serving as advisors in basic winter operations. The intent of this course is to build enablers throughout the MAGTF to conduct sustained operations in a cold weather operational environment. Graduates can sustain themselves, assist, and supervise others, applying considerations, techniques, sustaining routines and procedures, supervising, and advising others to enable effective operations in a cold weather, mountainous, and or snow-covered environments. Graduates can also assist in pre-environment training to their unit. These Marines are capable of teaching and advising their Marines in a cold weather environment and assisting mountain leaders in these efforts.

SUMMER MOUNTAIN ENGINEER COURSE

The Summer Mountain Engineer (M24MES1) course is a 24-day program that enhances the skills of combat engineers who will be operating in complex, compartmentalized, subterranean, and mountainous environments. This learning program provides academic instruction and field practical application in mountain warfare engineering tactics, techniques, and procedure, to include engineer planning considerations for maneuver and force protection warfighting functions for combat operations.

WINTER MOUNTAIN ENGINEER COURSE

The Winter Mountain Engineer (M24MEW1) course is a 23-day learning program that enhances the skills of combat engineers who will be operating in complex, compartmentalized, snow-covered, and mountainous environments. This learning program provides academic instruction and field practical application in mountain warfare engineering tactics, techniques, and procedures to include engineer planning considerations for maneuver and force protection warfighting functions.

APPENDIX B.
CLOTHING AND EQUIPMENT WEIGHTS

Table B-1 lists various clothing and equipment that Marines use in a cold-weather, mountainous environment.

Table B-1. Clothing and Equipment Weights.

Item	Weight (Pounds)	Item	Weight (Pounds)
Vapor barrier boots	6	3S sleeping bag	2.5
Trousers	1.25	3S compression sack	.5
Parka	3	Skins (set)	1
ECW mittens (pair)	.75	Improved sleeping mat	1.25
Intermediate cold weather gloves (set)	.75	Canteen cup	.5
Gridfleece (heavy weight)	2	Field tarpaulin	1.25
Silkweights	1	Avalanche probe pole	1
Fleece (100 weight)	.75	Transceiver, SOS	.5
Overwhite parka	1.5	Headlamp	.5
Overwhite bottom	1	Canteen 1 quart (full)	2.5
ECW 4-man tent repair kit	1	Snow shovel	1.5
Body	8	Sub belt and IFAK	4
Fly	8	MRE	1.5
Poles	6	Sling rope	1
Snowshoes (pair)	5	Military ski system	10
Flexible Litter (complete)	18	Adjustable ski poles	1.5
Fuel bottle (22 ounces, filled)	2	SUES stove (filled)	2
USMC pack	9	Cookset	2
Assault pack	2.5	Ski wax kit	.5
Main waterproof bag	.85	Overwhite pack cover	.75
Assault waterproof bag	.75	Fire team sled (SL-3 complete)	15
Bivvy cover	1.9	Thermos (1 quart filled)	4
ECW sleeping bag (winter only)	2.2		

APPENDIX C.
WINTER CONSIDERATIONS FOR A PATROL ORDER

The following are winter considerations that leaders should add to their patrol order.

Orientation

- Terrain model should include avalanche-prone slopes.
- Avalanche conditions—(aspect, angle, elevation, location, severity).
- Full weather report—(including wind direction and speed, temperatures, precipitation).
- Snow conditions for travel—(depth, wet or dry, crust or frozen, over-the-snow mobility).

Situation

- Enemy (include both foot and vehicle over-the-snow mobility assets and capabilities).
- Friendly.
- Attachments.

Mission

Ensure it is realistic for terrain and weather conditions, unit experience, and conditioning.

Execution

- Intent.
- Concept of operations:
  - Scheme of maneuver (route overlays should have avalanche-prone slopes marked and the TDF totals annotated).
  - Fire support plan.
- Tasks; for example, winter-specific collateral duties:
  - Avalanche search teams and probe line, marker, shovel, and hasty teams.
  - Trail-breaking team and rotation.
  - Sled team rotation if sleds are used.
  - Litter teams, augmentation litter teams.
  - Snow pit analysis and rutschblock team if scout skiers.
  - Ice reconnaissance team.

- Coordinating instructions:
  - Initial camouflage pattern for movement.
  - Transceiver checks, when and where.
  - Over-the-snow mobility selection, including sleds or no sleds, skins or wax type, snowshoes or skis, below or out of snow line.
  - Work priorities for a winter bivouac.
  - Track discipline for travel and bivouac.
  - When and where weapons are to be cleaned and bores punched.
  - Pull pole time.
  - Shelter selection—(tent, fly only, bivvy cover only).
  - Final inspection includes snowshoe or ski binding adjustment, thermos and canteens topped off, camouflage pattern check, pack, and sled check.

Administration and Logistics

- Type of ration, water, fuel, and other resupplies.
- How to protect prisoners of war from elements.
- How to conduct resupply from MSR to position, if applicable.

See Chapter 11 for additional logistics considerations.

Command and Signals

Hand and arm signal modification for cold weather clothing, if needed.

APPENDIX D.
EXAMPLE OF A
WINTER WARNING ORDER FORMAT

A. SITUATION

1. Enemy:
2. Friendly:

B. MISSION

C. GENERAL INSTRUCTIONS

1. Overwhite Pattern:
2. Shelter Type:
3. Chow per Marine:
4. Over-the-Snow Mobility:

NAME	CHAIN OF COMMAND	GENERAL ORGANIZATION (ELEMENTS)	SPECIFIC ORGANIZATION (TEAMS)	DUTIES	ARMS, AMMUNITION, AND EQUIPMENT	GEAR COMMON TO ALL	TIME SCHEDULE			
							When	What	Where	Who
						☐ Pocket items		Draw ration		
						☐ Assault load		Draw fuel		
						☐ Combat load		Draw weapons		
						☐ Transceiver		Draw communications		
						☐ Overwhites		Test communications		
						☐ Helmet		Draw ammunition		
						☐ VB boots		Draw		
						☐ Ski boots		Fire support coordination		
						☐ Gaiters				
						☐ Water		Foreign/adjacent unit coordination		
						☐ First aid kit				
						☐ Daypack		Chow		
						☐ Large pack		Patrol order		
						☐ Skis w/skins		Initial inspection		
						☐ Ski poles		Rehearsal		
						☐ Snow shoes		Final inspection		
						☐ Goggles		Pull pole		
						☐ Headlamp		Fill in position		
						☐ Overboots		Test fire		
						☐ Shovel		Transceiver check		
						☐ Thermos		Time of departure		
						☐ Sling rope		Time of return		
						☐ Carabiners		Debrief		

D. SPECIFIC INSTRUCTIONS

1. Assistant patrol leader is in charge when I am gone and will supervise patrol preparation and drawing of equipment. Adhere to schedule.

2. Element leaders supervise preparation of respective elements and report compliance to assistant patrol leader.

3._____ will construct terrain model.

E. SPECIFIC ORGANIZATION TEAMS

Aid and litter team(s), hasty avalanche search team, transceiver search team, probe team, shovel team, marker team, ice reconnaissance team, rutschblock and snow analysis team, trail-breaking team, and navigation team.

F. GEAR TO BE CARRIED

Machine gun, bulk ammunition, mortar, mortar round, rope, chemlights, radio, extra batteries, sleeping bag with bivvy, snow shovel, probe pole, thermos, field tarpaulin, fuel bottle, pyrotechnics, grenades, binoculars, team or large sled, ski litter, stove, compass, map (with protractor and pens), wax kit, litter, cook set, altimeter, snow analysis kit, ice auger, snow saw, route card, rope, hatchet, wire cutter, other.

APPENDIX E.
PATROL BASE SITE SELECTION CHECKLIST

Site Selection

__ Clear of avalanche path or runout zone
__ Tactically sound defensive position
__ Large enough for entire unit
__ In a forested area
__ In depression or knoll, if above tree line
__ Adequate water supply
__ Leeward side
__ Off valley floor

Security

Track Plan:
__ Jump-off point
__ Dummy track
__ Dummy position
__ Track plan in bivouac site
__ Defensive positions marked
__ Living areas marked

Specific Use Areas

__ Head area
__ Trash point
__ Water point
__ Storage point
__ Firewood scavenging area

Living Areas

Outside the Tent:

__ Security posted
__ Track plan established
__ Defensive position completed
__ Tent erected correctly
__ Entrance downwind and offset
__ Sled staged and cover closed
__ Snowshoe or ski pit built and organized
__ Urination area designated and marked

Inside the Tent:

__ Clothes brush at entrance
__ Sleeping space allocated
__ House duties assigned:
  __ Rotation of stove person or cook
  __ 15 minute early stove lighter
  __ Dressing sequence
  __ Two occupants moving at a time
  __ Sentry roster and alert state
__ Cold hole dug in vestibule
__ Packs and weapons arranged in vestibule
__ Improved sleeping mats laid out
__ Tent free of snow and ice

Tent Routine

__ Stove on, only the cook operates the stove
__ Melt water, hot liquids first
__ Top off all water bottles and thermoses before sleeping
__ Gear drying rotation
__ Air out feet and change socks
__ Extremity check, self and buddy
__ Fire or snow watch with arctic sentry
__ Weapons cleaned and lubricated
__ Snowshoes or skis scraped before putting in snowshoe or ski pit
__ Ski skins off, placed between sleeping bag and improved sleeping mat

__ No gear adrift
__ Shave and conduct hygiene steps before sleeping
__ Light and noise discipline
__ Trackplan and camouflage improvement
__ Ensure all eat and drink
__ Ensure cooking utensils are cleaned
__ Fire precautions with stove, lighting, and operating
__ Security rotating properly
__ Word passed

Pull Pole

Minus 15 Minutes:
__ Stove turned off
__ Packs packed and staged
__ Sled staged
__ Sleeping mats left out
__ Snow and ice removed from the tent and lines
__ Anchors dug out or cut away

Minus 5 Minutes:
__ Sleeping mats stowed
__ Pits and urination area filled in
__ Team members occupy pull pole position

On Order:
__ Collapse tent
__ Pack tent, fly, poles
__ All holes filled in
__ When ready, stage on track in order of movement

REFERENCES AND RELATED PUBLICATIONS

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3-09.3	Close Air Support

Miscellaneous

Department of Defense Dictionary of Military and Associated Terms

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US Navy Naval Air Systems Command (NAVAIR) Technical Manuals (TM)

13-1-6.7-2 Aviation-Crew Systems Aircrew Personal Protective Equipment (Aircrew/Passenger Equipment)

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1-3	Tactics
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12-10A.3 Mountain Leader's Guide to Mountain Warfare Operations

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3-97.61 Military Mountaineering

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4-33.31	Cold Weather Maintenance Operations
10-4520-261-12&P	Operator's and Organizational Maintenance Manual (Including Repair Parts and Special Tools List) Space Heater Arctic
10-4520-264-12&P	Operator's and Unit Maintenance Manual Including Repair Parts and Special Tools Lists (RPSTL) For Space Heater, Convective 60K BTU

GLOSSARY

Section I. Acronyms and Abbreviations

C-4	plastic explosives
CAS	close air support
CASEVAC	casualty evacuation
CLP	cleaner, lubricant, and preservative
DPICM	dual-purpose improved conventional munitions
°F	degrees Fahrenheit
FAC	forward air controller
FASCAM	family of scatterable mines
GPS	global positioning system
IED	improvised explosive device
LAV	light armored vehicle
lbs	pounds
LZ	landing zone
m	meter(s)
mm	millimeter(s)
MAGTF	Marine air-ground task force
MCMWTC	Marine Corps Mountain Warfare Training Center
MCTP	Marine Corps training publication
MCRP	Marine Corps reference publication
METT-T	mission, enemy, terrain and weather, troops and support available-time available
MRE	meal, ready to eat
MSR	main supply route
ORP	objective rally point
S-3	operations and training officer/office
SATCOM	satellite communications
SOP	standing operating procedure
TOW	tube launched, optically tracked, wire guided

UH-1Y	utility helicopter (Huey)
UIF	unit issue facility
UV	ultraviolet
VHF	very-high frequency
WP	white phosphorus

The following acronyms are applicable specifically to this publication.

AMS	acute mountain sickness
APECS	all-purpose environmental clothing system
ECW	extreme cold weather
HACE	high altitude cerebral edema
HAPE	high altitude pulmonary edema
LAW	lubricant arctic weather
MACK	Marine assault climber's kit
MCCWIK	Marine Corps cold weather infantry kit
MCW	meal, cold weather
SUES	small-unit expeditionary stove
TDF	time-distance formula

Section II. Terms and Definitions

abatis

A vehicular obstacle constructed by felling trees (leaving a 1- to 2-meter stump above the ground on both sides of a road, trail, gap, or defile) so that they fall, interlocked, toward the expected direction of enemy approach. The trees should remain attached to the stumps and be at a 45-degree angle to the roadway. The obstacle itself should be at least 75 meters in depth to be most effective.

ahkio

A boat-like sled used for pulling equipment over snow. (USMC Dictionary) Also can refer to sled teams and procedures for organizing embarkation and debarkation for assault lift.