UNITED STATES ARMY ALASKA

Northern Warfare Training Center

COLD WEATHER OPERATIONS MANUAL

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The Soldier And The Environment

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Introduction

A study of man's military history in cold and mountainous regions leads to one basic conclusion- his successes and failures are measured in terms of his regard for the dominant characteristics of a cold environment. As soldiers, we must be prepared to live, move, and fight in a cold environment. This book will teach you the characteristics of a cold weather environment are, as well as how to deal with the cold and it's related problems. Read it and remember the lessons and tips it contains.

Expertise in cold weather operations cannot be gained solely from reading this manual, therefore, to develop successful cold weather field techniques, applicable training and operational experience is necessary.

I. The Cold Weather Environment

Areas of the world with extreme cold temperatures, mountains or deep snow cover will effect military operations more than any other environment. Both leaders and soldiers need to understand the characteristics and phenomena common to these regions in order to successfully operate in this harsh, often unforgiving environment.

A. Cold Regions of the World

Cold regions of the world comprise over 50% of the planet's dry land surface. For military purposes, a cold region is defined as any area where snowfall or cold temperatures restrict movement or operations for more than one month of each year. Cold regions may be found in both the Northern and Southern Hemispheres, to include the entire continent of Antarctica, Patagonia (southern South America), the Andes mountains, 45% of the North American continent, and approximately 65% of the Eurasian land mass. In the Northern Hemisphere, there are three sub-regions:

1. The Arctic. Located above the Arctic circle, Arctic areas are typically subject to continuous permafrost, and barren with little to no cover, fuel sources or building materials. The Arctic is snow-covered approximately 9 months out of each year.

2. The Sub-Arctic. Located south of the Arctic circle, Sub-Arctic areas may have discontinuous areas of permafrost, and may be snow-covered from 6 to 8 months of each year. Sub-Arctic areas may be barren or heavily forested; abundant cover, fuel, and building materials are found in forested areas.

3. Temperate. Temperate areas are characterized by a complete lack of permafrost, and extensive forests that provide abundant building materials, fuel, and cover. They are generally snow-covered from 3 to 6 months of each year, although in dry years snowfall may be minimal.

B. Geography

1. Each of the sub-regions contain mountains, which will provide exceptional challenges to military operations. Among the difficulties encountered will be:

a. Obstacles to transportation and communications

b. Delays to movement and resupply caused by bad weather, and forcing units to be more self-sufficient

2. Rivers found in cold regions may aid movements or be major obstacles, depending upon the time of year.

a. Arctic/Sub-Arctic rivers are usually glacier-fed, with many braided channels and swift currents

b. Glacier-fed rivers change course frequently, making river navigation difficult, and rendering map data suspect

c. If shallow-draught boats are available, rivers may provide valuable lines of communication in summer, and once firmly frozen, may offer high-speed routes for both mounted and dismounted movement. During spring and early winter (break-up and freeze-up) however, rivers may be impassable. Some rivers, especially in temperate areas, may not freeze solidly enough to allow for winter movement.

3. Forests may cover temperate regions and large areas in the Sub-Arctic. There are no forests in the Arctic.

a. Forests provide abundant fuel and building materials, as well as cover and concealment.

b. Dense forests may severely restrict both mounted and dismounted movement.

4. Tundra is considered a terrain feature simply due to the vast size of the area it is found in. Most of the land found in the Arctic is tundra

a. Tundra is composed of mosses and grasses (clumps of grass are called tussocks).

b. Foot movement is difficult in summer, but becomes easier when tundra is frozen.

5. Muskeg is a form of Tundra found in areas with poor drainage.

a. Muskeg is characterized by numerous stagnant ponds, and the ground is usually damp and spongy, or may even be a vast shallow swamp.

b. As with other types of Tundra, foot movement is difficult in summer, but easier once the Muskeg has frozen.

6. Permafrost is ground that remains frozen year-round. Excavation in areas of permafrost may require demolitions or engineer support.

a. Permafrost forms when the ground temperature in a given area remains at 32°F or colder for two years or longer.

b. Permafrost may vary in thickness from several to over a thousand feet.

7. Glaciers and Polar Ice Caps cover 10% of the earth's surface. Alaska alone has 2% of the worlds glaciers within its borders. Glaciers are natural highways through mountainous regions.

a. Glaciated terrain often offers easier and safer routes for dismounted movement than surrounding peaks and ridges.

b. Specialized training is necessary to protect personnel from the hazards encountered during movement on glaciers. Two of the hazards are ice avalanches and falling into hidden crevasses.

B. Climates of Cold Regions

There are two basic types of climate that can be encountered in cold regions. The climate encountered will depend upon the geographic location of the region.

1. Maritime climates are found in areas that are subject to the influence of oceans or other large bodies of water. Typically, maritime climates experience cool summers and mild winters, along with heavy precipitation. In the winter months, precipitation will often be in the form of rain, sleet, or wet snow.

2. Continental climates occur in areas not subject to the influence of large bodies of water. Continental climates generally have much hotter summers and colder winters than maritime climates. Precipitation in areas subject to continental climates is generally not as great as in maritime climates, although violent summer storms are common. In winter, the bitter cold and reduced precipitation results in drier snow and shallower snowpacks than those of maritime climates.

3. Climate may vary greatly from one sub-region to another.

a. Arctic regions generally have summer high temperatures of +40°F, and winter lows of –40°F along with severe wind-chill.

b. Sub-Arctic regions have average summer temperatures of +65°F, with highs of +90°F possible. In winter, +5°F is normal although the temperature can easily drop to -65°F or even colder

c. The climate in temperate areas will vary greatly, and it is virtually impossible to make a general statement of the conditions. Either maritime or continental influences, as well as the latitude, elevation, and terrain will determine the climate.

d. In both the Arctic and Sub-Arctic cold temperatures are also the result of the decreased amount of sunlight experienced in winter. In the Sub-Arctic, on the shortest day of the winter the sun will only rise above the horizon for approximately four hours. In the high latitudes of the Arctic, the sun may disappear for several months.

e. The ability to predict weather is a valuable asset to soldiers operating in a cold environment. Certain occurrences or types of cloud formations are good indicators that a storm is approaching within the next 24 to 48 hours:

1. Cirrus clouds, or “Mare's Tails” indicate possible precipitation in the next 24 to 48 hours

2. Lenticular, or lens-shaped, clouds above peaks or ridges indicate high winds aloft as well as increasing moisture content in the air.

3. A halo around the sun or moon, followed by thickening cirrus clouds, indicates increasing moisture content in the air; possible precipitation in the next 24 to 48 hours

4. Plumes of blowing snow from peaks or ridges indicate high winds and an approaching storm.

5. Clouds that thicken and appear to be getting lower throughout the day are the best and most obvious indicator of deteriorating weather.

C. Phenomena and Associated Hazards

There are several phenomena that are characteristic of cold regions. Although not all of these phenomena create hazards, it's possible there may be a significant impact upon military operations when they occur.

1. Ice fog occurs when water vapor is introduced into still air conditions with temperatures at –30°F or colder. The water vapor crystallizes to form a cloud of ice particles. Some of the effects of ice fog are obscured vision, and the creation of noticeable bivouac, weapon, and vehicle signatures

2. Blizzard conditions are caused by high winds blowing snow from the ground or snowfall. Although blizzard conditions rarely last for more than 24 hours, they may restrict visibility to less than 100 feet while they exist.

3. Whiteout conditions are caused by sunlight diffused through an unbroken cloud layer onto uniformly snow-covered terrain, resulting in a loss of both the horizon and depth perception that may make it impossible to distinguish terrain features. Whiteout conditions rarely last for more than half an hour. If at all possible, movement should not be attempted during whiteout conditions.

4. Temperature inversions occur during periods of calm, fair, weather when cold air settles into low-lying areas and warmer air lies on top of the cold air. Temperatures in low areas may be as much as 20°F colder than those on surrounding higher ground.

5. Looming is an optical illusion, commonly encountered in extremely cold dry conditions, where objects and terrain features appear to be much larger and closer than they actually are. Looming may make range estimation extremely difficult.

6. The Aurora Borealis (Aurora Australis in the southern hemisphere), or Northern Lights, is caused by a flow of charged particles emitted by the sun, and drawn toward the Earth's magnetic poles. It is visible as a display of rippling, multi-colored lights visible in the nighttime sky. Most often they appear as a greenish-white glow, although other colors may appear. These "lights" occur approximately 280 days per year, but are not bright enough to be seen during daylight. They may cause disruptions in HF communications, but have been known to actually enhance FM radio transmission and reception.

II. Types Of Cold

A. Wet Cold

Wet cold conditions occur when the average temperature is above +14°F, and variations in day and night temperatures cause alternate freezing and thawing. Wet snow or rain, causing the ground to become slushy and muddy, often accompany these conditions. Under these circumstances soldiers require clothing that consists of a waterproof or water-repellent, wind-resistant outer layer and an inner layer with sufficient insulation to provide protection in moderately cold weather, (above 14°F). Waterproof footwear is essential.

B. Dry Cold

Dry cold conditions occur when average temperatures are below 14°F. The ground is usually frozen and the snow dry. These low temperatures, plus wind, increase the need for protection of the entire body. Under these conditions soldiers require clothing that will provide insulation for the body for a wind-chill factor of –80°F.

III. Wind-chill

We know from our own experience that when a high wind is blowing it feels much colder than when it is calm. Temperature alone does not give a true indication of the relative impact of the outdoor environment. In order to effectively gauge the difference between temperature and the relative impact of the environment, some scale must be used. The most commonly used reference is the wind-chill chart. Wind-chill is the combined effects of wind and temperature. The chart, in Appendix D, is a simple and practical guide showing the conditions under which cold weather is dangerous and how quickly exposed flesh is likely to freeze. The chart need not be memorized, but leaders should recognize that a temperature of +5°F combined with a 20 mph wind can be more dangerous than a calm day of –25°F.

V. Effects of the Cold on Military Operations

A. **Intense cold affects the mind as well as the body. It has a numbing effect whereby simple tasks take longer to perform and use up relatively more effort than in temperate climates. This must be considered when planning operations and giving orders, even for such routine tasks as vehicle maintenance or pitching and striking a tent. There is no simple formula for the extra time taken, as it will vary with the prevailing conditions, state of training and cold weather experience of the troops involved. It should not however, be used for an excuse of over insurance; troops readied unnecessarily early, or left standing in the open after striking camp will suffer physically and their morale will ebb, often a time when it should be at a high pitch.**

B. **When conditions become extreme and the temperature falls below –25°F, the problem of survival becomes of greater significance; everything tends to become subordinated to the quest for warmth and comfort. In such circumstances, personnel tend to withdraw into themselves, to adopt a cocoon-like existence, bundled in successive layers of clothing or wrapped in the warmth of a sleeping bag. These personal symptoms are also reflected by group behavior; the tent becomes a haven, and there can be a reluctance to leave its warmth and comfort.**

C. Effects of Cold on Personnel

In extreme cold a soldier can become numb and indifferent to non-essential tasks. Essential tasks require more effort. It has been repeatedly demonstrated that at temperatures lower than –10°F all other problems and requirements lose significance in the personal battle for survival.

VI. Existing in the Cold

A. **The human body must be protected. To remain functional, it must be kept reasonably warm with normal body processes maintained. Rest and nourishment are vital.**

B. **The correct approach to cold weather living will go a long way toward keeping you and your soldiers healthy and seeing you through difficult times. There are four basic rules to remember:**

1. Keep in shape

Cold weather clothing is heavy and an additional burden on top of a soldier's normal equipment. Along with the difficulty of walking in the snow, a soldier will expend a lot of energy just staying warm. The importance of being in excellent physical condition cannot be over emphasized.

2. Drink plenty of water

Because water may be hard to get, a soldier may drink less than needed. Normally, in cold climates, soldiers only drink when thirsty, and cold can "short-circuit the thirst mechanism. This may not give them the water needed to prevent dehydration. Drink plenty of water to avoid dehydration and the fatigue that will follow. Do not allow your soldiers to eat snow as a water

substitute; the moisture content of snow is relatively low and it will lower the body's core temperature.

3. Eat to keep fit

Regular, satisfying, hot food is essential for top performance. Even if you are not hungry, you must eat. If you do not, you will not stay fit very long.

4. Maintain a positive attitude

Your soldiers will find themselves confronting many new and challenging problems, but none that a properly trained soldier cannot overcome. The soldier's attitude toward the cold will reflect his leader's.

VII. Positive Leadership and the Right Attitude

A. **Most soldiers, after three or four weeks of cold weather training, will be able to cope with the environment. Some soldiers may not be as proficient as others, but nearly everyone learns to get by fairly well.**

B. **Leadership must be by example. At first, winter conditions tend to be frightening. Soldiers will find themselves up against many problems that they have never before been challenged with, and the cold will always be there to remind them that they can become a casualty if they make mistakes. Leadership that aggressively meets and overcomes the challenges of the environment is essential to mission accomplishment.**

C. **Initially, there are two opponents to contend with: the enemy and the cold. The first step towards dealing with these opponents is getting your soldiers into a confident frame of mind. Therefore, the leader must maintain a positive attitude towards the mission, his soldiers, and the equipment they have will have to use to carry out the job. If the leader does his job correctly, the cold may even become an ally that can be used to help defeat the enemy.**

D. The cold can defeat you psychologically if you are not aware of the symptoms. The following are some tips on how to defeat the cold when it begins to get on the minds of your soldiers.

1. If your soldiers get "blue", depressed, and moody and do not want to talk, force them to chat with each other. Talk things up and do not let the weaker ones get left out.

2. If your soldiers find it hard to remember things they have been taught, how drills go and what to do, show patience, review orders and drills. Get them to think and ask plenty of questions. Keep their minds busy.

3. If your soldiers are on edge and are getting on each other's nerves, remember that this is bound to happen. Maintain your sense of humor, lead by example, and show patience. Change their duties around, pair off weak soldiers with strong ones, in a buddy system, and remind them that everyone is in the same situation.

4. Be cautious that soldiers may begin to shirk any of their jobs that are not directly related to keeping themselves warm. Remind them that their job is to fight
and that weapons and equipment must be kept in fighting order. Winter training can too easily become a camping trip. Leaders must avoid this common trap.

5. Don't accept the cold as an excuse for not carrying out an order. It may be a reason for taking longer, but it is no excuse for letting things slide.

CAUTION: NEVER REQUIRE YOUR SOLDIERS TO STAND AROUND IN THE COLD UNNECESSARILY. PLAN AHEAD AND BE ORGANIZED

VIII. Conclusion

Remember the cold may make your tasks harder and they may take longer to accomplish, but it does not make them impossible. With knowledge, equipment, and proper training, you can neutralize the cold or even turn it into your advantage.

Chapter 2

Personal Clothing and Equipment

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I. The Cold Weather Clothing System

A. Design Principles

The design principles of the cold weather clothing system were based on the mechanisms of heat loss;

Convection- heat loss caused by air moving over a surface such as wind against the skin

Conduction- heat loss caused by physical contact such as skin touching a cold object

Respiration- heat loss caused when exhaling

Radiation- heat loss caused by the body attempting to warm its surrounding environment

Evaporation- heat loss caused by temperature dissipation as liquids turn to vapors such as when perspiration on the skin or in the clothing evaporates; evaporation decreases the temperature of the host

Leaders should understand the design principles of the military cold weather clothing systems. These principles are: Insulate, Layer, and Ventilate.

1. Insulate- insulating material reduces the amount of body heat lost to the environment. By regulating the amount of insulation, an individual can regulate the amount of body heat lost or retained. Insulation in clothing is the trapping of body warmed air within its fibers.

2. Layer- several loose layers of clothing provide more insulation and flexibility than one heavy garment.

3. Ventilation- ventilation helps maintain a comfortable body temperature by allowing the wearer to rid himself of excess heat, as well as moisture produced by perspiration.

There are four ways to make these principles work for the military clothing system: keep it Clean, avoid Overheating, wear it Loose in layers, and keep it Dry. By remembering the acronym COLD, a small unit leader can quickly check soldier's clothing.

Keep it *C*lean
Avoid *O*verheating
Wear It *L*oose In Layers
Keep It *D*ry

Figure 2-1 C-O-L-D

a. *Keep Clothing Clean*- Dirt and grease clog the air spaces in clothing and reduce the insulation. Dirty clothes are cold clothes.

b. *Avoid Overheating*- Select the clothing needed to keep comfortable, and even a little cool.

CAUTION: YOU MUST ENSURE THAT YOUR SOLDIERS ARE NOT OVERDRESSED FOR THE JOB THEY ARE PERFORMING.

c. *Wear It Loose*- All items of the cold weather uniform are sized to allow wearing of the appropriate number of layers; this means, for example, that the Gore-Tex jacket may appear too large when worn

without all of the layers designed to fit under it. If the uniform items do not fit loosely, the insulation's ability to trap warm air will be substantially reduced.

d. *Keep It Dry*- It is critically important to keep clothing dry since wet clothing can conduct heat away from the body much more quickly than dry clothing. Moisture can soak into clothing from two directions; from both melting snow, or frost which has collected on the outside of the clothing, and from perspiration. You must ensure that your personnel brush snow and frost from their clothing before entering any heated shelter or vehicle, and that they avoid overheating.

B. Wet Cold vs. Dry Cold

As mentioned in Chapter 1, temperatures that are consistently above 14°F produce cold wet conditions; temperatures consistently below 14°F will cause cold dry conditions. Cold wet conditions usually involve a freeze/thaw cycle, often accompanied by rain or wet snow; this type of weather is the most difficult to dress for since each soldier must fight a continuing battle against the elements to keep clothing dry. During cold dry conditions the ground is usually frozen and the snow is dry in the form of fine crystals. Although the temperatures during cold dry conditions may be much lower than during cold wet conditions it is often easier to stay warm in cold-dry conditions because it is not as hard to stay dry.

C. Extended Cold Weather Clothing System (ECWCS)

The ECWCS is an insulated, layered, clothing system designed to reduce the cumbersome weight of the older cold weather clothing systems while maintaining adequate environmental protection between +40°F and -60°F, ambient temperature. The system has distinct layers with different functions. The function of the wicking layer, or inner layer, is to wick moisture away from the body. The intermediate, or insulating layer, provides the insulating space. The outer layer, or protection layer, provides protection by virtue of being wind proof and water-resistant.

A feature of the layering design of this system is the user's ability to add or remove clothing layers to suit the environmental conditions and individual personal preferences. Synthetic fibers and innovative fabrics and design allow moisture, the prime conductor of the cold to the skin, to be removed quickly and efficiently from the system. The ECWCS issue consists of the following items:

Inner (Wicking) Layer-
Polypropylene undershirt and pants with standard wool socks

Intermediate (Insulating) Layer-
Mitten liner
Wool balaclava, and/or pile cap
Polyester fiberpile shirt and bib overall
Polyester batting field jacket liner and trouser liner

Outer (Protection) Layer
Vapor-permeable parka and overtrousers, standard trigger finger or arctic mittens, standard white vapor barrier boot

NOTE: The black vapor barrier boot, rated to –25°F, is only worn in a cold wet environment)

D. Tips on Wearing and Maintenance of Clothing

1. When deciding on how to configure your uniform, first determine the degree of protection you require, then select the items that will best meet your needs. Remember to keep it loose! Also, don't

forget that every soldier is different; as a leader you can, and should, specify the outer garment your soldiers must wear, but your soldiers' needs with regard to the number and types of insulating layers will vary.

NOTE: Outer gloves should be placed inside the outer clothing layer when not worn. This prevents snow from entering the glove.

2. Drying wet clothing:

a. Hang items separately.
b. Do not place anything too close to a direct heat source.
c. Do not allow items to be hung directly over a stove.
d. Clothes should not be hung over steaming pots.
e. Discourage soldiers from placing wet clothing in their sleeping bags. This practice transfers moisture to the sleeping bag, which is more difficult to dry than clothing

3. Drying damp clothing:

a. Damp items can be hung on the pack while on the march.
b. Place damp articles close to the body between the wicking and insulating layers of clothing, so that body heat can dry the items.
c. Small damp items may be placed in sleeping bags. They'll be dry by morning.
d. Larger items can be placed between the sleeping bag and the sleeping mat under the soldier's legs and body.

4. When washing clothing is not possible, "dry-rubbing" and air drying clothing will suffice.

5. A thin polypropylene liner sock should be worn underneath the issue wool sock when wearing vapor barrier boots. The black nylon dress sock is an acceptable substitute for polypropylene. This will help in wicking perspiration away from the skin of the soldier's feet, and will also help to prevent blisters caused by bunching or chafing from perspiration-soaked wool socks

6. Never allow soldiers in VB boots to attempt to warm their feet next to an open fire. The boots will be damaged long before the feet become warm.

7. VB boots should not be worn in sleeping bags. However, if the tactical situation dictates that boots must be worn while sleeping, the feet should be dried, have foot powder applied, and dry socks put on. This should be a last resort since wearing VB boots while sleeping can be dangerous; it may increase the risk of foot injury from immersion foot or frostbite. Dry boots can be placed inside sleeping bags, under the soldier's knees, or behind the head as a pillow. They will be warm in the morning when it's time to put them back on.

II. Cold Weather Equipment

A. Sleeping Equipment

The sleeping equipment consists of a sleeping bag, an insulated sleeping mat and a waterproof bag. There are four types of sleeping bags currently available.

NOTE: The temperature ratings of all these sleep systems can be extended depending on what you wear inside the bag.

1. Bag, Sleeping, Type I, Intermediate Cold

The temperature range of this bag is approximately from +45°F to +10°F, uses polyester batting for insulation, weight 7.5 pounds.

2. Bag, Sleeping, Type II, Extreme Cold

The temperature range of this bag is approximately from +10°F to -50°F. The construction is a combination of waterfowl feathers and down, and polyester batting for insulation. This bag weighs 9.5 pounds.

3. Bag, Sleeping, Extreme Cold Weather Sleeping System

The temperature range of this system is approximately from +10°F to –50°F. This system uses polyester batting for insulation. The system consists of a sleeping bag, a vapor-permeable bivy cover, a compression sack, and a hood and socks constructed of polyester fiberpile. The temperature range of this bag is dependent upon how many layers of the ECWCS clothing system are worn inside the bag., (with the exception of boots, and vapor-permeable parka and trousers) Weight of this system is 9.5 pounds

4. Modular Sleeping Bag, Intermediate Cold

The temperature range of this system is approximately from +30°F to –30°F. The bag contains polyester for insulation. This bag consists of: an inner, intermediate cold, sleeping bag; an outer patrol sleeping bag; a vapor-permeable bivy cover; and a compression sack. The patrol bag with bivy cover is rated to +30°F. The intermediate cold bag with bivy cover is rated to –10°F. When both bags are combined with the bivy cover, they are rated to –30°F. Again, these temperature ranges are dependent upon how many layers of the ECWCS are worn within the bag and it is possible to extend the range to –50°F with additional clothing. The weight of this system is 10.25 pounds.

5. Sleeping pad- constructed of closed cell foam; insulates from the ground; prevents heat conduction. The Insulated Sleeping Mat has replaced the old pneumatic mattress. It provides excellent insulation from cold ground or snow when used with the sleeping bag. It is also useful for sentries and for personnel in ambush positions who must remain prone for extended periods.

You should ensure that your soldiers are issued appropriate bags for the temperatures you expect to encounter, and that each soldier has a waterproof bag for the sleeping bag. All Sleeping systems temperature range can be extended by the clothing worn while in the bag.

B. Load Carrying Equipment

The All-purpose Lightweight Individual Carrying Equipment (ALICE) Pack comes in two sizes, medium and large. Ensure that your Soldiers are equipped with the large ALICE. This system will eventually be replaced by the Modular Light weight Load bearing Equipment (MOLLE) system. Regardless of what system your soldiers are using, the following considerations will apply.

In more temperate environments the method a soldier uses to organize a pack is not of great concern to you; however, during cold weather operations, you should establish a standard pack organization system to be followed by all of your soldiers. You may use any method you desire to organize your pack as long as everyone follows it. The principle consideration should be to avoid having to unpack during halts to get to frequently needed items. The tips listed below should help:

1. Small External Pockets: small high-energy foods (candy, cereal bars) to be eaten while on the move

2. Large External Pockets: rations for morning and evening meals; extra socks, scarf, spare cap; openings behind pockets can be used for carrying skis or other items

3. External Attachment Points: sleeping mat attached to bottom of pack or under top flap; other mission-essential items as required

4. Top Flap: overwhite camouflage and pack cover

5. Main Compartment: place sleeping bag in bottom of pack; spare clothes in upper half of compartment where they can be easily reached

> **NOTE: Pack heavy items close to the body and, in height, towards the middle of the back.**

C. Over Snow Movement Equipment

Before deciding to use snowshoes or skis, always determine if movement by foot is feasible: in shallow, (1 foot or less), or heavily crusted snow, or in snow dense enough to support a soldier's loaded weight, movement on foot provides better maneuverability with the least expenditure of energy.

1. Snowshoes: White painted, magnesium frame laced with nylon coated steel cable. They are approximately 48" x 12" and weigh 4.8 pounds with bindings. Check bindings for proper adjustment. When properly adjusted, the boot will be parallel to the long axis of the snowshoe. The toe of the boot will be approximately one third to half way across the opening, or window, in the snowshoe; the toe strap should be firm, but not so tight that it restricts circulation; the heel straps should permit minimal side to side movement. Ski poles can be very useful as aids to balance on steep terrain, or when carrying heavy loads.

2. Skis: The military skis currently available vary in length from approximately 180 to 210cm in length and have a hole in the tip for towing. Which ski length an individual is issued depends on that person's weight. Heavier soldiers should receive longer skis to assist in flotation.

3. Ski Bindings: The most commonly used bindings by the Army are the NATO and the Silveretta 125A. These are all-metal bindings consisting of a locking clamp or tensioner, toe plate, and a boot-heel retaining cable. Cables are available in a variety of sizes to fit different-sized boots. The NATO binding cables are not interchangeable with the cables for the Silveretta binding.

4. Ski Poles- The military ski pole consists of a steel shaft with rubber hand grips and baskets, and a leather wrist strap. The poles come in three lengths: 130, 137 and 147cm. When fitting the poles, the person being fitted should stand on the floor and place the pole at their side. It should come to the "point" of the shoulder (about 1" below the top of the shoulder).

Chapter 3

Group Equipment

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I. Tent Group Equipment

Tent group equipment is designed for use by a rifle squad; however, it can readily be structured to accommodate any task-organized unit, regardless of that unit's size or mission. This section will discuss equipment you will need to be intimately familiar with before undertaking field training in a cold weather environment. The tent group equipment is also commonly referred to as the ahkio group, as the tent and the ahkio are the two key items among all the equipment that constitutes the group.

The following is a list of typical tent group equipment recommended for a light infantry squad operating in cold regions:

ITEM	QUANTITY
a. Scow-sled, 200 lbs. capacity (ahkio)	1
b. Tent, ten-man Arctic, with telescoping pole, pole board, and 12 tent pins	1
c. M1950 Yukon stove with stove board	1
d. Five gallon fuel can	1
e. Five gallon water can	1
f. D-handle coal shovels	2
g. Machetes (with sheath)	2
h. Squad cook sets	2
i. Squad stoves	2
j. Fuel bottles	2
k. Bow saw	1
l. Ax	1
m. Hammers	2
n. 120 ft. rope	1

o. Trace, ahkio pulling, 9 ft
3

p. Trace, ahkio pulling, 27 ft. with snap ring
1

q. Hammers
2

r. Fire extinguisher
1

s. Lantern, gasoline*, with case
1

CAUTION: THE USE OF PROPANE-FUELED LANTERNS DURING COLD WEATHER OPERATIONS IS NOT RECOMMENDED. PROPANE TURNS TO LIQUID AT APPROXIMATELY –40°F. IN THIS LIQUID STATE IT MAY SPRAY FROM ITS' CONTAINER WHEN THE VALVE IS OPENED, CREATING AN EXTREMELY HAZARDOUS CONDITION.

II. Scow Sled, 200 lb. Capacity, Ahkio

A. The scow sled, 200 lb. capacity, commonly known as the ahkio, is the light infantry squad's primary means of transporting tents and other sustainment equipment in a cold weather environment. It is a 38 pound fiberglass sled with an attached canvas cover, and has a carrying capacity of 200 pounds. In addition to its' primary function of transporting the tent group equipment, the ahkio is excellent for transporting weapons, rations, and ammunition, providing a stable firing platform for crew-served weapons in deep snow, and for casualty evacuation.

B. Packing

Proper weight distribution is essential when packing the ahkio. Heavy items should be placed in the bottom and slightly to the rear of center. Loading lighter equipment toward the top will prevent the ahkio from becoming top-heavy. The load should be packed in a manner which results in the lowest possible profile, again, to avoid a top heavy condition. If the center of gravity is too high, the sled will be difficult to pull, and will tend to roll over, especially when moving parallel to a slope. Tools such as shovels, axes, saws, and machetes should be packed on the sides or top for easy access when breaking trail or clearing bivouac sites. Once all equipment has been placed into the ahkio, the canvas cover is folded over the load, and the lashing ropes are secured to each other with the lashing hooks, tightened, and secured.

C. Towing

Towing a loaded ahkio is arduous work; teams must be rotated frequently to prevent soldiers from becoming exhausted, and to prevent them from sweating through their clothing, which may expose them to a cold weather injury. Generally, snowshoes are preferred for soldiers who will have to pull an ahkio over snow-covered terrain, especially if the snow depth exceeds one foot. Ski poles are recommended as an aid to balance. Pulling of ahkios by ski borne troops requires a considerable degree of expertise, and this task should be included in a units' ski training syllabus if it is to be attempted. When pulling an ahkio with skis on, climbing skins can be an invaluable aid.

III. Ten Man Arctic Tent

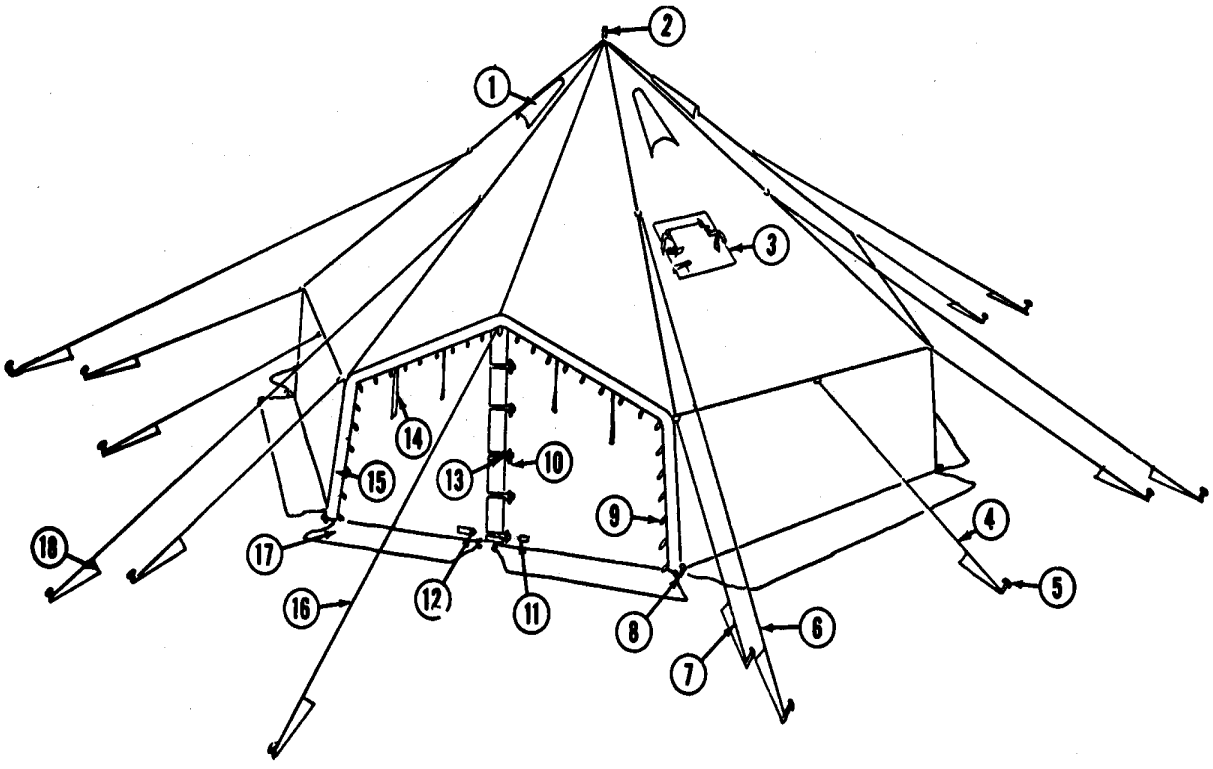
A. General Characteristics

1. This six-sided pyramidal tent supported by a center pole normally accommodates ten soldiers with their individual equipment, (see Figure 3-1). When necessary, it can accommodate additional personnel if their equipment is stored outside. It may also be utilized as a command post, aid station, or storage shelter. The tent has a liner and two doors, each of which is provided with a series of toggles and loops around their outer edges. When additional space is required, these toggles and loops allow two or more tents to be joined together with unrestricted access from one to another.

2. A snow cloth is attached to the bottom of the tents' side walls; it is used to seal the tent to the ground in order to conserve heat in exposed or wind swept areas. This is accomplished by placing insulating material such as spruce boughs, brush, cardboard or other suitable material between the ground and the snow cloth, then weighting the snow cloth with snow, dirt, logs, etc. to keep it in place.

<u>CAUTION:</u> NEVER ALLOW THE SNOW CLOTH TO FREEZE TO THE GROUND. IN THE EVENT OF A FIRE, PERSONNEL MUST BE ABLE TO ROLL OUT FROM UNDER THE WALLS OF THE TENT; THERE WILL NOT BE ENOUGH TIME FOR PERSONNEL IN THEIR SLEEPING BAGS TO GET UP AND FILE OUT OF THE TENT DOOR.

3. The tent is ventilated in four locations by built-in ventilators on opposite sides near the apex, or top, of the tent. Four drying lines are rigged inside the tent, on which personnel can hang wet clothing and equipment. The total weight of the tent, liner, telescoping center pole and tent pins is approximately 76 pounds. It is quite bulky and very heavy. Because of this, your soldiers should be familiar with the construction and use of other types of shelters. These will be addressed in a later chapter.



1. Ventilator
2. Telescopic tent pole
3. Stovepipe opening
4. Tent line, eave loop
5.
6.
7.
8.
9.
10. Wood toggle
11. Chape snap
12. D-ring
13. Toggle
14.
15.
16.
17.
18.

5. Aluminum tent pin
14. Tie tape
6. Tent line, corner
15. Tent lug
7. Tent line, corner eave
16. Tent line, door eave
8. Footstop
17. Snow cloth
9. Becket
18. Tent slip

Fig. 3-1 Ten Man Arctic Tent

B. Erecting the Ten Man Arctic Tent

This shelter is easily erected by five soldiers using the following procedures:

1. The snow in the area to be occupied by the tent is dug out to ground level, or packed down firmly. Digging in is preferred, as it reduces the tents' profile, and the tent is better protected from the wind. Digging in also provides some protection from enemy observation as well as from small arms fire.

2. If the tent is dug in, allow a minimum of 6.5 feet clearance between the walls of the tent and the walls of the snow pit; in the event of a fire, personnel must have room to roll out from under the tent walls in order to escape the flames. In open areas a snow wall should be constructed to protect the tent from the wind. This will facilitate heating of the tent, as well as reduce the likelihood of the tent being blown down.

3. Once the tent has been unfolded and positioned where it is to be set up, it should be rotated so that the main door is positioned at an angle of 45° away from downwind. Prevailing wind directions may be determined by examining the drift patterns of snow in the immediate area. In areas having variable winds, a windbreak may be constructed to shelter the main entrance. The main entrance is the tent door located closest to the stove pipe opening in the roof of the tent.

4. Ensure that both entrances to the tent and liners are zippered shut. If the tent zipper is unserviceable, use the metal clip and D-ring, located at the bottom edge of the door to hold the door shut while the tent is erected. If the tent is erected while the doors are open, you may not be able to zip the doors shut once all the tent lines are tightened.

5. Fully extend the corner eave lines. The corner eave lines are located on opposite sides of the tent, where the roof meets the walls and the walls form corners. Altogether there are three pairs of the corner eave lines.

6. Once these lines are extended, two soldiers will ensure that their corner eave lines are inline with the corresponding seams of the tent, and that the eave line in one soldiers hand forms a straight line from him through the apex of the tent to the hand of the soldier holding the opposite corner eave line. These two soldiers will then mark spots on the ground approximately six feet, (two steps), from the wall of the tent. This is where the corner eave lines will be anchored.

7. Two soldiers drive tent pins where directed by the soldiers holding the tent lines. Ensure the tent pins lean slightly away from the tent, this will prevent the lines from slipping off the pins and/or pulling the pin out of the ground. Leave the tent lines slack for erecting the tent.

8. One soldier, “pole man”, crawls under the tent with the center pole extended to a length between 6 and 8 feet and locked and with the center pole board if necessary. The stud at the top of the center pole is placed through the hole in the perforated metal plate at the roof apex.

9. While holding the pole vertically, the pole man places the baseplate on the tent floor surface, snow or dirt, directly under the pole, and places the bottom end of the pole in the baseplate center hole. The baseplate prevents the pole from penetrating the surface.

NOTE: Although the tent floor surface may be frozen upon tent assembly, after a period of time with the heater fired, the surface will thaw and the pole may sink without the baseplate

10. As the pole man maintains the vertical positions of center pole, the eave lines are tightened by pulling opposite lines simultaneously, by two soldiers. Continue tightening the remaining eave lines. The pole man can exit the tent after all the eave lines are tightened.

11. The six corner lines are located on the seams between the corner eave lines and the tent roof apex, These lines can be attached to the tent pins securing the corner eave lines. If not, place the additional pins at least 1½ ft. further from the tent. Ensure that the corner eave line and the corner line at each corner are aligned with their corresponding seams. (See Figure 3-1)

12. Anchor and tighten the four eave lines, located between the corner eave lines.

13. Anchor the two door eave lines. For each door, drive a tent pin in the surface approximately six feet from the tent. Hold the door pole vertically about three feet from the tent door, between the driven pin and the door eave line. With the door eave line, position a clove hitch about eye-level on the door pole and secure and then tighten the end of the line to the pin. The door pole raises the effective door height to about five feet, allowing more clearance for entering and exiting the tent.

14. Pins do not hold well in snow, and may be difficult or impossible to drive into frozen or rocky ground. In wooded areas, tent ropes may be rapidly and securely anchored by attaching lines to trees, branches, logs, or stumps whenever possible. If natural anchors such as trees are unavailable and difficulty is encountered driving tent pins, suitable anchors may be established in snow using "deadman" anchors.

a. A deadman anchor is simply any object with a large surface area which can be dug into the ground or snow with the long axis of the object perpendicular to the end of the tent line. The tent line is then attached to the center of the object, and the hole filled with the removed dirt or snow. The looser the material from the hole, the more surface area the object will require to be an effective anchor.

b. On rocky ground, tent lines may be tied off to large rocks, or weighted down with piles of stones. Occasionally, tents may be pitched on ice. Ice pitons or screws may be used in place of tent pins. If ice pitons or screws are unavailable, an anchor may be established by chopping a small hole into or through the ice, and placing a stick or pole into the hole.

c. The object placed in the hole may freeze in place permanently. To prevent damage to the tent lines, attach a separate rope or wire to the object in the ice hole and secure the tent line to this material. If you are unable to chop completely through the ice, water may be poured into the hole after the stick is placed into it, causing the object to freeze in position, creating a much more secure anchor.

d. The last step is to ensure that the snow cloth along the bottom of the tent wall is spread on the ground outside the tent. The snow cloth may be weighted down to prevent the wind from blowing through the tent, but, if this is done, insulating material must be used to prevent the snow cloth from freezing to the ground.

<u>CAUTION:</u> IF THE SNOW CLOTH IS SPREAD INSIDE THE TENT, IT MAY PREVENT PERSONNEL FROM ROLLING OUT IN THE EVENT OF A TENT FIRE.

IV. M1950 Yukon Stove

The M1950 Yukon stove is used to heat the ten man tent. The Yukon stove can burn both liquid and solid fuels, although operation with solid fuels requires some minor modification. The Yukon stove and component parts weigh approximately 33 pounds, (see Figure 3-2). Approved liquid fuels include leaded or unleaded gasoline, kerosene, light fuel oils, and JP-4; approved solid fuels are wood and coal.

A piece of plywood, slightly larger than the base of the stove and sheathed in tin or aluminum, should always be carried as part of the tent group equipment. This "stove board" provides a firm base for the stove to stand on, as well as reducing the fire hazard when the stove is operated in a tent where the floor is covered with grass, leaves, or other potentially combustible material.

When disassembled for transport, all of the components with the exception of the stove board will fit inside the stove body, reducing the space required to pack the stove in the ahkio.

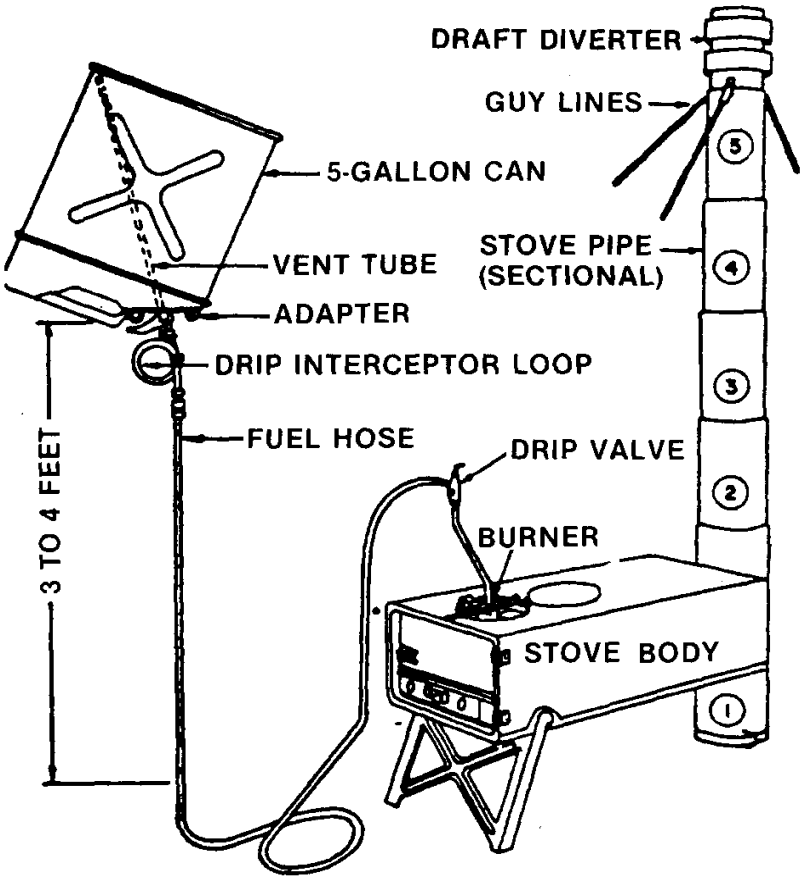


Fig. 3-2 Yukon Stove

A. Setting Up the M1950 Yukon Stove

1. Before setting up the stove, inspect the tent to ensure that no conditions exist which would make operation of the stove unsafe. Ensure that the stove pipe opening in the tent roof is serviceable, with no cracks or tears in the neoprene. Next, ensure that the stove pipe opening flaps are rolled and securely tied, and that each flap can be tied at both the top and the bottom.

<u>CAUTION:</u> THE LEADING CAUSE OF TENT FIRES ARE LOOSE STOVE PIPE OPENING FLAPS COMING INTO CONTACT WITH HOT STOVE PIPES

CAUTION: INSURE ALL FUEL SPILLAGE CONTROL MEASURES ARE IN PLACE BEFORE USING THIS STOVE.

2. Remove components from the stove body. The grate may be left inside the stove. Attach the largest section of stove pipe, (the base), to the rear of the stove. Ensure that all three lugs on the pipe engage the retainers on the stove body. Place the cap on the bottom end of the base section of the stove pipe, and fold down the legs on the stove body. Place the stove onto the stove board so that it is supported by both legs and the bottom of the stove pipe.

3. Place the stove board and stove on the ground inside the tent so that the stove door faces the main door of the tent and the stove pipe is positioned directly under the stove pipe opening in the roof of the tent. The stove board should be as level as possible.

4. Attach one end of the fuel line to the burner plate assembly, and the other to the fuel can adapter. Ensure that the drip valve is in the "off" position. Place the burner plate assembly into the stove body opening so that the lugs are on the outside of the stove body, and the retainers are on the inside. Secure the retainers with the wire loop.

CAUTION: ENSURE THE FUEL LINE IS ROUTED AWAY FROM THE STOVE BODY TO PREVENT IT FROM COMING IN CONTACT WITH THE STOVE BODY. THIS IS BEST DONE BY ROUTING THE FUEL LINE OVER THE DRYING LINE LOCATED ALONG THE EAVE OF THE TENT.

5. Ensure the burner plate is level. If necessary, reposition the stove board in order to level the burner plate. Close the draft gate in the front of the stove door.

6. Assemble the remaining four stove pipe sections and the draft diverter, ensuring that the seams on all pipes are aligned. Place the assembled stove pipe through the stove pipe opening in the tent, and connect it to the base section of the pipe, again ensuring that the seams on the stove pipes are aligned. Connect the three 15 foot guy lines on the draft diverter to the tent or tent ropes, so that the stove pipe is supported in a vertical position.

CAUTION: DO NOT CONNECT THE GUY LINES TO FIXED OBJECTS SUCH AS TREES OR ADDITIONAL TENT PINS. IF THE TENT IS MOVED BY WIND OR AS THE RESULT OF PERSONNEL BUMPING AGAINST IT, THE STOVE AND PIPES MUST BE FREE TO MOVE WITH IT. IF NOT, THE STOVE COULD COLLAPSE RESULTING IN A TENT FIRE.

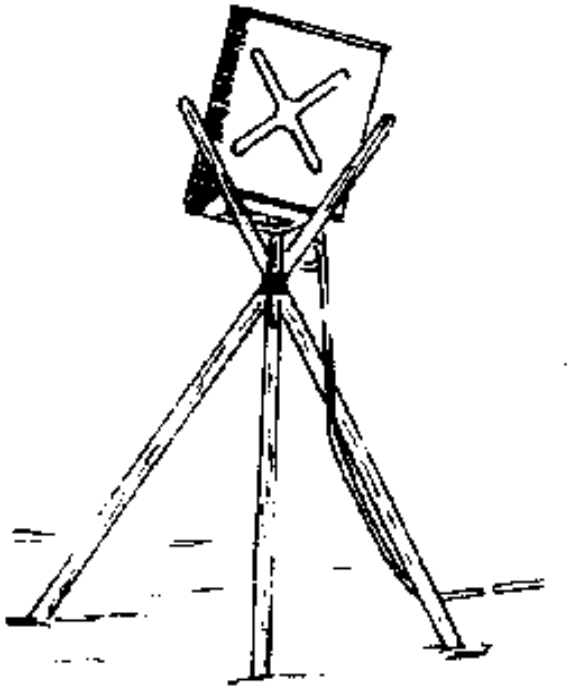


Fig. 3-3 Tripod With Fuel Can

7. Construct the fuel can tripod with three poles approximately 6.5 feet long. Tie these together about two-thirds of the length from the bottom, with nylon cord, rope, or wire. Place the tripod within the eave line distance from the tent, to the right of the main door. Place a HAZMAT pad, inside an opened plastic bag, under the tripod to catch any spilled fuel.

8. Place the vent tube into the fuel can adapter so that the cross air holes are opposite the adapter. Place the vent tube into the fuel can and tighten the adapter firmly on the can. Invert the fuel can and place it into the top of the tripod so that the fuel can adapter is the lowest part of the can, and ensure that a drip interceptor loop is placed into the fuel line within one foot of the fuel can. The lowest part of the fuel can must be between 1 and 5 feet above the drip valve. Finally, secure the fuel can to the tripod with rope, nylon cord, etc.

9. When setting up the Yukon stove for solid fuel operation, some modification is necessary. The burner plate assembly, fuel line, fuel can and adapter, and tripod are omitted. The stove body opening is closed with its' attached cover, and the grate (inside the stove body) is flipped upright, so that there is about an inch clearance between the grate and the bottom of the stove.

B. Operation (Liquid Fuels)

<u>CAUTION:</u> WHEN LIGHTING OR REFUELING THE STOVE, ALL PERSONNEL IN THE TENT MUST BE AWAKE AND PREPARED FOR EMERGENCY EXIT. A FIRE GUARD MUST BE STANDING BY WITH A FIRE EXTINGUISHER AT THE READY.

<u>CAUTION</u>: WHEN THE STOVE IS IN OPERATION, A FULLY DRESSED, ALERT FIRE GUARD MUST BE MONITORING THE STOVE AT ALL TIMES.

1. Ensure the draft gate at the bottom of the stove door is closed. Open the stove door. Open the drip valve enough to allow the burner plate to become saturated with fuel. Once the burner plate is

saturated, close the drip valve. Ensure that a fire guard, equipped with a fire extinguisher, is standing by inside the tent.

2. Light the burner, keeping your face and body away from the stove door. Observe the burner plate through the stove body opening. The flame should burn completely around the edge of the burner plate. If it does not, the burner plate is not level, and must be adjusted. Once the burner is lit, gently close and latch the stove door.

3. Once the stove door is latched, open the drip valve and adjust it for the desired fuel flow. The drip valve is used to regulate the temperature of the stove. Do not allow the stove to burn too hot (red hot). Allowing the stove to burn too hot not only presents a fire hazard, it can result in the stove body warping. This can make it difficult, if not impossible, to level the burner plate and to close and latch the stove door.

4. In the event that the stove goes out, or you decide to change the fuel can, immediately close the drip valve. Open the stove door, and allow the stove to vent any fumes, and the burner plate to cool.

CAUTION: THE BURNER PLATE MUST BE COOL ENOUGH TO TOUCH PRIOR TO RELIGHTING THE STOVE. IF THE STOVE IS LIT BEFORE THE BURNER PLATE HAS COOLED, THE FUEL WILL VAPORIZE PRIOR TO IGNITION, CAUSING AN EXPLOSION.

CAUTION: WHEN REFUELING OR RELIGHTING THE STOVE, ALL PERSONNEL IN THE TENT MUST BE AWAKE AND PREPARED FOR EMERGENCY EXIT. A FIRE GUARD MUST BE STANDING BY WITH A FIRE EXTINGUISHER AT THE READY.

5. Once the burner plate is cool enough to touch, visually inspect the inside of the stove. If any unburned fuel has accumulated inside the stove, mop it out with a HAZMAT pad or rags, and dispose of the fuel-soaked material outside the tent. Then, light the stove using the procedures described in paragraphs one through three of this section.

C. Operation (Solid Fuels)

1. Open the draft gate on the stove door, and ensure that it slides freely between the open and closed positions. Look inside the stove and verify that the grate is in the upright position. Place combustibles such as paper, dry twigs, leaves and grass on the grate, and place a small amount of solid fuel (wood or coal) on top of the combustibles. Do not use accelerants such as gasoline to assist in lighting the stove.

2. Light the stove. Once the fuel has caught fire, slowly add more wood or coal until you have a brightly burning bed of coals. Regulate the temperature of the stove by adjusting the draft gate. As with liquid fuels, do not allow the stove to overheat. Regularly monitor the amount of ash collecting in the bottom of the stove. Once ashes accumulate to the point they reach the bottom of the grate, they must be removed; failure to do so will result in the stove going out, because the accumulated ashes will cut off the air flow to the fire coming in through the draft gate.

3. If you must burn wood, the best fuel is dry spruce. If dry wood is unavailable, green birch will produce less smoke than most other types of green wood.

During daylight hours, burn wood taken from the tops of trees, as it gives off lighter smoke, and reduces the risk of the enemy locating your position. The smokier wood taken from lower on the tree can be burned at night. Remember to maintain track discipline, and to gather fuel from the designated area.

4. Again, it is the fire guards' responsibility to monitor the stove and to regulate the rate of burning to prevent overheating.

V. Squad Stove

The MSR "Whisperlite" stove is the most commonly used squad stove in the Army. Although primarily used for cooking, you may also use this small stove as a heat source when living in improvised shelters, or tents smaller than the ten man Arctic tent. This capability may increase your units' flexibility during operations in cold regions by decreasing your reliance on the heavy ahkio group.

As with any stove that burns fossil fuels, you must be wary of the possibility of carbon monoxide poisoning, especially when such stoves are used in small relatively airtight shelters such as snow caves or thermal shelters. Virtually all of your cooking and snow-melting tasks are accomplished using the squad stove, and one stove is adequate for the needs of from two to five soldiers. It is ideal for opening in forward or remote areas where heavy/bulky equipment could be an impediment. The squad stove is small, compact, light, and will operate on either leaded or unleaded gasoline or kerosene. (See Figure 3-5)

B. Operating Instructions

CAUTION: DO NOT LIGHT THIS STOVE IN AN ENCLOSED AREA.

CAUTION: INSURE ALL FUEL SPILLAGE CONTROL MEASURES ARE IN PLACE BEFORE USING THIS STOVE.

CAUTION: ALWAYS REFILL FUEL BOTTLES OUTSIDE OF THE TENT/SHELTER.

1. Assembly and usage

a. Insure fuel bottle has fuel but not above the "full line," approximately two inches from the top.

b. Insert pump assembly into fuel bottle and turn clockwise, while holding bottle, until tight

c. Unfold stove legs from the storage position; legs should be at equal angles from each other as in Figure 3-5

d. Insert fuel line from stove into pump assembly; fuel line will only seat completely to pump assembly if turned to correct position; fuel line insertion "stop" will seat completely if mounted correctly

e. Swing lock latch into position so the latch is centered on the fuel valve on the pump assembly

f. Stove and fuel bottle should appear as in Figure 3-5

g. Insure fuel valve is closed

h. Pump fuel bottle 5 to 15 strokes for a full bottle

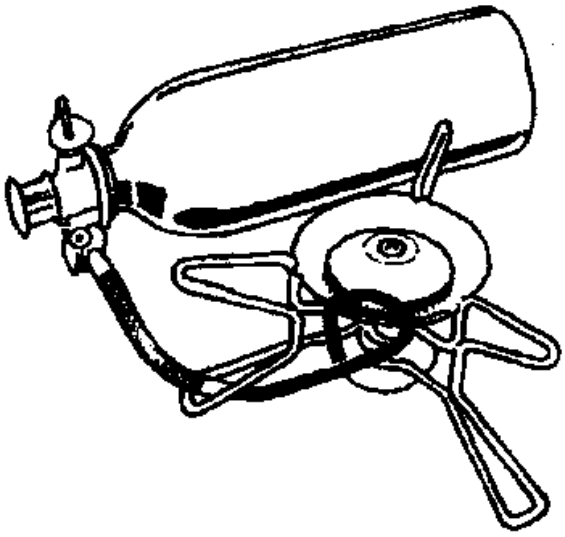


Fig. 3-4 Squad Stove

i. Open fuel valve long enough for fuel to soak the primer pan on the stove bottom and close fuel valve.

j. Carefully light the fuel in the primer pan; as this fuel burns the fuel in the generator tube snaking through the stove becomes atomized

k. Before the fuel in the primer pan stops burning, open the fuel valve slowly until the stove burner area produces a flame

l. When the burner flame becomes steady and settles to a bluish color, the stove is ready for use

2. Refueling, disassembly and storage

a. Close fuel valve and allow stove to cool

b. Invert stove and attached fuel bottle onto a Hazardous Material Absorbing Pad

c. Open fuel valve and allow pressure escape from bottle; a minimal amount of fuel will drain from the stove

CAUTION: IF STOVE HAS NOT COOLED SUFFICIENTLY, THE ESCAPING FUEL COULD IGNITE.

d. When all pressure has escaped, close fuel valve

e. Invert stove and bottle

f. Move safety latch from position over fuel valve

g. Carefully pull fuel line from pump assembly

h. Remove pump assembly from bottle by turning pump assembly counterclockwise while holding bottle

i. Refuel and replace pump assembly; if storing, place threaded cap in bottle and reconfigure stove and bottle in storage container(s).

VI. Other Items

A. There are a number of other items you should always carry in a cold environment. While the remainder of the items of the Ahkio group stores need not be described in detail, they, nonetheless are critical to your unit's success.

B. There will obviously be other types of equipment used dependent on the mission, however, those items listed in this section form the nucleus and will invariably be needed regardless of the task at hand.

C. Whenever a unit, regardless of size is training away from a camp location, the following equipment is to be carried among the group. This list should be a requirement, which is stringently enforced regardless of whether in a training, or combat environment. If this requirement is violated, your unit may pay the price with needless casualties.

Squad stove and fuel

Cook set (one per squad)

Map

Compass

Radio

Ski repair kit and ski wax (if skiing)

Emergency signaling device(s)- VS-17 panel, strobe light, pen flares, etc.

D. This list is a minimum requirement for the group, whether in a training or combat environment. Failure to carry these items may cause your unit to suffer needless casualties.

E. Miscellaneous Equipment

1. Sunglasses- The issued sunglasses should always be worn on bright days when the ground is covered by snow. Failure to wear sunglasses, even on overcast days when the need for them is less apparent, may result in snow blindness. A snow blind soldier is a liability to your unit. Ensure your soldiers have their sunglasses and require their wear!

2. Canteens- The plastic canteen will freeze very quickly in cold weather if it is carried in the standard fabric carrier. Since the canteen cannot be applied directly to a heat source there is no quick method for thawing it. Whenever possible the canteen should be carried in one of the interior uniform pockets, or wrapped in clothing and placed in the pack. During extreme cold, do not fill the canteen over two-thirds full; this will allow for expansion if ice should form.

F. Recommended Personal Items

Sunblock

Sunglasses

Chapstick

Small sharp knife

Sleeping bag with pad and poncho

Thermos bottle

A whistle with no moving parts

Small flashlight

Five meters of strong nylon cord

Candle

Emergency rations equal to 2500 calories

All weather, strike anywhere matches carried in a waterproof container.

Chapter 4

Rations and Diet

CONTENTS

PAGE

Introduction

The greater part of what we eat and drink goes towards maintaining our body heat, while only a small proportion is expended on producing energy for physical work; a larger intake of calories is therefore needed in a cold climate than is needed in temperate areas. A minimum of 4500 calories per day has been found necessary for personnel performing hard work in the cold, and efficiency is likely to fall off rapidly if this level of nutrition is not maintained. Under conditions of severe stress, soldiers may require as many as 6000 calories per day to maintain health and performance.

The body loses liquid at an exceptional rate in extreme cold conditions, up to 2 quarts of water per day by respiration alone. However carefully the amount of clothing and ventilation is adjusted, the heavy exertion of movement on foot, preparation of bivouacs and defenses in the snow, etc., exacts its toll in sweat and loss of moisture in the breath. These liquids must be regularly replaced, preferably by hot drinks that, if they contain sugar, have the additional advantage of providing extra calories.

I. Rations

A. Specialized cold weather rations have been devised to provide the 4,500 calories needed for the average soldier to live and fight effectively in the cold; they also have the correct proportion of carbohydrates, fat and proteins necessary for good health. The proper intake of all these essential items depends on the whole ration being eaten in properly spaced meals. The lethargy induced by the cold, combined with the difficulties and inconvenience of cooking, may sometimes tempt soldiers to "skimp on" or miss meals. The principles of sound leadership and discipline in cold weather require that meals be prepared and that the entire daily ration be eaten.

B. Soldiers involved in cold weather operations may be fed with two different types of individual combat rations. Leaders should be familiar with the characteristics of both of these rations:

1. MRE, (Meal, Ready-to-Eat): This 1200 calorie ration may freeze in low temperatures. Soldiers may carry the individual liquid-containing food items in their shirt pockets inside their field jackets, or inside the insulating layer(s) of the ECWCS.

<u>CAUTION:</u> MRE'S THAT HAVE BEEN THROUGH A FREEZE-THAW CYCLE MUST BE EATEN IMMEDIATELY OR DISCARDED.

If soldiers are going to eat MRE's during cold weather operations, commanders should consider issuing 4 meals per day or providing supplements to make up the calorie deficit that will occur if soldiers are only given three MRE's per day.

2. RCW (Ration, Cold Weather): This ration provides a minimum daily intake of 4,500 calories. Some of the items within the ration are very similar to commercial “snack food” and provide soldiers with an easy way to eat throughout the day, or when on the move. Unlike MRE's, RCW's are impervious to freeze-thaw cycles. **The RCW is the preferred ration for cold weather operations.**

II. Liquids

A. The point has already been made that the body loses an unexpectedly large amount of fluid in the cold, and that this fluid must be replaced; soldiers who become dehydrated are at increased risk of sustaining a cold weather injury. The daily requirement will vary from a minimum of 3½ to over 5 quarts of water a day in circumstances involving heavy exertion.

B. Water is always readily available, either from streams or lakes, or by melting snow or ice. A limiting factor may be the availability of fuel to melt the latter. To save time and fuel, water should be obtained from a running stream or from a lake whenever possible. The milky water of glacial streams

should be allowed to stand until coarser sediment settles. If a hole is cut in ice to get water it should be covered by a snow block, board, or poncho covered with snow, to prevent re-freezing. In very cold weather the hole should be broken open frequently. Any hole must be clearly marked so that it can be found again easily.

C. Leaders must insist that as much of the daily liquid requirement as possible should be taken in the form of hot drinks such as soup, cocoa, etc. Main meals should preferably begin with soup and between-meal snacks should be based on a hot drink with plenty of sugar. Caffeinated liquids such as coffee should be avoided as this is a diuretic.

D. If no water is available, ice or snow must be melted. Ice produces more water in less time than snow. When melting snow, a small amount should be put into the cooking pot initially. Once this snow has melted, more can be added to the resulting water. This process is continued until enough water has been produced.

Whatever the source of water, it should be purified by boiling it rapidly for three minutes, by filtering with an approved device, or by using water purification tablets.

E. Alcohol should never be consumed while on operations or by soldiers who are exposed to extreme cold. Its warming effects are illusory and are brought about by quick release of internal body heat to the skin surface. This temporary feeling of warmth is soon lost, leaving the soldier much colder than before.

III. Tips for the Leader

The following tips should help to insure that your soldiers are better prepared to meet the demands that cold-weather operations will place upon them:

A. Ensure your soldiers eat all their rations. Plan ahead to allow time for hot meals whenever possible. A hot meal is more satisfying than cold rations.

B. Save snacks (cookies, chocolate bars, etc.) for between meals and when on the march.

C. Before going to bed, ensure that your soldiers' canteens and the water cans are filled and enough water has been prepared for breakfast.

D. Teach your soldiers to drink plenty of liquids, preferably hot sweet drinks, such as cocoa.

E. When heating water use all available stoves, as this is a most time consuming operation. Melting and boiling sufficient snow for a beverage may take 30 to 40 minutes as unknown source water should be boiled for 3-5 minutes to eliminate any danger of water borne illness or disease.

F. When operating the Yukon or Squad stoves, a cook pot should always be used to melt ice for snow. Canteens and water cans should be kept as full as possible from this source. Never use tightly closed containers such as ammo cans.

G. Do not allow your soldiers to eat snow or ice as it may result in painful cracking of the lips as well as the danger of infection. Frostbite or hypothermia are possible results of eating snow. Snow contacting the lips and mouth can cause frostbite. The body's core temperature can be reduced to dangerous levels by eating snow.

H. Do not allow the consumption of alcoholic beverages.

I. Teach soldiers to "repack" canteens (wrap canteens in insulating material and place them inside the rucksack).

J. Teach soldiers to carry at least one water bottle or canteen close to body.

K. Remember that cold weather will probably make your tasks harder and they may take longer to do, but it does not make them impossible. It does, however, require your soldiers to spend more time in the cold, and in doing so they will expend a great deal of energy just staying warm. Proper nutrition and hydration, enforced by you, the leader, is a critical factor in your soldiers' ability to meet the intense physical and mental demands of the cold weather battlefield. Don't ever forget that before your troops can defeat the enemy, they must be able to deal with the environment.

Chapter 5

Medical Considerations

CONTENTS

PAGE

Introduction

Soldiers operating in cold weather environments can be exposed to a variety of illnesses and injuries. The majority of these can be easily prevented with only a basic understanding of each affliction and by following a few simple preventive measures.

I. Dehydration

Dehydration is the loss of body fluids to the point that it prevents or slows normal body functions. Dehydration precedes most cold weather injuries and is a significant factor in high altitude illnesses. It contributes to poor performance in physical activities, even more so than lack of food. Requirements for water in a cold environment are no different than in the desert and can be even higher as a result of the extra effort required to move in heavy clothing. During periods of extreme cold, and at high altitudes, the air is very dry and as much as two quarts of fluid can be lost per day due to respiration alone.

Humans need approximately 3½ to 5 quarts of water a day to prevent dehydration when living in and performing physical labor in a cold environment. Alcohol and caffeine products, (diuretics), should be avoided as they are detrimental to fluid retention and alcohol impairs judgment.

A. Contributing Factors

The thirst mechanism does not function properly in cold conditions; water is inconvenient to obtain and purify; there is a lack of moisture in the air in cold climates and at high altitudes. Cold causes more frequent urination.

B. Signs and Symptoms

Darkening of urine
Decreased amounts of urine output
Dry mouth
Fatigue
Mental sluggishness
Lack of appetite
Rapid heartbeat
Dizziness
Unconsciousness

C. Prevention and Treatment

The easiest and best way to prevent dehydration is by consuming from 3.5 to 5 quarts of fluids per day. Avoid caffeine and alcohol, which may contribute to dehydration; they are diuretics. In advanced cases, administer fluids both by mouth, if the individual is conscious, and intravenously. If the condition has not improved within an hour or the patient is unconscious, evacuate to a medical facility.

II. Hypothermia

Hypothermia is the lowering of the body core temperature at rate faster than the body can produce heat. Hypothermia can arise slowly through general exposure to the elements or rapidly by immersion into cold water or being exposed to rapid cooling caused by inadequate, wet, clothing combined with wind and cold.

A. Contributing Factors

Dehydration, poor nutrition, decreased physical activity, accidental immersion in water, high winds, inadequate amounts or types of clothing, and excessive sweating causing clothes to become wet can all result in hypothermia.

B. Signs and Symptoms

1. Begins when the body core temperature, (rectally measured), falls to approximately 96°F.

2. Shivering may be uncontrollable and may interfere with the individual's ability to care for his or her self.

3. Core temperature of 95° to 90°F. results in sluggish thinking; irrational thought and a false sense of warmth may occur, (frequently, victims are found naked and dead within reach of adequate clothing, food, and shelter). Once the victim experiences a false sense of warmth, shivering will stop.

4. Core temperature from 90°F to 86°F results in muscle rigidity, unconsciousness, and barely detectable signs of life.

C. Prevention and Treatment

Prevent by using the buddy system to observe each other for signs. Consume adequate amounts of liquid daily and eat well. If you come upon someone exhibiting signs of hypothermia and they are conscious, prevent further heat loss by adding dry clothing, shelter or heat. You can provide heat by placing a second person into a sleeping bag with the victim. Re-hydrate with liquids not warmer than tepid, and refuel with food if possible.

If the individual is unconscious or appears dead without any signs of obvious injury, prevent further heat loss, and handle extremely gently. If a medical facility is only a short distance away, treat the casualty as you would a cervical/spine injury, and transport immediately. If a medical facility is more than an hour away, the individual should be re-warmed carefully.

If not breathing, or if there is no detectable heartbeat, CPR should be started along with re-warming. Keep in mind that all bodily systems in hypothermic patients are fragile, and the casualty should be treated as gently as possible. As these attempts are being made, evacuation should be attempted simultaneously, as severe complications may arise as the body temperature rises, POSSIBLY RESULTING IN CARDIAC ARREST**, even though the casualty appears to be doing well. Remember, when it comes to hypothermia, the patient isn't dead until warm and dead!**

Re-warming methods include hot water bottles insulated inside socks or mittens and placed underneath armpits and groin, or body to body contact inside a sleeping bag or other dry insulator.

III. Immersion Foot (Trench Foot)

Trench foot is damage to the circulation and nervous systems of the feet incurred by prolonged exposure to cold and wet at above freezing temperatures. This can occur inside vapor barrier boots, and a soldier may not feel any discomfort until after the damage is done.

A. Contributing Factors

Stepping into water over the boot tops, wearing wet socks, and inattention or lack of planning.

B. Signs and Symptoms

A "pins and needles" sensation, or tingling and numbness, followed by pain. The skin will initially appear wet, soggy, white and shriveled. As it progresses and the damage appears, the skin will take on a red and then a bluish or black discoloration. The skin may crack, leaving the feet open to infection. In severe cases, gangrene may ensue.

C. Prevention and Treatment

Prevent by keeping feet dry and clean; do this by changing socks frequently, drying the insides of the boots, and using foot powder. If affected, usually allowing the feet to dry for 24 hours will heal mild cases. If severe or unable to dry the feet, evacuate as a litter patient. Do not allow the patient to walk if at all avoidable.

IV. Frostbite

Frostbite is a freezing injury to living tissues, which damages all of the cell structures involved. Upon hospitalization, frostbite is categorized in the same manner as burns. Under field conditions soldiers should only attempt to establish which of two categories a frostbite injury falls into:

1. **Superficial- involves only the skin surface and occasionally the next layer.**

2. **Deep- extends beyond the initial layers and may include the bone.**

A. Contributing Factors

Dehydration, below freezing temperatures, skin contact with supercooled materials/liquids, consumption of alcohol or caffeinated liquids, tobacco use, or just plain neglect all contribute to frostbite.

B. Signs and Symptoms

These vary with the severity of the injury and may include a biting cold feeling, pain, burning, numbness, or in the final stages a false sense of warmth. The skin first turns red and then pale. It may become bluish or purple in color and then may appear waxy white. The skin may feel stiff or wooden to the touch and may not be movable over the joints or bony prominences frozen solid. Although superficial frostbite is often easily identifiable, identification of various degrees of deep frostbite is only done two to seven days after re-warming in a medical facility and by qualified medical personnel.

1. Superficial frostbite signs

a. Redness in affected area

b. A frosty white or waxy patch of skin. In soldiers with dark complexions, the skin may appear grayish.

c. Stiffness of the skin in the affected area. The underlying tissue will still be soft, but a dent may remain in the affected area if it is pressed upon

2. Deep frostbite signs

a. Skin and underlying tissue may be wooden to the touch

b. Joints may be stiff or immovable

c. Skin may turn blue or purple due to blood "sludging" in the affected area

d. A distinctly visible line may appear marking the boundary between the affected area and surrounding tissue

C. Prevention and Treatment

Early signs of frostbite may be treated by re-warming with skin to skin contact between buddies, or by sheltering the part underneath insulating layers of clothing next to your own skin. This must be done immediately to be of any help. If the tissue is frozen, or if there is any doubt as to whether the injury is superficial or deep, evacuate without allowing the part to thaw. If the feet are involved, evacuate as litter patient. Do not rub the affected area, and never rub it with snow. Once thawed, protect from refreezing.

If there is any possibility that a patient with frostbitten feet will have to walk during the evacuation process, do not the patient's feet to thaw until the evacuation is complete. If frostbite isn't recognized before it thaws, it must not be allowed to refreeze as this causes three to four times as much damage and may convert a relatively minor injury into one that may result in major tissue loss or amputation.

NOTE: The most frequently affected body parts are the fingers, hands, ears, toes, and feet.

V. Constipation

Constipation is the infrequent or difficult passage of stool caused by a lack of fluids, improper nutrition, or not heeding nature's call.

A. Contributing Factors

Unavailability of water, dehydration, no protected sites from the elements for defecation, or not eating properly are all contributing factors.

B. Signs and Symptoms

Loss of appetite, headache, abdominal cramping, painful defecation/inability to defecate or hard stool.

C. Prevention and Treatment

Consume adequate amounts and varieties of food, drink 3.5 to 5 quarts of fluid a day, heed nature's call. If allowed to exceed beyond self-care stages, seek medical care.

VI. Carbon Monoxide Poisoning

A. Contributing Factors

Burning fossil fuels without proper ventilation such as stoves, heaters, gasoline engines

B. Signs and Symptoms

Signs appear slowly and often go unnoticed as carbon monoxide is a colorless, odorless, tasteless gas. Many of the signs are similar to other common illnesses- headache, tiredness, excessive yawning, and confusion, followed by unconsciousness and death. The one characteristically visible sign is a cherry-red coloring of the tissues of the lips, mouth, and inside eyelids. This symptom is indicative of the extreme stages of CO poisoning; by the time a victim looks like this, it is often too late to help.

C. Prevention and Treatment

Remove the casualty from the source of contamination, administer CPR if necessary, administer oxygen if available, and evacuate to a medical facility as

severe complications may develop even in casualties who may have appeared to recover perfectly.

Following two simple rules can prevent most deaths of this type: don't sleep in a running vehicle and don't cook with an open flame inside an unventilated tent. (Meals can be prepared inside the Ten Man Arctic Tent or the vestibule of a smaller tent with adequate ventilation.)

VII. Snowblindness

Snowblindness is the burning of the cornea of the eye as a result of overexposure to ultraviolet radiation.

A. Contributing Factors

Reflections of sunlight from all directions off of snow, ice, or water. Cloudy days lull people into believing that the sun isn't getting through although the ultraviolet radiation is.

B. Signs and Symptoms

Painful, red, watery eyes, a gritty feeling, blurred vision, and there may be a pink cast to the vision.

C. Prevention and Treatment

Snowblindness may be prevented by using quality sunglasses, even on cloudy days, on snow covered terrain. Improvise by making a pair of "slit" glasses from cardboard or birch bark.

Treat by removing from sunlight, patching affected eyes, for 24 hours and administering aspirin or Tylenol, two every six hours, or as required for pain. If still painful after this treatment, keep patched and evacuate as a litter patient.

VIII. Sunburn

Sunburn is the burning of exposed skin surface by ultraviolet radiation.

A. Contributing Factors

Exposure of unprotected skin to solar radiation. Personnel with fair skin/light colored hair are more susceptible, although sunburn can happen to people with any shade of skin.

B. Signs and Symptoms

Pain, burning sensation, redness or blistering of affected area

C. Prevention and Treatment

Wear clothing that provides maximum skin coverage, avoid wearing sunglasses with mirror lenses, utilize sunblock/sunscreen. Treat as you would any other burn.

IX. High Altitude Illnesses

High altitude illnesses occur primarily at elevations above 8000 feet, due to the reduced partial pressure of oxygen found at higher elevations. The effects are due primarily to unavailability of oxygen at normal concentrations. Even when fully acclimatized man is still only able to perform at a decreased percentage of his maximum sea level capacity. Additionally, all

personnel are affected in their ability to reason and comprehend at times. Dehydration is a major contributor to altitude illnesses

A. Acute Mountain Sickness (AMS)

AMS is a condition experienced by unacclimated persons after arrival at altitudes above 8000 feet, and characterized by an uncaring attitude, headache, insomnia, upset stomach, and depression. This can last up to 2 to 3 days and progressively gets better with a subsequent total resolution of symptoms. Maintaining good hydration along with good nutrition, recognizing your physical limitations and progressing slowly usually prevents a severe course.

B. High Altitude Pulmonary Edema (HAPE)

HAPE consists of a filling of the lungs with fluid at high altitudes. This results in limiting the availability of oxygen for the body.

1. Signs and Symptoms

Progressive shortness of breath, rapid heartbeat, coughing and as condition worsens, a productive cough. When compared to others a HAPE victim may appear to not be "keeping up with the group"; may experience a rapid respiration and heart rate which aren't reduced by rest; as fluid develops in the lung tissue rales are heard during breathing. Rales are a crackling cellophane type noise normally heard only with a stethoscope.

2. Prevention and Treatment

Prevent by practicing good hydration and nutrition and slow ascents to altitude. A typical climb could be 1000 feet per day and a rest day for every 3000 feet of elevation gained. Immediate recognition is vital and immediate descent is mandatory. A descent of 1000 feet could make the difference between a cure and the need rapid for evacuation. Never delay manual descent while waiting for air evacuation.

C. High Altitude Cerebral Edema (HACE)

HACE is the accumulation of fluid in and swelling of the brain resulting in decreasing brain function that may result in death.

1. Signs and Symptoms

Mild personality changes, inability to concentrate, increasing headache, vomiting, decreased urine output and a lack coordination similar to that of drunkenness. These may be combined with symptoms of HAPE. Hallucinations may be present, frequently a patient is left alone thinking he is just having a bad day or personality problems. The conditions of this illness can progress rapidly to death and none should ever be ignored.

2. Prevention and Treatment

Prevent by practicing good hydration and nutrition and slow ascents into elevations. A typical climb could be 1000 feet per day and a rest day for every 3000 feet. Immediate recognition is vital and immediate descent is mandatory. A descent of 1000 feet could make the difference between curative and the need for evacuation. Never delay manual descent while waiting for air evacuation.

X. Foot Care

A. Toenails should be trimmed straight across leaving a ninety-degree angle on the sides. This provides an arch so the corners can't dig into the skin below.

B. Blisters are prevented by proper fitting of footwear. When a "hot spot" first develops, place a generous amount of tape over the hot area and extend well beyond any area the tape might irritate. Benzoin Tincture may help the tape adhere to the skin and will also toughen the skin. Once a blister has formed, a doughnut shape should be cut from moleskin large enough to encircle the blister and placed around the blister and taped for added insurance. Never pop and drain blisters unless surrounded by redness or draining purulent material indicating infection. If this is the case, the blister should be cut off after cleansing with soap and water and covered with a clean dry dressing.

XI. Water Purification

A. All water found in nature should be purified to make it fit for consumption. This may be done by boiling the water for three to five minutes, which will kill all bacterial or viral contaminants normally found.

B. Chemical purification may be accomplished with iodine tablets or Calcium Hypochlorite; in extremely cold water, contact may need to be increased to approximately 15 minutes and dosages doubled even though water may appear to be clean.

C. A commercially available mechanical purifier may be used also. These work by manually pumping the water directly from the source with the purifier. A series of filtering systems are inside the pump housing. The manufacturer's literature will specify pumping times and life-span of the filter(s).

D. Giardiasis

1. Better known as giardia, is caused by a waterborne protozoan in cyst form. It originates from an infected animal host's feces. Giardia has a long incubation period, from one to three weeks after the organism is ingested. Prevention is by proper purification of drinking water.

2. Symptoms: Symptoms include watery explosive diarrhea, cramps, flatus, and vomiting.

3. Treatment: There are medications for giardia but laboratory diagnosis is necessary.

XII. Personal Hygiene

Personal Hygiene is difficult at best and water made from snow or ice is precious. It should be consumed, not bathed in. Snow may be used as toilet paper and in fact is much cleaner once the initial discomfort is overcome.

Shaving, if required, should be done at night in the shelter so that oils stripped in shaving will be replenished overnight and be available during the day when the skin is again exposed to the elements.

Teeth should be brushed daily as a minimum. If a toothbrush is not available, a twig chewed up on the end or salt on a fingertip may be used.

Underwear should be changed twice weekly at a minimum and socks changed at least once a day or as often as needed to keep the feet dry.

XIII. Heat Injuries

All too often heat injuries are forgotten in a cold weather or mountain environment, but they are as likely to strike as cold injuries due to the natural tendency of soldiers to overdress in the cold. Indeed, heat injuries may be more likely in a cold environment due the difficulties encountered in maintaining proper hydration. Leaders should allow extra time for clothing adjustments and proper hydration.

Soldiers should never enter a cold weather environment without the ability to produce water by melting snow or ice, thereby maintaining proper hydration levels. Leaders should remember that reliance on logistic assets for water resupply vastly increases the requirements placed upon these assets, while simultaneously decreasing their ability to carry other classes of supplies.

XIV. Tips for Leaders

Use the buddy system. Leaders should assign cold weather buddies to check each other occasionally during the period spent in the cold environment. No soldier should be without a cold weather buddy. Fingers, hands, and feet can be checked by touch and facial features and the ears can be looked at closely as well as rewarmed by the cold weather buddy.

Mark “prior cold weather injury” personnel. Personnel with prior cold weather injuries are more susceptible to additional injury to the affected area/limb. Use a colored tape marking system for outer garments and head gear.

Keep IV fluids warm. These fluids can freeze easily and if administered while the liquid is cold can be hazardous to the patient. Normally IV fluids are carried in the aid bag, that is usually carried in a manner which doesn’t protect it from ambient temperatures. These can be carried between the inner and intermediate clothing layers to maintain a usable temperature. These fluids should be protected during transport, storage, and delivery.

Chapter 6

Living in the Cold

CONTENTS

PAGE

Introduction

This chapter discusses various factors which leaders should take into consideration when establishing, occupying, and striking bivouac sites, as well as information concerning construction of improvised shelters.

The four essential requirements for survival in a cold weather environment are warmth, food, water, and shelter. Shelter is of particular importance because, without it, it is extremely difficult to provide yourself and your soldiers with the remaining three requirements, especially during inclement weather. Tents can be erected quickly with proper training and adequate practice. However, in the confusion of combat, soldiers may become separated from their equipment or their tents may be destroyed or lost. In such circumstances, available materials must be utilized to construct shelters. Unless your soldiers have mastered the techniques of expedient shelter construction, they may be unable to survive in the cold weather environment, let alone accomplish their mission.

I. Bivouac Sites

Bivouac sites, other than those of a relatively permanent nature found in base areas, are tactical in nature, and are designed to provide living accommodations within a defended position. A tactical bivouac should seldom be occupied for more than one night, unless it is being established in conjunction with a deliberate defense. Bivouac sites are normally established at or after last light, should require the minimal amount of preparation possible, and must be organized to allow for rapid and coordinated responses to enemy action.

The layout and placement of tents and shelters must be determined carefully, keeping security in mind. When you establish a tactical bivouac site your primary planning considerations must be:

A. All-around defense of the bivouac

B. Mutual support between shelters/positions

C. Concealment of the site

II. Site Selection

Some types of terrain offer better bivouac sites than others; if the mission and tactical situation permit you to do so, try to choose a bivouac location while keeping the following factors in mind.

A. Forested Areas

Forests, especially those where the vegetation is spruce or pine, provide excellent bivouac sites. Material for camouflage, firewood, and construction of both shelters and fighting positions is abundant. Spruce and pine forests are preferable for a variety of reasons, one being that these types of trees generally grow on well-drained soil. Another reason is that, because they retain their leaves or needles year-round, they offer better concealment as well as protection from wind and inclement weather than do deciduous trees, which lose their leaves during the winter months.

B. Marshy Ground

Firmly frozen swampy areas, especially those that are covered with trees and brush, may also offer a good location to establish a bivouac site. Streams and rivers which are located nearby, and which are covered with ice thick enough, may offer excellent routes for resupply, as well as both mounted and dismounted movement. However, it is generally difficult to construct dug-in fighting positions; you may be forced to construct above-ground positions in these areas, using available materials. In addition, leaders should remember that a sudden thaw may leave them and their soldiers wallowing in a pool of mud.

Finally, areas lying in the bottom of deep valleys should be avoided, due to the tendency of masses of cold air settling in low ground (also known as a temperature inversion). During windless conditions, temperature inversions may result in a low-lying bivouac site becoming enveloped in a cloud of ice fog, which could reveal the location of the site to enemy observers, especially if they are located on a higher vantage point than the bivouac site.

C. Open Country

Open country should be avoided for bivouac purposes whenever possible, because it provides poor concealment, as well as exposure to high winds and drifting snow. If you must establish a bivouac in open areas, tents should be pitched (or shelters constructed) in the lee of natural windbreaks such as depressions or the downwind side of ridges and hills. Where no natural windbreaks exist, tents should be dug into the snow as deeply as possible and/or loose snow or blocks of snow used to construct windbreaks.

D. Mountainous Terrain

Above the tree line, mountainous terrain will provide little shelter from either observation or the elements. During high winds, lee slopes may offer shelter, however, for the same reason that they offer shelter to you, they can increase your exposure to avalanche hazards; wind-driven snow is deposited on lee slopes, and if the slope is steep enough, that snow will eventually slide. In snow-covered mountains, or when snowfall is imminent, you must examine a slope's potential for avalanche prior to establishing a bivouac upon it. Refer to chapter 7 in this publication for more information concerning avalanche hazard identification.

E. Other Considerations

Regardless of the type of terrain in which you establish your bivouac, the following factors should always be considered:

1. Proximity of the enemy

2. Likelihood of enemy patrols

3. Air threat

4. Dominating features from which an attack could develop

5. Prevailing wind direction (the wind may carry sound to you or to the enemy, depending upon its direction; try to select a site which is downwind from suspected enemy positions/avenues of approach, especially when wind speeds are low)

6. Escape routes which facilitate rapid withdrawal

7. Availability of camouflage/construction material

8. Illumination/weather conditions (in good weather or bright moonlight, try to select a shadowed area such as a north-facing slope or the middle of a wooded area)

9. Thermal detection capabilities of enemy forces

III. Site Reconnaissance

Before occupying a bivouac site, it should be layed out by a reconnaissance or quartering party that precedes the main body. Tasks that must be accomplished prior to the arrival of the main body include:

A. Site the Bivouac

1. All of the factors that were mentioned earlier in this chapter should be taken into consideration when choosing the exact location of a bivouac. In addition, the establishment of a dummy bivouac site should be considered.

2. Dummy bivouac sites, when used, should be positioned between the actual bivouac site and the area that you determine to be the most likely enemy location, along the most likely avenue of approach. Ideally, the dummy bivouac position should be far enough away that your soldiers have adequate time to get into the appropriate defensive posture once the enemy is detected, and be outside of small-arms range of the actual bivouac site. When establishing a dummy site, make maximum use of mechanical ambushes and early warning devices, and, if possible, have it plotted as a target by your fire support assets.

B. Establish Security

Initially, security may be established, and maintained until arrival of the main body, by the use of LP/OP's along likely avenues of approach as well as by emplacement of early warning devices. The reconnaissance party is responsible for the security of the bivouac site until relieved by personnel from the main body.

C. Establish a Track Plan

1. Track plans (see figures 6-1, and 6-2) should be established before anyone enters the site. Normally, the incoming track will be extended well beyond the point where it enters the bivouac, and may lead to a dummy bivouac site (see above). Branching off from the incoming track, preferably at an acute angle to the direction of the enemy, is the bivouac site track, or "main street". This is the single track that enters the actual bivouac site perimeter. Minor tracks are established leading off of main street to sub-unit areas where tents are located. Both inner and outer perimeter tracks are also established.

2. Defensive positions are established along the outer edge of the inner perimeter track. The outer perimeter track should parallel the inner perimeter track outside of hand grenade range of the positions along the inner track. LP/OP's may be established along the outer edge of the outer track, and extensive use of early warning devices/mechanical ambushes should be made there as well.

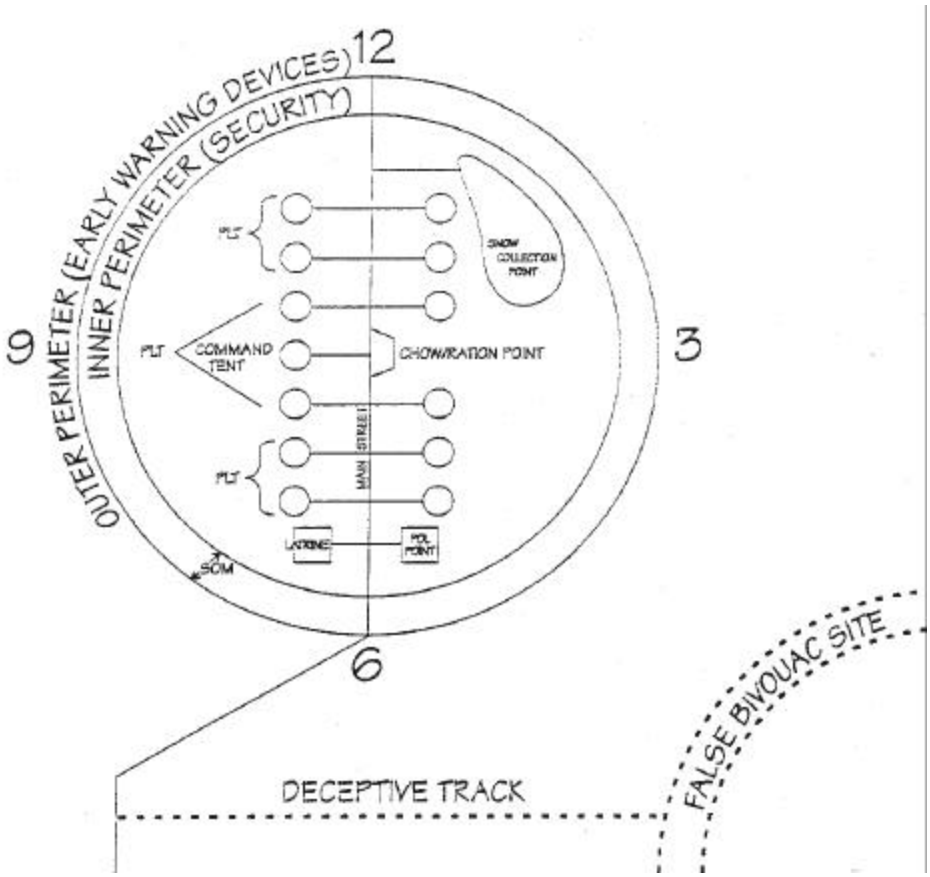


Figure 6-1 Company Bivouac Track Plan

D. Select Defensive Sectors

The reconnaissance party should designate the defensive sectors of responsibility for each sub-unit of the main body. The boundary between each sub-unit sector should be marked.

E. Mark Tent Sites

The location of each tent to be set up should be marked and a single trail established to that point. Sub-unit integrity should be maintained to the greatest extent possible, and sub-unit tent sites should be designated with regard to ease of access to that elements defensive sector.

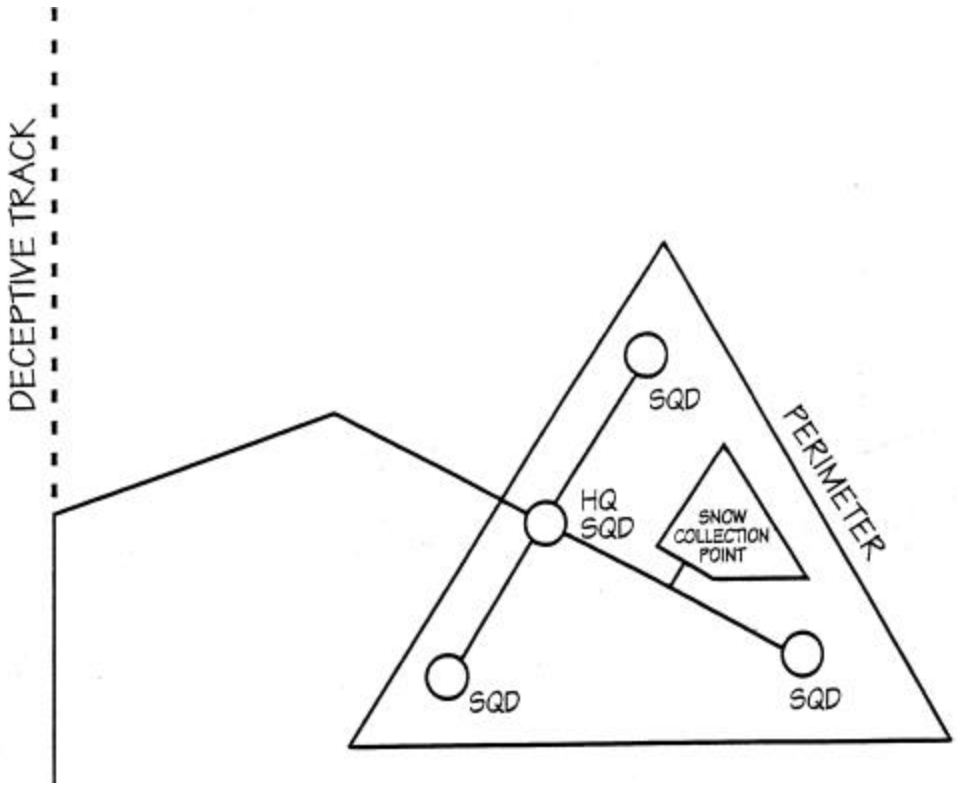


Figure 6-2 Platoon Bivouac Track Plan

F. Select areas for cutting brushwood/gathering snow. If brush or wood will be required for construction of shelters or fighting positions, an area should be designated for personnel to obtain this material. This area should be within the inner perimeter track, and cutting should be done in a manner that minimizes the chances of detection by enemy observation from either the ground or air. Areas for gathering snow (for water production) should be designated within the inner perimeter as well, but away from latrines, wood cutting areas, and POL storage points. Care must be taken to minimize the possibility that snow gathered from this area could be contaminated, which would render the snow unfit for producing potable water.

G. Provide Guides for the Main Body

Once the main body arrives, it is imperative that they be able to rapidly occupy the bivouac site without at the same time compromising the track plan, or noise/light discipline. Speed is essential because soldiers who have just completed a long oversnow movement are likely to be perspiring as well as tired. If they are left standing in the cold while their chain of command is trying to determine where they belong, the unit is at risk to suffer cold weather injuries.

IV. Occupation

After link-up between the guides and the main body, the guides (at least one for the commander and for each sub-unit) the guides should explain the site layout and track plan before actually leading their assigned element into the bivouac site.

A. Immediately upon arrival, the commander should confirm decisions made by the reconnaissance/quartering party and issue orders as follows:

1. Confirm/modify the track plan

2. Designate temporary location(s) for weapons/equipment under his direct control to prevent loss in the snow

3. Decide the type of fighting positions (built up vs. dug in) to be used, and site them

4. Confirm/modify tent locations

5. Confirm/modify brush cutting/snow gathering areas and latrine sites

6. Designate method of, and, if necessary, location for, garbage disposal

7. Decide type of improvised shelters to be constructed (if tents are not used). If there is a high probability of the enemy employing thermal detection devices/sights, improvised shelters such as thermal shelters or molded dome shelters (quingy huts) emit a much smaller thermal signature than heated tents or personnel sleeping in unheated tents (see figure 6-3)

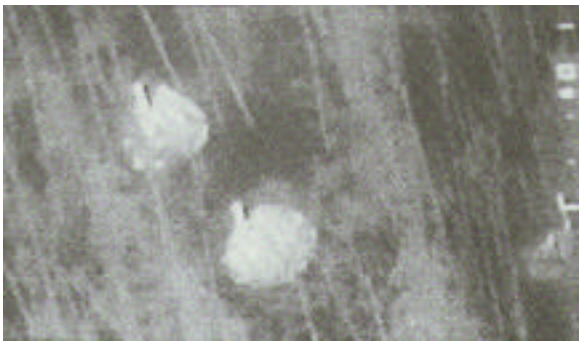


Fig. 6-3 Thermal Image of Two 10 Man Arctic Tents

8. Give orders for preparation/consumption of hot drinks and a hot meal. When this order is given is determined by the amount of progress made in preparation of defenses, as well as the need for shelter (based upon weather conditions)

B. As the main body moves into the bivouac site, care must be taken to ensure that track discipline (strict observance of the track plan) is enforced. In addition, noise and light discipline must be rigidly enforced. Although it is virtually impossible to occupy a site in total silence (especially when you have to pound tent pins or cut wood for positions and shelters) your soldiers should be trained well enough so that they do not need lanterns or flashlights to enable them to accomplish their tasks.

C. Once the main body has arrived, the security elements provided by the reconnaissance party should be relieved as quickly as possible. As temperatures decrease, the need for speed in conducting this relief becomes increasingly important. However, soldiers designated to relieve reconnaissance party security forces must be allowed to change out of clothing that may have become perspiration-soaked during the movement to the bivouac, and to adjust their clothing to ensure adequate protection while performing relatively sedentary duties in LP/OP's.

V. Security

In very cold conditions, sentries can only remain alert for relatively short periods of time. They cannot remain motionless or look into the wind for long, and their hearing is impaired by the additional headwear required in cold temperatures. Leaders must use their judgment on how long their soldiers can remain outside and be able to perform their duties at peak efficiency, and without increased risk of cold weather injury. The time a soldier can spend outside of a heated shelter performing relatively sedentary tasks will vary with the temperature, degree of wind chill, visibility, and the cold weather training and experience level of the soldier. The following are some techniques that may be used for maintaining security in cold

weather; if you decide to use one, ensure that you select the technique which best suits the tactical situation:

A. Combined living and fighting positions may be established on likely enemy avenues of approach. Tents or improvised shelters may be used. Ensure that warning systems are established and/or that these positions are far enough from the main bivouac site to give adequate warning of an attack to the occupants of the main site.

B. One complete sub-unit may be used to perform security duties at any given time; this will allow the remainder of the unit an extended period of time to rest in heated shelters.

C. Double the number of personnel on guard, to allow one soldier to act as a fire guard inside the shelter/tent while another performs sentry duty. After waking up his relief the fire guard leaves the tent to relieve the sentry, who then returns to the tent to rest and warm himself.

D. When establishing LP/OP's or emplacing mechanical ambushes/early warning devices, always approach the location you have selected from a flank; do not leave a trail in the snow that points the enemy directly toward or leads them straight into the bivouac site.

E. Keep lanterns inside tents turned as low as possible; this will minimize loss of night vision for personnel inside the tent, as well as reduce the bivouac site signature created by light showing through tent openings.

F. Balance the need to provide heated shelter against the necessity to reduce the thermal signature of the bivouac site. Natural terrain features and snow constructions may be used to mask thermal signatures.

VI. Duties of Tent Group Leaders

The tent group leader, usually the squad leader or senior occupant of the tent, is responsible for ensuring that the tent group is properly set up, maintained, struck, and packed, as well as for everything that occurs inside his tent. While bivouacking, the leader must ensure that:

A. Sleeping space is properly allocated

B. Weapons and equipment are stored outside the tent in accordance with standard operating procedures

C. Track, camouflage, noise, and light discipline is strictly enforced

D. Guard/sentry rotations are established and disseminated, and guards/sentries know who their relief is and where that soldier sleeps

E. Blackout is maintained when personnel enter/exit the tent

F. The tent is de-iced/brushed off, and drifted snow removed regularly

G. Fire precautions are observed

H. Squad stoves and lanterns are re-fuelled outside

I. Weapons, equipment, stoves, and lanterns are regularly maintained

J. Personnel brush snow off clothing and equipment before entering the tent

K. Soldiers dry clothes at every opportunity

L. Water is made continuously and proper hydration is enforced

M. Each soldier receives adequate rations and all rations are consumed

N. Cooking utensils are clean

O. The highest standards of personnel hygiene and sanitation are maintained

P. Ensure lanterns are hung by a chain a minimum of 18 inches below the apex of the tent. If the lantern is closer to the tent it is a fire hazard.

VII. Organization Within a Tent

A. Tents are just large enough to provide adequate sleeping space for the occupants together with a small area for cooking, washing, and performing duty as fire guard. Orderly and disciplined arrangements are a necessity in such cramped circumstances. The following procedures are established to enhance the comfort, safety, and operational effectiveness of personnel required to live in tents. Many of these procedures are readily adaptable to life in improvised shelters as well.

B. The minimum required individual clothing, equipment, and rations is allowed inside the tent. Generally, your canteens, daily rations, insulated sleeping mat, sleeping bag, a small, sharp, knife and the clothing you will require if you leave the tent will be the only items you require. Of course, damp clothing and equipment may be brought inside where it can be hung up to dry, but once dry these items should be placed in your rucksack outside the tent. Prior to every stand-to, all items should be packed into the rucksack so that you will have the essential equipment to survive with you (except the tent group) if your unit is forced to execute a rapid withdrawal under pressure.

C. All personnel living in a heated tent should have a knife immediately available at all times, and especially while sleeping. If, despite precautions, a tent fire occurs it may take as little as ten seconds for fire to completely engulf a tent, and less than a minute to destroy it. If personnel are asleep, with the zipper of their sleeping bag closed, they may not have enough time to unzip the bag. If they cannot do this, because of lack of time or a jammed zipper, they must attempt to roll out from under the wall of the tent while still in their sleeping bag. This may prove difficult, especially for someone just shocked into wakefulness, and still disoriented. A small, sharp, knife immediately at hand will give an individual the ability to cut his or her way out of the sleeping bag and through the wall of the tent. This single item of equipment may end up being the difference between life and death.

D. As stated earlier, the tent group leader is responsible for allocating personal space within the tent. When doing so, the leader should take into consideration the duty roster, as well as the need for an orderly exit in the event of an emergency.

E. Spare batteries for equipment such as NVG's or radios should be kept in the tent, although away from sources of direct heat such as stoves and lanterns, due to their diminished power output when allowed to become cold or frozen. Small battery-powered items such as flashlights or electric razors may be kept in the tent as well, and are ideally stored in the owners sleeping bag.

F. Weapons racks should be constructed outside the tent as close as possible to the main entrance. A poncho should be used to keep sights, barrels, and moving parts on weapons from becoming clogged with snow. Personnel should always remember exactly where on the rack their individual weapon is located, so that, if a situation arises which results in a mad rush to arms, they will be able to grab the correct weapon. The weapons rack is constructed in a manner identical to the cross-tree latrine, but without the wind break a latrine requires

G. Rucksacks should be lined up on the ground outside the main door of the tent where they will not interfere with personnel entering or exiting the tent. A specific order in which individuals in the tent must

line up their rucksack in relation to the others should be established to make it easy for soldiers to identify their gear during conditions of limited visibility. Other personal equipment such as LBV/LCE's and kevlar helmets/body armor may be draped over or placed into the rucksack.

H. In a cold-dry environment, it is not necessary to cover rucksacks and other gear (except weapons, ammunition, NVG's, and communications equipment) with a poncho; the temperature is too cold to allow the equipment to become wet. Simply brush off any snow before using the item. In a cold-wet environment, all weapons, ammunition, and personal equipment stored outside should be covered with a poncho or other type of waterproof cover.

I. A plastic trash bag filled with snow taken from the snow collection area should be kept inside the tent. One of the duties of the fireguard is to melt snow for drinking water, as well as to have hot drinks ready for personnel coming in from sentry duty. The five gallon water can, which the fireguard can use as a seat, should be kept inside the tent and topped off whenever it is less than full.

J. The amount of clothing worn by personnel while resting inside the tent will be dictated by the tactical situation, as well as whether or not the shelter is heated. For example, if there is an increased chance of enemy contact, you may decide that your soldiers should rest on top of their sleeping mat, fully dressed, with their outer garments unzipped. When a scenario such as this occurs, tent group leaders will need to ensure that the temperature of the stove is regulated so that it is warm enough to keep the soldiers comfortable, but not so warm that they begin to perspire.

K. When living in a close environment such as a tent or improvised shelter, the highest possible standards of sanitation and personal hygiene must be maintained. Failure to enforce or practice good sanitation and hygiene may expose you and
your soldiers to sickness and disease. As discussed in chapter nine the conditions that soldiers must live in during cold weather create an exceptionally good opportunity for biological attack. In addition, a soldier is more susceptible to becoming a cold weather casualty if he does not keep both himself and his clothing clean. Remember the "***C***" in the key word ***C-O-L-D***!

1. If necessary, personnel should shave in a heated shelter just before going to sleep. This will allow natural facial oils stripped off by shaving time to replenish themselves before the face is once again exposed to the cold. These facial oils provide natural protection against cold weather injury.

2. Soldiers should brush teeth daily. If a tooth-brush is unavailable, one may be improvised with the chewed end of a twig. If a twig is not available, salt on a fingertip may be used to gently scrub the teeth.

3. Underwear should be changed as often as is practical, but at least twice weekly.

4. Finally, socks should be changed as often as is necessary to keep the feet dry.

VIII. Heating at Night

A. The tactical situation, weather, and your soldiers' level of hydration must all be taken into account when determining whether or not to operate heaters throughout the night. The major disadvantages of heating your shelters all night long, other than increased fuel requirements, are the obvious thermal signature of a heated shelter in the middle of a cold environment and the necessity of an additional soldier losing sleep to perform duty as a fire guard.

B. Some advantages of keeping the stove burning are that soldiers will lose less body heat and conserve more energy while sleeping (with improved performance the following day). Also, troops can be more ready to react to a threat by sleeping fully clothed on top of their sleeping bag (or just their insulating pad).

C. Soldiers sleeping in heated shelters will have the opportunity to dry wet clothing by allowing it to hang in the tent while they sleep; they should not try to dry wet clothes in their sleeping bags while they rest.

D. Fire guards can use their guard shift to melt snow to provide potable water and hot drinks for sentries, as well as perform weapons maintenance, monitor communications, or conduct personal hygiene.

IX. Latrines

A. Normally, a central latrine should be established if dispersion within the bivouac site is not too great. One latrine will normally serve the needs of up to a platoon-sized unit. The following should be taken into consideration when establishing latrines:

B. The preferred type of latrine for field use is a straddle trench. However due to environmental restrictions during training, or to solidly frozen soil, it may not be permissible or possible to construct a latrine of this type. Another type of latrine that is recommended for use is the cross tree type latrine, especially when used in conjunction with a ration case lined with trash bags. Once filled, the bags can be sealed, closed into the case, and burned or hauled to the rear to be properly disposed of (see figure 6-4).

C. Latrines must be sited downwind from bivouac sites, but not so far from the shelters that soldiers are encouraged to violate sanitation discipline. They should also be downwind and well away from snow gathering areas within the bivouac site. They should be wind-proofed with branches, ponchos, snow blocks, or other available materials, and must be camouflaged.

D. Soldiers should urinate in a designated spot on the ground, and fresh snow should be used to cover this spot daily. The spot should not be covered after each use, because the color of the snow at this location will give leaders valuable feedback on whether or not their soldiers are properly hydrated. If the spot is bright yellow or a darker color, it's time to start melting more snow and forcing hydration.

X. Waste Disposal

A. Poor waste disposal practices, in addition to being violations of both environmental regulations and proper field sanitation procedures, can provide the enemy with a great deal of information which should be denied them. Follow these guidelines for proper waste disposal:

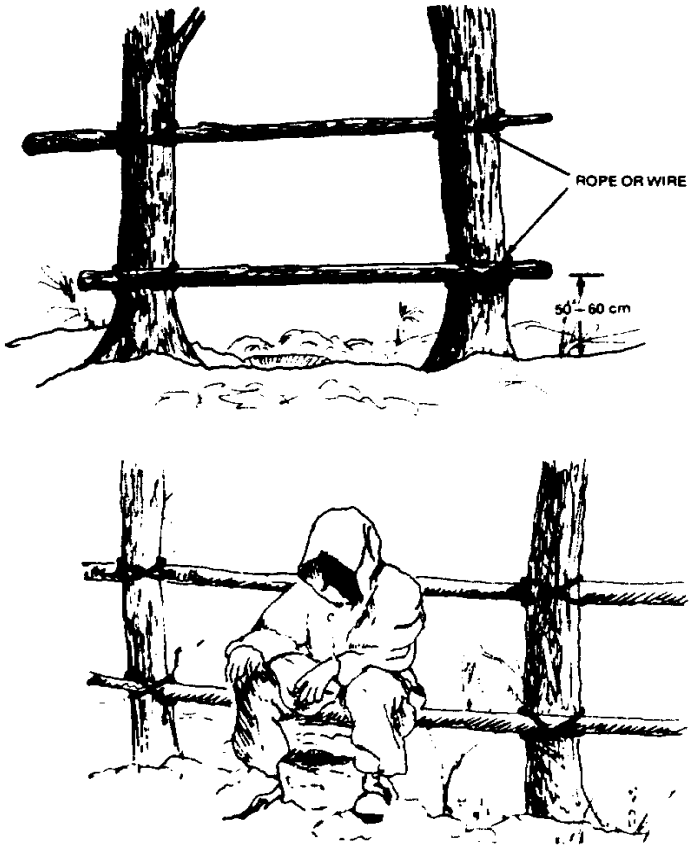


Figure 6-3 Cross Tree Type Latrine

1. When ever possible, dispose of all garbage in pits; burn or bury it prior to departing the bivouac site. There should be a pit for each platoon-sized element, and they should be located away from and downwind of snow gathering areas.

2. Patrols should never leave any evidence of their presence behind them; they should carry all waste with them until it can be properly disposed of to avoid providing the enemy with potential intelligence information.

3. During training, bag all trash and garbage and haul it to the rear for proper disposal.

XI. Breaking Camp

A. When a unit departs a bivouac site the commander determines what time the unit will begin movement. Using the backwards planning process, he or she will also determine "pull-pole" time as well. The time interval commanders allow their soldiers between "pull-pole" and departure must be kept as short as possible, and pulling poles should be done in the same order in which movement will be conducted. The bottom line is that you must prevent your soldiers from standing around in the cold unnecessarily.

B. In order to do this, every leader must know how long their troops require between the time the order to pull poles is given and the time they are ready to move. This length of time will be in inverse relation to the amount (and quality) of both the individual and collective training that you conduct to prepare for cold weather operations. A well trained squad should require 15 minutes, provided they have been given at least 30 minutes of advance warning to prepare all of their personal gear and all of the tent group equipment, except the tent itself, packed and ready to move. It is the tent group leader's responsibility to ensure that their tent is ready to strike at the designated time.

C. Before departing a bivouac site, all latrines and garbage pits should be covered with at least two feet of earth or packed snow. Finally, leaders must ensure that security precautions are not relaxed, nor track, camouflage, noise, or light discipline forgotten.

XII. Striking Tents

A. If a tent is slowly or improperly set up, only the occupants of that tent will suffer; however, if a squad is slow in striking their tent, more efficient squads will have to stand in the cold and wait for them. Therefore, ensuring that breaking camp and striking tents becomes a battle drill for your soldiers is extremely important. In order for your soldiers to be ready to strike the tent at "pull-pole" time, the following preparations must be made for the five-man (GP small) and ten man Arctic tents:

1. The tent group leader should warn the other tent occupants "pull pole in thirty minutes". At this time personnel begin to pack all of their personal gear. No later than fifteen minutes prior to "pull-pole" all rucksacks and personal gear should be placed outside the tent, far enough out of the way that it will not hinder soldiers striking the tent. This gear should be kept organized, to preclude the danger of losing items in the snow.

2. No later than fifteen minutes prior to "pull-pole", the stove is shut off to allow it to cool. All tent group equipment is removed from the tent and packed into the ahkio. As soon as the stove body is cool enough to touch, the stove is disassembled and packed. Care should be taken to keep stove components, especially the burner plate assembly, out of the snow; even if the stove is cool enough to touch, it is probably still warm enough to melt snow on contact. This melted snow will re-freeze, coating the stove component(s) with ice, making it difficult, if not impossible to set up/light at your next bivouac site.

3. The last two items out of the tent are the lantern and the fire extinguisher; as long as a flame-producing device is operating in the tent, the fire extinguisher must be present. Ensure that the lantern is off before removing it from the tent during periods of limited visibility.

4. Remove snow or other materials from the from the snow cloth if it was weighted down, and ensure that the tent has not become frozen to the ground. Unfasten both the corner and intermediate eave lines, roll them, and fasten them to the tent.

5. As each line is undone, its corresponding tent pin should be pulled from the ground and placed into the ahkio; failure to do so may result in their becoming lost in the snow.

6. By "pull-pole" time, all equipment except six tent pins, the center pole, and pole board (if used) should be packed into the ahkio. Only the corner eave lines should remain fastened to their anchors. Both the liner and tent doors should be zipped fully closed.

7. The tent is now ready to strike, and all members of the squad are in position to do so. The leader, assisted if necessary, is inside. At "pull-pole" time:

a. The leader gives the command "pull pole", and grasps the bottom of the center pole. He pulls the bottom of the center pole toward the door of the tent, lowering the tip of the pole toward the rear of the tent

b. The leader backs out under the door of the tent, bringing the pole and pole board with him. The center pole is then collapsed and placed into the ahkio, along with the pole board.

c. The remaining soldiers remove the corner eave lines from their anchors and fully extend them, ensuring that they are cleared of all knots. Any remaining tent pins are removed from the ground and placed into the ahkio.

d. The tent is spread out on the ground, and the soldiers grasp the tent by the skirt, with one soldier positioned where each corner eave line meets the tent. The group leader gives the command "shake out", and the soldiers holding the tent shake it vigorously to remove any remaining snow or ice.

e. The tent is carried off to one side of the spot where it was standing, a police call is conducted, and snow is shoveled back into the hole or bare spot to conceal it as much as possible. This will reduce your unit's signature.

f. The tent is elongated, and folded accordion-style. The six corner eave lines are "daisy chained" together, and placed on top of the tent. The tent is then folded in half lengthwise, with the "daisy-chain" folded inside.

g. The tent is folded into thirds, placed into the ahkio in a manner that will produce the lowest possible silhouette, and the ahkio cover laced closed. If the movement plan includes pulling ahkios, the traces and harnesses must be removed prior to the cover being laced shut.

XIII. Improvised Shelters

A. Improvised shelters, when properly constructed, can provide soldiers with living accommodations that, if not quite as comfortable as a tent, will protect them from the elements just as well as a tent can. Under certain circumstances, such as mountainous terrain above the tree line, improvised shelters may provide both more protection and comfort than a tent.

B. From a tactical point of view, certain types of improvised shelters produce virtually no thermal signature, even when a squad stove is being used to heat them. Although they are extensively discussed in other publications, brushwood bivouacs, such as lean-to's, will not be dealt with here. Typically, brushwood shelters will not hold heat and are thus an inappropriate choice in extreme cold weather, or in areas where the potential for extreme cold exists.

C. Each of the shelters described here is designed to retain heat; the source of which may be a stove, radiant energy from the ground, your own body, or any combination thereof.

D. Thermal Shelter

1. The thermal shelter is primarily designed as a one to two person shelter, however a larger shelter can be constructed to accommodate a small team or squad. In forested areas, a wooden framework is normally built and covered with a parachute, ponchos, or evergreen boughs, etc. This structure is then covered with about 8 to 10 inches of snow for insulation. (See Figure 6-6)

2. The key to both construction methods is to remove the snow from the ground surface, exposing the frozen soil which will then radiate thermal energy into the shelter. The doorway is best sealed by filling a trash bag or other large sack with loose snow and form-fitting it into the door opening. A rucksack or other bulky item can also be used.

3. The shelter actually becomes more efficient as the outside temperature decreases. Inside one of these shelters, temperatures of +5°F have been measured with an outside air temperature of -40°F. This was achieved solely by the shelters capacity to retain emitted thermal radiation; there was no additional heat provided by personnel, stoves, or candles. If a candle or stove is used in the shelter, the door must

be cracked open or a ventilation hole must be added during construction as when building a standard snow cave.

4. Aside from the obvious benefits gained during survival situations, the shelter can also be built to enhance forward fighting positions, LP/OPs, and other static positions away from the bivouac site. The shelter will increase soldier comfort and lengthen the time a team can remain at these perimeter positions. Because the conditions within the shelter are reasonably comfortable without the use of additional heat sources, use of thermal shelters in static positions may provide an excellent alternative to using heated shelters when detection by infrared and other thermal devices must be avoided.

E. Thermal Shelter Construction

1. Remove snow and ice exposing ground surface.

2. Construct framework from available materials. (Figure 6-4)

Fig 6-4 Thermal Shelter Framework

Fig. 6-5 Thermal Shelter with Covered Framework

3. Ensure front and sides of framework have enough slope to retain snow

4. Frame door opening large enough so a heavily clothed soldier will fit.

5. Door opening should be I or 2 ft. above ground to ease entry and exit.

6. Cover framework with parachute, evergreen boughs, or other suitable material,- ensure material extends I or 2 ft. beyond skirt of framework. (Figure 6-5)

7. Secure material at skirt with logs, rocks, snow, etc.

8. Cut a hole in material over door opening so material overlaps door frame.

9. Lash material to door frame for a secure fit.

10. Tie a 10- 12 in. diameter log or bundle of sticks above door frame to support snow load.

11. Cover entire framework with 8- 10 inches of snow. (Figure 6-6)

Fig. 6-6 Completed Thermal Shelter

12. Fill a trash bag or waterproof bag with snow and form-fit to plug door opening; a rucksack filled with extra clothing, etc., will also work fine.

CAUTION: REMEMBER TO ADD A COUPLE OF SMALL VENTILATION HOLES IF YOU ARE GOING TO BURN CANDLES, STOVES, ETC.

CAUTION: IT'S ALWAYS BEST TO LEAVE A SMALL CRACK IN THE DOOR OPENING TO ENSURE ADEQUATE VENTILATION EVEN IF STOVES OR CANDLES ARE NOT USED.

CAUTION: KEEP A SKI POLE OR SIMILAR OBJECT IN THE SHELTER TO PERIODICALLY CHECK AND CLEAR VENT HOLES.

CAUTION: EXTINGUISH ALL FLAMES PRIOR TO SLEEPING

F. Snow Caves

1. Snow caves are relatively easy to build provided there is enough snow of the proper quality available. Snow caves have many advantages:

a. More easily concealed than tents

b. Display almost no thermal signature

c. Easy to conceal

d. Because of the white reflective walls, are easily illuminated

e. Simple to build

f. Comfortable

g. Are very warm

2. Snow caves requires a large snow bank or drift, and it is important to choose this carefully and estimate the depth of the snow before starting work: examination of the ground behind the snow bank, protruding saplings, wind blown ridges, and exposed moss surfaces and rock are often a useful guide. For a 2 or 4 man cave a drift 10 feet wide and 7 feet deep is needed. Larger caves require proportionally

larger drifts. A snow cave can be built either by tunneling or by building it up with blocks. Here are a few principles to observe:

a. The top of the entrance should be lower than the sleeping bench. This will ensure that warm air is trapped around the occupants.

b. The ceiling should be arched and smooth to prevent dripping. Ceilings will melt back with age and the internal dimensions of the shelter will increase.

c. At least one snow shovel should be kept inside each snow shelter so you can dig out if the cave or entrance collapses. Another shovel should be kept outside the entrance.

d. Every snow shelter must have a permanently open ventilation hole in the roof or walls. A hole made with a ski pole is suitable for this.

e. Building snow caves follows no firm rules as the depth and condition of the snow will vary and the tactical needs may dictate the type and degree of comfort which can be achieved.

G. The Tunnel Method

A tunnel is made into the snow bank. Initially only one man can work but later two can be employed. The front man tunnels while the second clears the excavated snow away from the entrance. Having dug in about two meters, the location of the sleeping bench must be decided. If there appears to be plenty of snow, it is best to have a sleeping bench on either side of the tunnel lying along the axis. If the snow bank is narrow, it may be necessary to have the sleeping bench at right angles to the tunnel. A snow block can be used to seal the entrance but care must be taken to ensure that a ventilation hole is kept open. (See Figure 6-7)

H. The Block and Cave Method

A. If the snow is easy to cut into blocks, the block and cave method should be used. The principles for deciding the internal layout are the same as for tunneling. Having decided on the total internal width of the snow hole, digging can proceed straight into the snowdrift all along the width. There is plenty of room to work and several men can work together while one man digs the entrance tunnel to the side of the main excavation.

B. Once the snow hole is completed and the sleeping benches and stove position determined, the cave can be sealed with snow blocks. These are best cut during the last stages of excavation as the snow is usually more densely packed inside a drift. Using snow blocks from this area reduces the amount of snow moving. (See Figure 6-8)

E. Quingy Hooch

In alpine regions and other barren conditions, shelter can be constructed by piling up a large mound of snow and then digging into it. Even light powder snow will solidify enough once it is disturbed and shoveled into a mound. This variation to the Thermal Shelter, similar in appearance to a snow cave, is referred to as a molded-dome shelter or "Quingy Hooch".

Although the quingy hooch may look like a snow cave, this molded dome should not have a sleeping bench. Dig the entire living area down to ground level and seal the entrance as you would the thermal shelter.

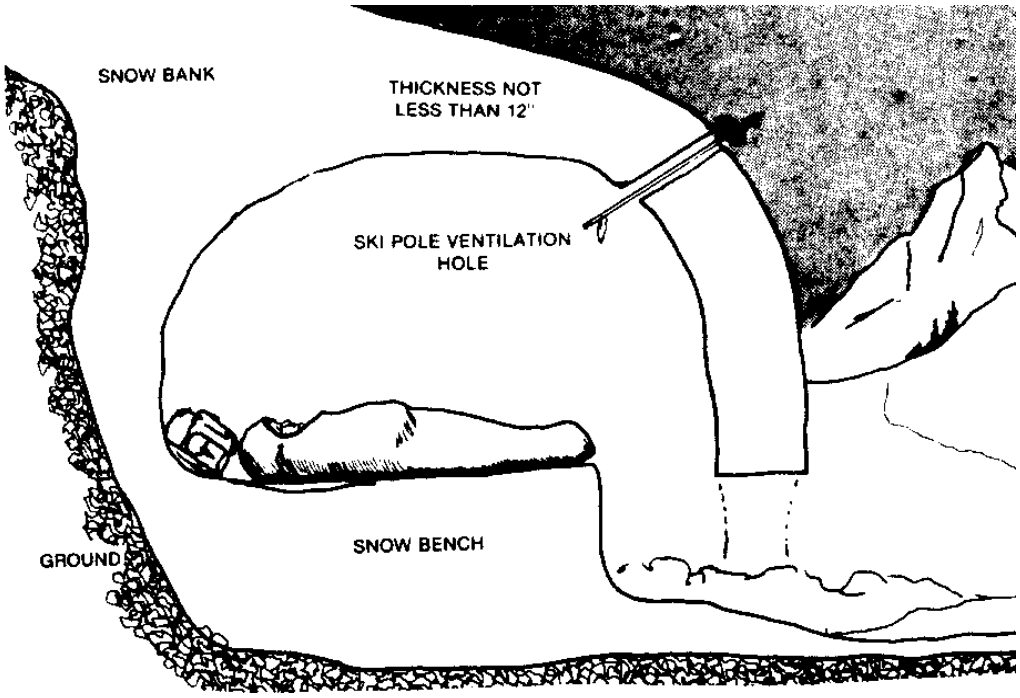


Fig. 6-7 Tunnel Method Snow Cave

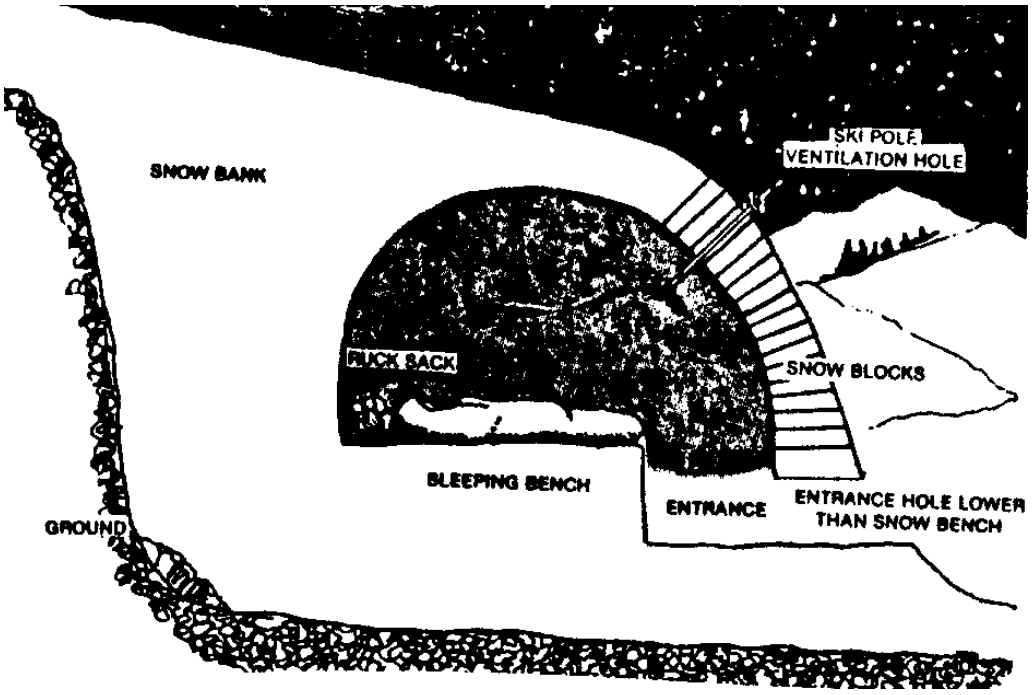


Fig. 6-8 Block and Cave Method

Chapter 7

Navigation and Route Selection

CONTENTS

Introduction

For soldiers operating on a cold, snow-covered battlefield almost every task they must be able to perform is more difficult to accomplish than the same tasks would be in a warmer climate. Land navigation and route selection are no exception to this rule. This chapter addresses some of the specific problems you may expect to encounter and offers some techniques to solve these problems. In addition, it covers selecting routes for movement, and details the factors that must be taken into consideration when planning a route for dismounted movement across snow-covered terrain

I. Navigation Problems

Prior to beginning a movement consider the following factors that may affect your ability to find the way to your objective:

A. In cold regions long periods of darkness, snowfall, fog, and wind-driven snow may drastically reduce visibility. At times, overcast skies above open, snow-covered ground may produce a condition known as "whiteout", where the surrounding terrain appears to blend into the sky; terrain features disappear, and depth perception becomes impossible.

B. Deep snow may completely cover tracks, trails, streams, and improved roads, making them indistinguishable from one another or completely concealing their presence from the observer.

C. Lakes and ponds, when snow-covered, may be confused with areas of open ground. If a body of water appears to have an easily recognizable and distinct shape on your map, this shape my not be so easily recognized when you look at the same body when it is blanketed with snow.

D. Drifting snow may hide small depressions which appear on your map, or it may change the appearance of small hills by collecting on the lee side, making the hill appear to be larger or differently shaped than the map indicates.

E. Aerial photographs taken during winter may be difficult to read because of their lack of detail and the absence of discernible relief or contrasts.

F. Except where they cover population centers, maps of cold regions are notoriously inaccurate and outdated. In general, the cold regions of the world are sparsely populated, and are characterized by very limited road networks and a lack of man-made structures. This has meant limited demand for detailed surveys, and makes surveying on the ground difficult, at best. Only recently, with the development of aerial and especially satellite surveying techniques, has this situation begun to improve.

G. Handling maps, compasses, and other navigation instruments in extreme cold temperatures is difficult with the bulky hand-wear necessary to protect against cold weather injuries. Battery-operated global positioning systems (GPS) may become unreliable or inoperable in cold weather. The "plugger" GPS will not operate in temperatures below –4°F unless it is kept warm. On an extremely cold day, it may become too cold to operate so quickly that it cannot obtain an accurate position, even if it is carried beneath a soldier's insulating layer of clothing, and only exposed to the cold when it is needed.

H. In Polar regions, areas like the arctic coastal plain, or the dense Boreal forests often found in cold regions, the lack (or concealment by forest) of terrain features may make terrain association difficult or impossible.

I. As you approach the earth's magnetic poles, compass deflection (expressed as the grid-magnetic angle) increases. The further north or south you move, the more your ability to

accurately determine direction will be affected, to the point that, when you reach either of the magnetic poles, the needle of a compass will continually rotate about its axis.

J. 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. Prior to beginning a movement consider the following factors which will affect your ability to find your way from where you are to your objective.

II. Navigational Techniques

The same methods used to navigate in other parts of the world are used in cold regions; there is no special technique that is used only in the snow or cold. However, certain techniques work better than others in the conditions of both terrain and weather that are characteristic of cold regions.

A. Navigation by Dead Reckoning

Dead reckoning is a navigational technique that you can use to determine your location by accurately and continuously plotting where you have been. Specifically, dead reckoning consists of plotting and recording a series of courses, each measuring distance and direction from a known starting point. Dead reckoning is the best technique to use in areas where terrain association is difficult, either due to a lack of terrain features or to your inability to see or identify the existing features.

When navigating by this method, it is imperative that a written record of the direction and distance of each leg on your route be maintained. The greatest drawback to this technique is that the lensatic compass and, especially, the pace count are imprecise navigational tools. These deficiencies are aggravated by the facts that most dead reckoning routes are not single-legged straight line movements and that errors made while dead reckoning are cumulative. You must be as precise as possible when using this method of navigation. The equipment required for this technique is listed below:

1. Appropriate map(s) or aerial photograph(s) of a known scale
2. Compass
3. Protractor
4. Route card (see figure 7-1)
5. Dead reckoning log (see figure 7-2)
6. Pace counter
7. Measuring cord (preferably 100m)

When preparing to navigate by dead reckoning the following tasks must be accomplished:

1. Select the route to your objective

2. Plot the route on a map or an aerial photograph. If using an aerial photograph, you must know the scale so that you can determine distance

3. Fill out a route card

4. Determine an accurate pace count for the method of movement you will employ (foot, snowshoe, or ski) on terrain which closely approximates the terrain you will encounter along the route.

5. Prepare a blank logbook or form, to be filled out during movement

Start Point				Destination			Name	
Description				Description			Unit	
Grid Location				Grid Location			Departure DTG	
	End Point							Route Descrip/ Notes
	Grid	Mag.	Point	Distance		Time		
Leg #	Loc.	Az.	Descr	m	Pace	Arr	Dpt	

Fig. 7-1 Route Card

While navigating by dead reckoning, you must do the following;

1. Trust the compass

2. Maintain an accurate pace count

3. Adjust the plotted route as required to negotiate obstacles

4. Record azimuths, distances, times, adjustments to the route, and any pertinent notes in the log. The log should be constantly updated during movement; fatigue may dull your memory

5. Wherever possible, verify your location by terrain association or resection. Remember, errors are cumulative!

B. Distance Measuring

Distance can be measured by pacing or by using a measuring cord. When the pacing method is used, the pace must be checked against a measured distance over terrain similar to that which will be encountered during movement, and using the same, if any, aids to movement (snowshoes or skis) that will be employed. A soldier's pace will be affected by the following:

Stop #	Magnetic Azimuth	Grid Azimuth	Distance (meters)	Arrival Time	Remarks

Fig. 7-2 Dead Reckoning Log

1. Slopes

2. Surface composition/snow density

3. Head/tail winds

4. Weight of clothing and equipment

5. Stamina

6. Level of proficiency (usually only applies if wearing skis)

Since it is virtually impossible to maintain a normal pace while breaking trail, pacemen should travel with trail elements of a unit. This will allow them to move on a well-broken trail, where they can make steady progress, and are less likely to become confused by having to backtrack in order to find a way around an obstacle. Whenever possible, take rest halts at the end of a leg or at a predetermined distance, for example, every 1000m. If you decide to change pacemen, do so only upon completion of a planned leg on the route. This will reduce the possibility of an error in distance.

Although skis are the fastest, most energy-efficient, and least tiring method of dismounted movement (for soldiers with a high level of proficiency) in snow-covered terrain, it is very difficult for a soldier on skis to maintain an accurate pace. Because skis will, to some degree, glide across the snow with each step, the pace will vary in length with almost every step. This problem is compounded on sloping terrain. Therefore, the use of a measuring cord, preferably 100 meters in length is preferable for determining distance when traveling on skis. The following is one technique for determining distance with a 100m measuring cord:

1. The lead soldier moves off in the desired direction dragging the cord behind him and carrying nine markers

2. Rear man jerks the cord when the lead man reaches the end, signaling the leader to drop the first marker. When the leader feels the jerk, he should check to ensure that what he felt was not the cord snagging on something, and, having done so, drop the marker.

3. Both soldiers move out, with the fully extended cord dragging between them

4. When the rear soldier reaches the first marker, he stops, jerks the cord, and picks up the marker. The leader stops, checks for snags, and drops the second marker

5. This procedure is repeated until the rear soldier has collected all nine markers. When the rear soldier reaches the ninth marker, the leader has traveled 1000 meters.

6. The leader remains stopped while the rear soldier moves to his position to hand over the markers. Then the entire procedure is repeated until the objective is reached

It is recommended that the pacers travel at the rear of the navigation party so their progress can be steady and no confusion results. Pacers should not be changed until the end of a leg and a breaks on the trail should, if possible, be taken when both men are together, i.e. at the end of a 1000m leg.

C. Direction

The standard, military dry card compass functions well in the cold. If you are using a liquid filled compass, you will have to keep it warm or it will become sluggish. Use aiming marks when navigating in a cold environment in the same manner as they are used in a temperate environment. If easily recognizable terrain features are present within view from along your route, periodically do a resection to verify your location.

D. Determining Direction by Expedient Means

There are a number of ways to determine direction without referring to a compass or other navigation equipment. None of the methods discussed here are accurate enough for precision navigation, but they can be used to keep you moving in the general direction of your destination. The one major drawback that applies to all of these methods is that, with the exception of celestial navigation in the southern hemisphere, they are unreliable in Polar regions, which the Department of Defense defines as regions above 60 degrees of latitude in either hemisphere.

1. Watch Method

This is probably one of the most widely known methods. However, it is only accurate at noon, local time; at all other times of day it should be considered a rough guide only. To determine direction using this method, hold your watch so the face is horizontal. In the north temperate zone only, the hour hand is pointed at the sun. A south line can be found midway between the hour hand and the 12 o'clock position on the watch face during standard time.

During daylight savings time, the south line will be found located midway between the sun and 1 o'clock. In the south temperate zone, a north line may be found by pointing the 12 o'clock position on the watch face at the sun, and locating a line midway between this and the hour hand. On daylight savings time, the north line is located midway between 1 o'clock and the sun. The watch method becomes less reliable the further you move (north or south) away from the temperate zones.

2. Shadow-Tip Method

This is a simple and accurate method, and has the advantage of needing no equipment other than a stick, preferably about three feet long, and an area of level ground; if a stick is unavailable, fix you bayonet. Place the stick into the ground at a level spot where a distinct shadow will be cast. Mark the tip of the shadow with a stick, stone, or any available item. This first mark will always be the west direction. Wait ten to fifteen minutes until the shadow has moved several inches, then mark the new location of the shadow in the same way as before; this will be the east direction. Draw a straight line on the ground through both marks to obtain an approximate east-west line. Stand on the line with the first (west) mark to your left; north will be to your front, south to your rear, and east on your right. Again, this method is not accurate above 60 degrees of latitude in either hemisphere.

3. Celestial (Star) Method

Of the approximately 5,000 stars visible to the naked eye, less than sixty are used by navigators. These visible stars are not distributed evenly across the night sky, but are found in groups called constellations. What constellations can be seen will vary with the time of year, time of night, and your location on the earth. However, there is, in the northern hemisphere, one star which is visible in the same place every night, all night, of every year; this star is Polaris, or the North Star. Polaris is less than one degree off of true north, and does not change its location because the axis of the earth is pointed toward it. Polaris is in the constellation Ursa Minor, also known as the Little Dipper. It is the last star in the handle of the dipper. To locate Polaris, there are two stars in the Big Dipper, or Ursa Major, called the Pointers which can be used as aids. An imaginary line drawn through the pointers and extended five times the distance between them points to Polaris (see figure 7-1). Polaris is not a bright star, but it is, from a navigator's point of view, the most important star in the northern sky.

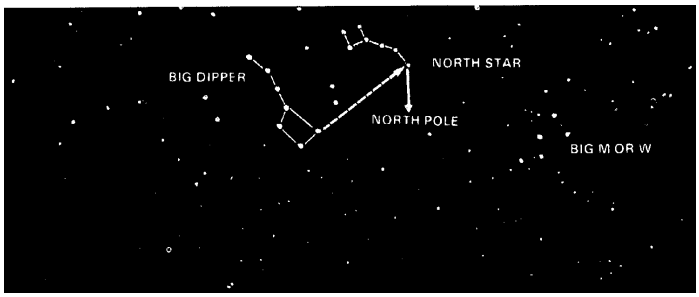


Fig. 7-1 Determining Direction by the North Star

The two disadvantages of navigating by this star are that it is not visible from any point south of the equator, and, above 70 degrees north, it appears so close to directly overhead that it is not useful. In the southern hemisphere, the constellation Crux, or the Southern Cross, is used as a guide. An imaginary line is drawn connecting the stars at the ends of the long axis of the cross, and then extended four-and-a-half times the distance between the two stars to a point above the horizon. The point on the horizon directly below this is south (see figure 7-2). Unlike Polaris in the north, crux us still useful as a navigational aid at latitudes above seventy degrees (south).

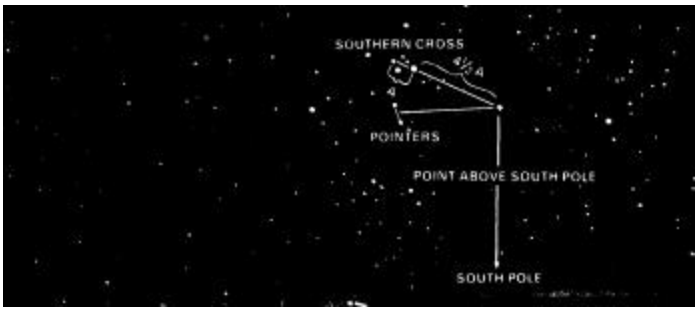


Fig. 7-2 Determining Direction by the Southern Cross

E. Navigation (Compass) Patrols

In areas where navigation may be difficult, or where the commander wants the unit to be able to move at a steady, fairly rapid pace, leaders should consider using a navigation, or compass, patrol. The navigation patrol should move out one-half to one hour ahead of the trail breaking party. By employing a compass patrol, the trail breaking party is relieved of the task of determining the route, and can make faster work of preparing the trail for the main body. The main body, in turn, will be less likely to overtake the trail breaking party, which would force it to halt while waiting for the trail breaking party to advance. A navigation patrol may consist of:

1. Leader carrying map and compass
2. Compass man, whose primary duty is to take compass bearings and mark the trail
3. Pace man (or men)
4. Radio operator or runner
5. Security element (as required)

III. Route Selection

In addition to the normal considerations regarding the tactical situation leaders must take into account the following when selecting a route across cold/snow-covered terrain:

A. Initial Route Planning

A map, or preferably, an aerial or ground reconnaissance of your route may enable you to plan a route that takes into consideration the following factors:

1. Going around terrain features may be faster than going over them; check the contour, and select a route which involves the minimum amount of ascending and descending

2. Are your personnel on skis or snowshoes? How proficient are they, and are they more capable of negotiating the terrain along the route with one or the other?

3. Will your soldiers be carrying heavy rucksacks or pulling sleds? What will the temperatures be during movement?

4. Do you have any vehicles attached, and if so, what type of terrain/snow depth are they capable of negotiating?

5. How will you camouflage your tracks? Do you need to? In barren areas, or areas above the tree line tracks may be difficult if not impossible to conceal

6. Will the route be feasible during conditions of limited visibility?

7. Will the route cross any potential avalanche areas?

8. What obstacles can be anticipated? Will streams and other bodies of water be sufficiently frozen to support troops/vehicles? Will plowed roads perpendicular to your route have high banks of plowed snow? Will the water level in streams be so low that your soldiers will have to negotiate high banks?

B. The planned route, in the form of a route card, should be given to the navigation patrol, or to the trail breaking party if a navigational patrol is not used. The detailed selection of the route is the responsibility of whichever of these groups establishes the route. Some guidelines for them are as follows:

1. In open terrain, break only one track, and follow tree lines or along terrain features such as stream banks as much as possible

2. Avoid densely forested areas as much as possible by traveling along their edges, or by finding a route through less dense areas

3. In mountainous terrain, use gentle traverses for both ascent and descent; follow slope contours once elevation is gained, and avoid moving cross-compartment if at all possible. Avoid avalanche-prone areas

4. Check ice thickness before following a water route. Move close to the shore or bank to help conceal your tracks, but be aware that drifts along stream banks may conceal thin ice on a stream or river which appears to be adequately frozen (see appendix D).

5. Bypass any obstacles that are not imperative for you to negotiate

6. Routes to be traveled upon at night must follow the easiest possible terrain and should be well marked

7. Remember that as the likelihood of enemy contact increases, emphasis should shift from ease of movement to concealment

IV. Avalanche Hazard Identification

The effect of an avalanche can be disastrous. Chances of survival after burial by an avalanche are approximately 90% if located in the first 15 minutes. Probability of survival drops off rapidly after the first 15 minutes. After 2 hours, chances for survival are remote. Sixty-five percent of avalanche fatalities are from suffocation, 25% from collision with obstacles such as rocks and trees, and 10% from hypothermia and shock.

A. Two Types of Avalanches

There are two types of avalanches, a loose snow slide and a slab avalanche. The loose snow slide or point release usually occurs on steeper slopes from 55° and up.

1. Loose snow slides start small, at a point, and grow in width as descent occurs, picking up more snow as it goes; typically this involves only the very top layer of fresh snowfall These type of avalanches typically do not carry much snow but can trigger slab avalanches. In late spring, however, these types of slides can become very significant as they become wet snow slides carrying large amounts of heavy wet snow and can be quite destructive.

2. The other type of avalanche is a slab avalanche. This type contains a more cohesive mass of snow and ice as the formation of the slabs can occur at any depth in the snowpack. A typical winter snowpack could contain many separate slabs varying from an inch to ten feet or more in thickness. Each new snowfall eventually forms a definable layer in the snowpack. The bonding of these adjacent layers determines the overall strength of the snowpack. Not all layers in a snowpack evolve into slabs. Many detailed events occur within the history of the snowpack to effect the bonding process. The lack of a strong bond between layers increases the probability of avalanche. In addition to the strength of the various layers, other factors affect avalanche probability.

Typically, as the slope angle increases, the probability of an avalanche increases. Based on statistics, without an angle greater than 20°, the gravitational force on the snowpack is typically not great enough to produce a slide. While avalanches usually occur on slope angles between 20° and 60°, a majority of avalanches occur between 30° and 45° and a disproportionately large number occur between 35° and 40°. Although slope angles above 55° predominately produce loose snow slides, slab avalanches can occur. Snow falling on the steeper slopes tends to "sluff" off upon falling.

The failure of the elastic energy in a slab of snow is the basis of an avalanche. Elastic strength is defined as the strength within a slab cross section. An example of elastic strength is the strength necessary to tear a pan cake apart with two hands. With enough force, the slab will separate from itself, with one side remaining on the slope while the other slides downward. In the example with the pancake, the outside force was the strength of the hands. In the snowpack, the outside force could be a skier, snowshoer, other travelers, cornice breaks, or other natural occurrences putting stress on the snowpack. In simple terms, the proverbial "straw that broke the camels back" is all that's needed to start an avalanche. An outside force is anything that comes in contact with the snowpack and not just on the upper slopes either. An avalanche could be triggered from the valley floor away from the slope. The slab structure will sometimes be all encompassing of an entire valley floor and a surrounding slope.

B. Factors Affecting the Snowpack

1. <u>Wind</u> is probably the most important factor affecting the snowpack stability. When wind speeds are in excess of a few meters per second, snow is removed from the ground. Once this snow is picked up, the action of the wind rounds the sharp shapes of the snow crystals and makes them more like little snow balls than snowflakes. This wind action also reduces the size of each crystal, making the resulting snowpack extremely dense (heavy) and possibly unstable.

Wind transported snow will be deposited on lee slopes in the form of slabs and cornices, making these slopes extremely dangerous for travel.

2. Both the angle and shape of a slope have a significant affect on the occurrence of avalanches. Ninety percent of all destructive avalanches occur on slopes between 30º and 45º; however, keep mind that slopes outside of this range do avalanche. Generally, convex slopes are more prone to avalanche than are concave or straight slopes. Remember that even though the slope you are on may not be steep enough to avalanche, the slopes above you may be; people often trigger slides by moving below the release zone and being buried from above.

3. Heavy precipitation over a short period of time can also be a significant factor in avalanche occurrence. A snowfall of 1 inch per hour or greater is usually cause for concern. Heavy rain introduces free water into the snow pack which lubricates the snow crystals possibly creating a hazard. It should also be noted that the large majority of avalanches occur either during or immediately after a storm.

4. The aspect of a slope, or the direction it faces, greatly affects the occurrence of avalanches. North-facing slopes are usually more prone to avalanche in mid-winter while south-facing slopes are more dangerous in spring and on sunny days. As the sun moves to shine on a particular slope during the day, that slope usually becomes more avalanche prone.

5. The temperature throughout the snowpack determines how well the snow crystals will bond, or stick together. A constant temperature from snow level to ground is favorable to a stable snow pack. On the other hand, a radical difference in temperature (greater than 1º C/10 centimeters) is an indicator of possible severe instability. This condition can be assumed when air temperatures of -20º F or colder have persisted for several days. The final temperature indicator is when the temperature has been above freezing for a period such that the snowpack has become very wet, and lubricated, and hence, very unstable.

6. General indicators of avalanche prone areas include:

a. Evidence of previous avalanches- debris piles at the base of a slope, flagged trees, trees all pointed away from the slope

b. Steep slopes between 30º and 45º

c. Heavy snowfall- added weight to the existing snowpack

d. Visible fracture lines in the snow- even on low angle terrain indicates possible weaknesses on surrounding steeper terrain

e. Audible settling of the snowpack- a "whoompf" sound comes from collapse of an underlying weaker layer of snow or hoare frost

f. Corniced ridges- (Figure 1.1) Cornices are formed from wind carrying snow over a ridgeline and depositing the snow on the leeward edges. The overhanging shape is made from the swirling movement of the airflow as it moves over the edge. A cornice can break causing a severe stress on the downslope snowpack. Slab avalanches are sometimes caused by cornice breaks.

g. Severe changes in temperature- increasing temperature increases weight of surface layer(s) through melting

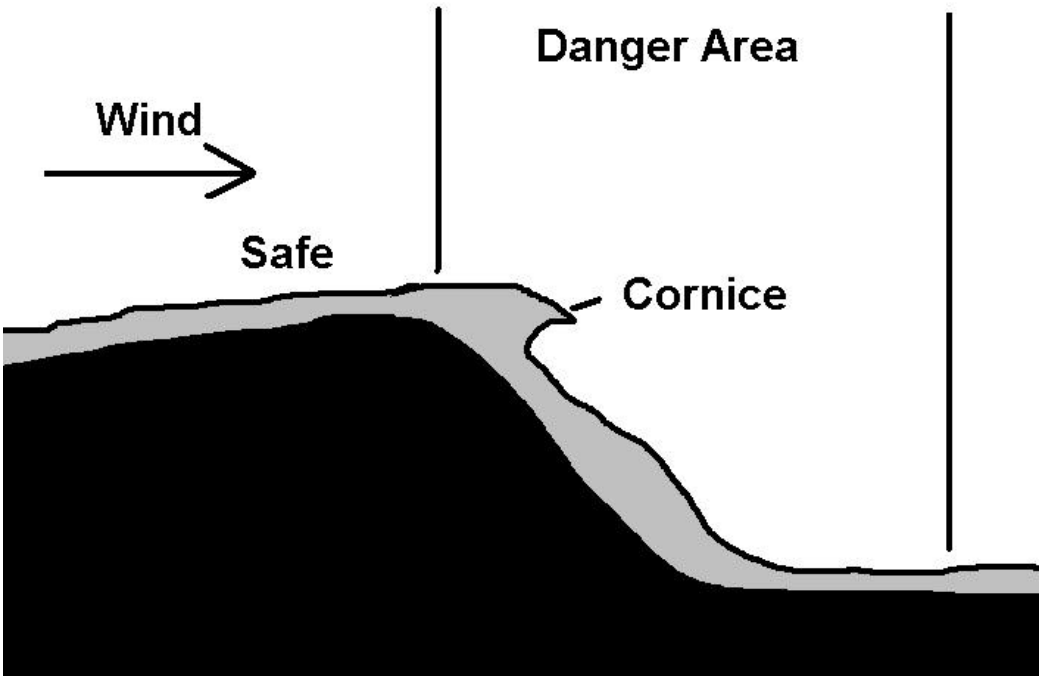


Figure 1.1 Cornice Construction

h. Lee slopes- usually are topped by a cornice; as the cornice is built the excess snow is deposited downslope by the same wind and adds weight to the existing snowpack

i. Snow plumes and high winds- build cornices and leeward deposits

j. Underlying smooth slopes (grass, etc.)- bad anchors for snow; slopes covered with many trees and boulders will provide some anchoring until completely covered

k. Slushy "spring" snow- very heavy and apt to slide at high angles

l. An outside force to give the force to break the stability.

The ingredients for a slab avalanche are listed below in a mathematical equation:

Suitably steep terrain
+ Snow structure instability
+ Critical balance between stress on and strength of snowpack
+ Outside force to tip the balance
AVALANCHE!

C. Route Selection

Alpha Angle-The measured angle from your location to the potential avalanche start point. This is based on elevation difference and potential runout distance. 17º or less is considered safe. Once a safe alpha angle has been achieved, insure you did not back into another hazardous area. Consider all surrounding slopes. The higher the start point upslope, the further you need to be from the base of the slope for safety. Watch your back for opposing Alpha Angle problems.

1. Snowpack Analysis

Snowpack analysis consists of you making a decision on the stability of the snowpack- could the snow slide?

a. There is slab avalanche potential when relatively strong, cohesive snow overlies weaker snow or when this overlying snow is not bonded to the layer underneath.

b. A slab avalanche is created from snow that is cohesive enough to bond together and form a slab; soft fresh snow does not bond immediately. Freshly fallen snow that has not bonded to itself or the existing snowpack does place stress on the existing snowpack, typically causing fractures in the existing snowpack.

c. Shooting cracks in the snow, as you move on the snow, indicates a weakness in the snowpack. A loud "whumpf" sound is the settling of the snowpack. The noise is caused by a weak layer in the snowpack collapsing. Shooting cracks and "whumpf" sounds on steeper slopes are precursors to avalanches.

d. Snow falling at a rate of one inch or more per hour is cause for immediate concern. Most natural releases will occur within 24 to 48 hours following a storm.

e. As wind moves across a valley and up the slopes it carries snow and deposits it on the leeward slopes of the mountains and ridges. This wind loaded snow is added weight and stresses the elastic strength of the leeward slope.

f. Changes in temperature effect the bonding process of the crystal structure of the snowpack. This process is called the freeze/thaw cycle. This bonding is the cause of slab formation. Extreme decreases in temperature will make the snowpack more brittle and likely to fracture. As temperatures in the snowpack increase, the bonding process time of recent snow to old snow is decreased. In other words, warmer temperatures increase the stability of the snowpack. However, when temperatures rise above freezing, rain and meltwater can rapidly destabilize an otherwise safe snowpack. Increases in temperature can cause wet snow slides.

g. Snowpack stability tests- There are many test you can perform on the snowpack to determine stability. Many of the tests will tell you nothing unless you study snow pack science and study snowpacks frequently enough to remain proficient and use the knowledge. For the average snow terrain traveler, there are a few tests that produce practical results and are simple to perform.

(1) Ski pole test- As you travel on the snow occasionally push you ski pole into the snow and "feel" the slab construction with the basket as you pull the pole from the hole. Not scientific, but this test gives you clues as to the strength of the snowpack.

(2) Snowpit test- This test gets your eyes and hands into the snowpack. Choose a safe slope with a similar aspect, direction and angle, as the suspect slope or the slope you want to travel. Carefully dig into the bank above you with a shovel or similar device. When finished you will have three walls of the snowpack exposed. In this pit, you can further analyze the strengths and weakness of the layers of snow, the bonding between old and new snow layers.

(3) Shovel shear test- This test puts pressure on a representative sample of the snowpack. Locate a slope of similar aspect, same as in the snowpit. The core of this test is to isolate a column of the snowpack from three sides. The column should be of similar size to the blade of the shovel. Dig out the sides of the column without pressing against the column with the shovel, (this affects the strength). To isolate the rear of the column, use a rope or string to saw from side to side to the base of the column.

If the column remained standing while cutting the rear, place the shovel face down on the top of the column. Tap with varying degrees of strength on the shovel to see what force it takes to create movement on the bed of the column. The surface that eventually slides will be the layer to take a closer look at. This test results in a better understanding of the snow pack strength but to get a better result you will need to do this test in many areas and formulate a scale for the varying methods of tapping the shovel.

(4) Rutschblock Test and Banzai Jump

These tests give the best representation of snowpack strength specifically because the test weight for failure is a human or humans. The Rutschblock Test and Banzai Jump tests are the easiest to evaluate and understand and the most accurate for the typical snow traveler. For either test, isolate a column, (same method as for the shovel shear test), slightly longer than the length of your snowshoes or skis and perpendicular to the fall line

For the Rutschblock test, one person moves on their skis or snowshoes above the block without disturbing the block. Once above, the person carefully places one snowshoe or ski onto the block with no body weight for the first stage of the test. The next stage is adding weight to the first leg. Next, place the other foot on the block. If the block is still holding up, squat once, then twice, and so on. The remaining stage is to jump up and land on the block.

The Banzai test is very similar except three or four people lock arms while facing the block and simultaneously jump onto the block.

2. Human Factors

Do you have to travel in that particular area or on that slope? What are your alternatives to that route and their possible consequences? Are the risks worth the possible consequences? Use the question/checklist in Figure 1.2 for a guideline of decisions to make before entering avalanche prone areas.

AVALANCHE HAZARD EVALUATION CHECKLIST

Critical Data		Hazard Rating		
PARAMETERS:	**KEY INFORMATION**	**G**	**Y**	**R**
TERRAIN: *Is the terrain capable of producing an avalanche?*				
-Slope angle (steep enough to slide? prime time?)		☐	☐	☐
-Slope aspect (leeward, shadowed, or extremely sunny?)		☐	☐	☐
-Slope configuration (anchoring? shape?)		☐	☐	☐
	Overall Terrain Rating:	☐	☐	☐
SNOWPACK: *Could the snow fail?*				
-Slab Configuration (slab? depth and distribution?)		☐	☐	☐
-Bonding Ability (weak layer? tender spots?)		☐	☐	☐
-Sensitivity (how much force to fail? shear tests? clues?)		☐	☐	☐
	Overall Snowpack Rating:	☐	☐	☐
Weather: *Is the weather contributing to instability?*				
-Precipitation (type, amount, intensity? added weight?)		☐	☐	☐
-Wind (snow transport? amount and rate of deposition?)		☐	☐	☐
-Temperature (storm trends? effects on snowpack?)		☐	☐	☐
	Overall Weather Rating:	☐	☐	☐
Human: *What are your alternatives and their possible consequences?*				
-Attitude (toward life? risk? goals? assumptions?)		☐	☐	☐
-Technical Skill Level (traveling? evaluating aval. hazard?)		☐	☐	☐
-Strength/Equipment (strength? prepared for the worst?)		☐	☐	☐
	Overall Human Rating:	☐	☐	☐

Decision/Action:
Overall Hazard Rating/GO or NO Go? **GO ☐ or NOGO ☐**

***HAZARD LEVEL SYMBOLS:**
R = Red light (stop/dangerous)
G = Green light (go/OK)
Y = Yellow light (caution/potentially dangerous).

Figure 1.2 Avalanche Hazard Evaluation Checklist

D. There are a few items which will be extremely helpful while traveling in avalanche prone areas. as with all specialized equipment, proper training is necessary before use. Remember, having these items does not protect you from avalanches, only training, experience, and applying these attributes will do. This equipment will merely increase your chance of survival if caught in an avalanche.

CAUTION: HAVING SEARCH AND RESCUE EQUIPMENT DOES NOT GUARANTEE SURVIVAL IN AN AVALANCHE. THE BEST DEFENSE IS TO AVOID BEING CAUGHT IN AN AVALANCHE.

CAUTION: POSSESSING ALL THE LATEST LOCATING AND RESCUE EQUIPMENT DOES NOTHING FOR YOUR CHANCES OF SURVIVAL IF YOU OR YOUR PARTNERS DO NOT KNOW HOW TO USE IT. PRACTICE USING ALL EQUIPMENT BEFORE ENTERING AVALANCHE AREAS.

CAUTION: THE SURVIVABILITY OF THE VICTIM DEPENDS SOLELY ON THE ACTIONS OF THE PEOPLE IN THE IMMEDIATE AREA. IF OUTSIDE ASSISTANCE IS NEEDED, THE VICTIM WILL PROBABLY NOT SURVIVE, DUE TO THE TIME IT TAKES TO GET ADDITIONAL HELP.

1. A shovel, heavy duty, wide blade, short handle for easy stowage

2. Avalanche probe- at least eight feet long, ten is better; a folding stowable model is best

3. Avalanche transceiver- quickest device for finding avalanche victims only if the victim and the searcher BOTH are using transceivers correctly; transceivers are costly-about $200.00 each; at least two are them to be of any use; if the victim is wearing one and it is transmitting as it should be and a searcher is wearing one and has it switched to receive necessary for

4. Inclinometer- either a compass with a built in inclinometer, a specially designed device, or an improvised inclinometer made from a protractor.

The issued Army protractor, GTA 5-2-12, 1981, can be modified to read slope angle easily. Punch a hole in the exact center of the device and thread a tiny string through and tie a securing knot on the backside of the card. Extend the string well beyond the farthest outer corner of the card, add 2-3 inches and cut the string. Tie a weight, such a small washer or threaded nut to the fresh cut end. (Figure 1.3)

a. Hold the card vertically so the data is legible and rotate until the weighted string hangs on the zero mark. The corners containing the 2400 and 4000 outer marks define the sighting edge of the device with the eye point being the 2400 corner.

b. Hold the card vertically, aligning this sighting edge with a slope and allowing the string to hang freely against the card. When the string stabilizes, pinch it on the outside edge of the card between the thumb and a finger. Move card from sighting position and read the indicated angle.

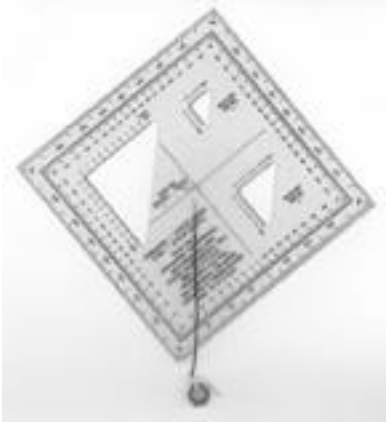


Figure 1.3 Improvised Slope Angle Measuring Device

There are other items commercially available that will increase your chances of survival if you are caught in avalanche, however you should concentrate your efforts on prevention of being caught in an avalanche.

E. Actions to be Taken During an Avalanche- Before entering a possible avalanche area, ski safety straps, ice ax leashes, or ski pole straps should be removed. In the event of a slide, these items can be released easily. Those items could be twisted and pulled causing injuries or pulling the victim under. Rucksacks or backpacks should be kept on and secured, this additional size will provide flotation if the pack is not heavier than the person. Before crossing an avalanche area, a lookout should be posted to carefully watch each person in order to provide "last location seen" information if a slide occurs. Another watch can be posted to scan terrain above for danger signs.

If caught in a slide, try to remain on top of the snow by means of a swimming motion. If still under the surface, try to create a breathing space with the arms prior to the avalanche coming to a complete stop. Those observing an avalanche should carefully note the last seen point of the victim and the location of any equipment.

F. Actions to be Taken After an Avalanche

1. Immediate action- Survivors at the avalanche site are organized into the first rescue team and immediately start rescue operations. If any indication of the location of the victim is found, random probing starts in that vicinity. The tip and edges of the slide are also likely areas to search. A human body is bulky and is apt to be thrown toward the surface or the sides.

2. General Procedures- Establish from witnesses where the victim was just prior to the avalanche, then determine the point where the victim disappeared - the "last seen" point. Making use of this and any other information, establish a probable victim trajectory line leading to high priority search areas. Make a rapid but systematic check of the slide area and the deposition area and mark all clues. Look for skis, poles, ice axes, packs, gloves, hats, goggles, boots, or any other article the person may have been carrying, it might still be attached to the victim.

3. Organize initial searchers and probers. If using avalanche beacons, immediately select a few people to begin a beacon search and insure all other beacon carriers turn their beacons to receive or off, this will eliminate erroneous signals. Everyone should have a shovel or other tool for digging or if there are sufficient people, a shoveller(s) can be standing by to assist when needed. If the initial search reveals items from the victim, make an initial probe search in that area. This probing should take only a few seconds.

If no other search method exists, make a coarse probe of all likely areas of burial, and repeat it as long as a live rescue remains possible. Resort to the fine probe only when the possibility of a live rescue is highly improbable, within the first thirty minutes. Unless otherwise indicated, start the coarse probe at the deposition area.

4. Establishing the victim's most probable location -In many respects, a moving avalanche resembles a liquid. A human body, with a higher density than the flowing snow, would be expected to sink deeper and deeper into the avalanche, however, several factors influence this. Turbulence, influence of terrain, and the victim's own efforts to surface himself, all interact to determine the final burial position. Study of a large number of case histories leads to the following conclusions:

a. The majority of buried victims are carried to the place of greatest deposition, usually the toe of the slide.

b. If two points of the victim's trajectory can be established, a high probability exists that the victim will be near the downhill flow line passing through these two points.

c. Any terrain features which catch and hold avalanche debris are also apt to catch a victim.

d. If an avalanche follows a wandering gully, all debris deposit areas are likely burial spots. The likelihood of a victim being buried in a particular bend is proportional to the amount of debris deposited there.

e. Vegetation, rocks, and other obstacles act as snares. The victim tends to be retained above the obstacle. An obstacle may simply delay the victim's motion, leading to final burial down flow from the obstacle.

f. Maximum speed of the flowing snow occurs at the avalanche center. Friction reduces flow velocity along the edges. The closer the victim's trajectory is to the center of the slide, the greater will be his burial depth.

g. Efforts of the victim to extricate himself by vigorous motion and "swimming" definitely minimize burial depth. Conversely, the limp body of an unconscious victim is likely to be buried deeply.

h. An occasional exception to the above is emphasized. The victim may not be buried but may have been hurled away from the avalanche by wind blast. In the case of large and violent avalanches, a search of the surrounding terrain is advisable. Victims have been located in tree tops outside the slide area.

G. Probing for Avalanche Victims- Probing offers the advantage of requiring very simple equipment that can be operated by personnel without previous training. Although the probers do not need previous training the search leader must be familiar with the technique to insure proper execution of the probe line.

1. Probe Poles- Rigid steel tubing approximately ¾ inch in diameter is recommended for the primary probe pole. Lengths of approximately 10 ft. are best. Longer poles are difficult to manage, especially in a high wind. This type is the best performing probe pole but are difficult to transport to the avalanche site as they are long and heavy for personnel to carry normally.

2. Although the rigid steel probe poles perform best, folding sectional poles should be carried by each person operating in avalanche areas. These poles are of similar construction as folding tent poles but are stronger and are connected with cable instead of bungee cord. These should be carried on the outside of the pack to facilitate immediate access. This provides an immediate capability to begin probing by surviving members.

3. In the absence of any kind of probe pole, initial probing attempts can be started using ski poles. This can be accomplished in two ways; the ski pole can be reversed, probing with the wrist strap down, or the basket can be removed, the preferred method, so that the point is down. This method allows the ski pole to penetrate the snow more easily than in the first method.

4. For the probing operation to be effective, lines must be orderly and properly spaced. To insure systematic and orderly probing, the number of personnel per line should be limited. Twenty per line is satisfactory, while thirty is normally the upper limit. The number of probers in the line will be dictated by not only the width of the area to be probed but the amount of people available. A string may be used to keep the probe lines aligned, but will require added time to maintain.

5. The probe line maintains a steady advance upslope. Advancing uphill automatically helps set the pace and permits easy probing to the full length of the probe. Probing does not come to a halt when a possible contact is made. The probe is left in contact and the line continues. A shovel crew follows up on the strike by digging down along the pole. Extra probes are carried by the shovel crew to replace those left in contact. Such a plan of operation is especially important when more than one victim is buried.

6. Striking a body gives a distinct feel to the probe. This feel is easily recognizable in soft snow but is less easy in hard compacted snow. A common problem is encountering debris within the snow that can be mistaken for the victim. The only sure check is by digging.

7. Probing Techniques

Two distinct probing methods are recognized: Coarse Probe and Fine Probe. As evidenced by their names, coarse probing implies a wider spacing of probe pole insertions with emphasis on speed. Fine probing involves close-spaced probing with emphasis on thoroughness. Coarse probing is used during initial phases of the search when live recovery is anticipated. Fine probing is the concluding measure which almost guarantees finding the body. The coarse probe technique has a 70 percent chance of locating the victim on a given pass, while the fine probe has essentially a 100 percent chance of locating the body.

8. The Coarse Probe functions as follows:

a. Probers are spaced along a line 30 inches center to center, with feet about 15 inches apart.

b. A single probe pole insertion is made at the center of the straddle span.

c. On signal of the probe line commander, the group advances 20 inches and repeats the single probe.

d. Three signals are used for the complete sequence-

"DOWN PROBE"
"UP PROBE"
"STEP FORWARD"

By adhering to these commands, the leader can keep closer control of the advancing line of probers. It is important that the signals be adjusted to a rhythm which enforces the maximum reasonable pace. Further, a string could be used along the probe line to keep the probers dressed, although this would require the use of two people to control the string. Strict discipline and firm, clear commands are essential for efficient probing. The probers themselves work silently.

9. The Fine Probe- The fine probe functions as follows:

a. Probers are spaced the same as for the coarse probe. Each man probes in front of his left foot, then in the center of his straddled position, and finally in front of his right foot.

b. On signal, the line advances 1 ft. and repeats the probing sequence. Each probe is made 10 inches from the adjacent one.

c. The commands for the fine probe are:

"LEFT PROBE"
“UP PROBE"
“CENTER PROBE"
"UP PROBE"
"RIGHT PROBE"
"UP PROBE"
"STEP FORWARD"

10. Good discipline and coordinated probing is even more necessary than with the coarse probe. Careless or irregular probing can negate the advantages of fine probing. Use of a string to align the probers is especially important with the fine probe. The three insertions are made along the line established by the string line which is then moved ahead 30 centimeters.

The best chance of survival in snow country is to not get into a avalanche, but if a member of your group is in an avalanche, they are depending on you for rescue!

Chapter 8

Over-Snow Mobility

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I. Over-snow Mobility on the Modern Battlefield

During the Russo-Finnish war of 1939, two Russian Motorized Rifle Divisions were cut off and annihilated by Finnish ski troops at the battle of Suomussalmi. Out-gunned and under-manned, the Finns relied on swift hit and run maneuvers, using the deep snow and frozen terrain to their every advantage. The Finn's ability to move virtually unhindered over the snow was a significant force multiplier, and with their vastly superior mobility they were able to employ tactics which completely dumbfounded their opponents.

The battle of Suomussalmi is the classic example of what a well-trained ski force can accomplish on the winter battlefield, but the level of skiing skill displayed there by the Finns will probably never be seen again on a winter battlefield. The average Finnish soldier of 1939 learned to ski not as the graduate of an outstanding military ski training program, but because cross-country skiing was an inherent part of his everyday rural life. Today, skiing has been almost universally relegated to the status of a pastime or sport; it is no longer an essential survival skill, even for the indigenous inhabitants of cold regions.

Militarily, modern technology has given the United States and other developed countries superior means of mobility and infiltration. The use of over-snow vehicles and rotary-wing aircraft gives us maneuver capabilities inconceivable in 1939. Does this mean that the days of the ski trooper are over? The answer is probably both yes *and* no.

With the possible exception of some special operations forces, today's conventional forces simply have "too much on their plates" to devote significant amounts of time and training resources to becoming masters in every aspect of over-snow mobility.

On the other hand, some of the ski techniques employed in 1939 could, in all likelihood, prove invaluable on a modern snow-covered battlefield. When weather or terrain preclude movement by other means, the commander whose troops are trained in over-snow techniques may have a decisive advantage over his opponent.

Attaining a level of performance adequate for typical over-snow operations is not as difficult or time-consuming as many leaders presume. However, it does require a very clear understanding of what the specific goals are, what skill-development training it takes to get there, and a qualified cadre to bring everything together in a safe, efficient program of instruction. The leaders' challenge is to determine exactly what skills to focus on to make the best use of limited training time and resources.

II. Skiing vs. Snowshoeing

Most people recognize that skiing has some distinct advantages over snowshoeing. Generally, skiing is faster and less tiring than movement with snowshoes. The planning tables tell us that a soldier on skis may be able to move as much as four times faster than a soldier moving over the same terrain on snowshoes, (see Appendix B).

Realistically, heavily laden soldiers, especially those pulling ahkios, will probably move at a slow to moderate pace regardless of whether they are wearing skis or snowshoes. The primary purpose of the ski, therefore, like the snowshoe is for flotation in deep snow. The added benefit of speed that skis offer will only appear when soldiers are not heavily burdened. Small patrols whose missions require speed and/or stealth are more likely to need the advantages offered by skis than is an infantry battalion.

The larger conventional force is more likely to use skis as a more efficient alternative to snowshoes, because, all other factors being equal, the trained skier still expends less energy than the soldier on snowshoes, even though their rates of movement may be identical. This alone can be an important consideration during conditions of extreme cold, when much of a soldier's energy is expended just trying to stay warm.

The greatest advantage of snowshoes is that they are quite simple to use. The standard issue magnesium-frame snowshoe is one of the best snowshoes available today. Aside from providing good flotation in soft snow, they are almost indestructible (grunt-proof), and allow relative ease of movement in all but the steepest terrain. On steeper slopes, skis are often easier to use for ascent, but descent is only easier on skis if the skier is adequately trained.

Another advantage of skis (possibly their greatest advantage) is a commander's ability to incorporate skijoring into the movement plan. Quite simply, skijoring is towing skiers behind an over-snow vehicle. This often overlooked mode of travel permits relatively large numbers of troops and equipment to be moved long distances in a short period of time, using far fewer vehicles than would be required to carry the same number of soldiers.

One disadvantage common to both skis and the standard-issue snowshoe is that they can be quite unwieldy when attempting to maneuver in densely wooded or other confined areas, and can be a serious detriment to individual fire and movement. Under these conditions a smaller "bear-paw", or assault snowshoe is the answer.

Lacking the tail found on the issue snowshoe, the assault snowshoes are much easier to use in confined areas, and allow soldiers to conduct fire and maneuver with minimal hindrance. The loss in flotation resulting from their smaller size is insignificant in comparison to what is gained in offensive maneuver capability (for short distances). The military has validated this type of snowshoe for use, but their availability is still limited at present.

III. Skiing

Trained ski troops can move swiftly over the snow often at a pace faster than that of soldiers marching on firm ground. Skis provide mobility; this mobility should encourage commander's to conduct swift maneuvers to exploit surprise, and to conduct operations against enemy flanks and rear areas. Skis should be used only on the approach march and should be discarded prior to an assault.

Though skiing skill certainly takes longer to develop than snowshoeing, it may not take as long as many people believe. One caveat to this is that leaders must ensure that the individuals conducting the training program really know how to teach skiing. Injuries, improper technique, and bad habits that hinder skill development are common results when unqualified soldiers are placed into ski instructor positions.

Since our main focus is not to fight on skis, but to use skis as an efficient mode of travel when enemy contact is not likely, we can narrow our focus to specific skills and maneuvers designed to support this purpose. For a typical conventional unit, skiing will allow the ability to move unimpeded over flat to moderately rolling terrain in a variety of reasonable snow conditions. We emphasize “reasonable” here, knowing that some conditions, breakable crust, wet, slushy snow, can present extreme difficulties to even the best skiers.

Most soldiers (80 to 90 %) should be able to negotiate flat terrain, climb uphill, and link turns down gentle to moderate slopes, while wearing a 40 to 50 pound rucksack, after three to four weeks (120 to 160 hours) of ski training. This is the recommended program to produce a proficient all-around military skier. A shorter one to two week (40 to 80 hour) program of instruction will enable most soldiers to negotiate relatively flat terrain, and to learn skijoring well enough for their commander to consider it a viable movement option.

Extra time will be required to complete the training program for the 10 to 20 % of soldiers who don't catch on as quickly as the others. Experience has shown us that, contrary to what some sources may state, “5 to 10% of soldiers will never learn to ski…”, almost anyone capable of meeting the physical fitness requirements for military service can learn to ski well enough for military operations. All that is required for some soldiers is a little more time and training under the supervision of a qualified instructor.

Military skiers should be taught the following basic skills as a part of any ski training program:

A. Proper fitting of ski bindings and basic ski waxing technique

B. Ski maintenance

C. Movement on level ground

D. Turning on level ground

E. Skiing up a slope

F. Straight downhill running

G. Turning while skiing downhill

H. Proper falling technique/fall recovery

Although a groomed ski slope is an ideal training site for novice skiers, a military skier must be able to perform all of the tasks listed above on unprepared snow, while carrying his or her combat load. Commanders need to keep this in mind when designing a ski training program, and allow sufficient time for their soldiers to not only learn the basics, but to apply them under the conditions they can expect in the field. For more information concerning specific ski training tasks, refer to the NWTC Ski Instructor Guide.

IV. Skijoring

As previously mentioned, the benefits of skijoring are often overlooked, or dismissed as being a technique that requires an inordinately large amount of training to successfully execute. Actually, the payoff gained by being able to rapidly move large numbers of troops and equipment over long distances for the minimum training time invested can be a big plus.

The other main advantage of skijoring is that soldiers expend minimal energy while being towed as opposed to cross-country skiing or snowshoeing and should be well rested and ready for follow-on missions once they arrive at their destination. Heavy rucksacks, crew-served weapons systems, and ahkio groups may be loaded on tow vehicles while troops may skijor with minimal gear (LBE/LBV, kevlar helmet, and weapon). Furthermore, skijoring may allow light forces to keep pace with mechanized or armored units without the extensive use of additional transportation assets.

The primary drawback to skijoring is that soldiers are exposed to an increased risk of cold weather injury, especially wind-chill-induced frostbite. Facial areas not completely protected from the elements can easily become frostbitten, and the risk of frostbitten fingers and hands is also increased if soldiers grip the towrope too tightly, restricting circulation to these areas. As long as leaders and soldiers are aware of these hazards, appropriate measures such as increased protection and proper technique can be utilized to minimize or eliminate the risks.

<u>CAUTION:</u> SPEEDS IN EXCESS OF 15 MPH, (24 KPH), SHOULD NOT BE PERMITTED WHEN SKIJORING.

Skijoring should never be attempted when enemy contact is likely. Timely detection of the enemy will be difficult for vehicle crews and virtually impossible for soldiers being towed, and, even if the enemy is detected, responses to enemy contact cannot be initiated quickly by soldiers who are skijoring.

Some guidelines to follow when conducting skijoring follow:

A. Use of the Tow Rope

1. Two ropes 120 to 150 feet long are connected to the rear of the tow vehicle, one at each corner.

2. Skiers, in column of twos, are spaced at equal intervals behind the vehicle, to the outside of the ropes. A gap of approximately ten to twelve feet is maintained between individuals.

3. The rope is half-hitched around the ski pole shafts just below the handles. The poles are held under the outside arm, and the skier can rest against the baskets of the ski poles. A small fixed loop is tied in the end of each rope, and the last soldier on each rope inserts the shafts of both ski poles halfway through the loop. These soldiers grasp their poles on each side of the loop, in a manner similar to water-skiing.

4. Skiers are never allowed to fasten themselves directly to the rope. In case of a fall they must be able to immediately release the rope, to avoid serious injury. If a soldier falls, the skiers immediately behind the fallen skier must be able to release the rope so that they can maneuver to avoid the fallen skier.

B. Technique

1. The vehicle should have, in addition to the driver, an observer who can notify the driver in the event a skier is experiencing problems

2. The vehicle operator follows the easiest route that the terrain permits. Steep slopes, obstacles, and sharp turns are avoided. Whenever these cannot be avoided, speed is reduced to allow the skiers to negotiate the obstacle. The observer should advise the driver when to speed up, slow down, or stop.

3. When the vehicle begins to move, each skier shuffles forward a few steps, gradually placing his weight onto the tow rope. Failure to do so will most likely result in the skier being jerked forward abruptly enough to cause a fall. Stopping and starting is always performed gradually.

4. Once under way, the skier leans slightly backward, with his or her weight being supported by the ski pole baskets. The skier's upper body should be generally erect, and the knees slightly flexed, to act as shock absorbers. The skis may be in a slightly wider than normal stance, and one ski should be slightly advanced. This will increase the skiers' stability, as well as his ability to compensate for irregularities in the terrain and the vehicles' rate of movement. The skier should be able to relax, but must remain alert for obstacles.

5. If a sharp turn is necessary, speed is reduced to a walk, and the skiers walk around the corner, being careful not to drop or step on the tow rope. Once the last skier has completed the turn, speed is gradually resumed. When descending hills, the skiers must keep the rope taught by using a braking wedge. If the skier(s) find that they are unable to control the rate of descent, and collision with the vehicle is imminent they must drop the rope and maneuver to avoid the vehicle. On short downward slopes the vehicle should temporarily increase speed so that the skiers do not need to brake. On longer steep slopes, the skiers should descend independently of the vehicle and reattach themselves to the rope at the bottom of the hill.

<u>CAUTION:</u> IN THE EVENT THAT A SKIER FALLS, HE SHOULD IMMEDIATELY RELEASE THE ROPE AND ROLL TO THE OUTSIDE TO AVOID BEING RUN OVER BY THE NEXT SOLDIER ON THE ROPE.

V. Snowshoeing

Snowshoes are an aid to over-snow movement that allow the average soldier to move at roughly the same speed he would be able to achieve in boots, on firm ground, though at the price of a much greater expenditure of energy. As with skis, the

soldier's rate of movement will be determined by the consistency of the snow. Some areas, where the snow is exceptionally loose and deep, may virtually preclude movement, while in other areas, where the snow is packed hard enough to support a soldier's weight, aids to movement such as snowshoes or skis may be unnecessary.

Snowshoes are very useful for soldiers who are performing tasks that require unhindered use of hands and arms, because ski poles are not necessary (although they can be a valuable aid to helping heavily laden soldiers maintain their balance). When enemy contact is possible, snowshoes are ideal, because they allow the best compromise between mobility and the soldier's ability to carry his or her individual weapon at the ready.

A brief list of the advantages and disadvantages of snowshoes over skis includes the following:

A. Advantages

1. Snowshoes are simple to use, and soldiers require little training

2. Snowshoe training programs rarely result in the number of bruises, twists, and sprains that are encountered in the normal course of a unit ski training program

3. Soldiers on snowshoes can generally pull heavier loads than can soldiers on skis

4. Snowshoes are somewhat easier to maneuver through rough/densely forested terrain than are skis

5. Snowshoes are durable, requiring less maintenance than skis

6. Snowshoes are light, and are easy to pack/carry

7. Snowshoes leave the hands and arms free to perform other tasks

B. Disadvantages

1. Snowshoes do not glide, and so do not make best use of the characteristics of snow

2. All other factors being equal, snowshoes are far more tiring to use than are skis

3. On steep slopes snowshoes lack traction and will slide, causing soldiers to lose their footing

VI. Trail Breaking

The purpose of trail breaking is to use a small body of troops to prepare a track or trail so that the main body can move as easily and as quickly as possible, arriving at their destination fresh and ready for follow-on missions. A trail breaking party is generally responsible for performing four tasks; these are reconnaissance and selection of the route, navigation (both covered in chapter 7), preparation of the route, and acting as an advanced guard for the main body. Leaders should consider the following when deciding whether, when, or how to use a trail breaking party:

A. Planning

Whenever a commander contemplates an over-snow movement that does not make use of existing tracks, he should automatically incorporate the use of a trail breaking party into the plan. Although the general route and the number of routes are determined by the commander in overall charge of the operation, the detailed selection will depend upon conditions underfoot, and the responsibility for this decision must rest with the leader of the trail breaking party.

1. The initial selection of a route is made based upon maps and aerial photographs, as well as any information that can be gathered from reconnaissance reports or local inhabitants. Factors to be considered are:

a. The tactical situation

b. The main body's method of movement, and the equipment they will be required to carry

c. The terrain

d. Snow, weather, and light conditions

2. The commander will also have to determine the size of the trail breaking team. This number could be as large as one third of the total force moving; a rule of thumb is that a squad breaks for a platoon, a platoon for a company, and so on. The final determination will depend upon a number of factors, to include:

a. The size of the main body, and the number of trails required to accommodate it.

b. The likelihood of enemy contact. A security force may need to accompany the trail breakers

c. Anticipated difficulties in opening the route

3. The commander will have to determine how far in advance of the main body the trail breaking team will depart. The trail breaking party should depart in time to reach the destination and to provide local security before the arrival of the main body. The trail breakers should not be allowed to get so far ahead of the main body that they move outside the radius of available indirect supporting fires. They must also maintain contact with the main body so that the commander can be made aware of any changes to the route or tactical situation. When determining the trail breaking team's departure time, consider the following:

a. The type of terrain

b. Weather, light, and snow conditions

c. The number of trails to be broken

d. The degree to which the trails need improvement

e. The tactical situation

B. Organization

Once the sub-unit leader has been tasked to perform the trail breaking mission, he or she must organize the party and assign duties within the team. The leader should make every effort to preserve the tactical integrity of the element selected to actually break the trail. For example, If the trail breaking

party consists of a platoon, and only one trail is being broken, one squad will break the trail, with the other squads rotating as the breaking element tires.

1. Within the element actually breaking the trail, organization is as follows:

   a. Party Leader: Selects the route, navigates (if a navigation patrol is not utilized), and rotates teams within the party

   b. Breaker: This soldier is first in the order of movement, and breaks the initial trail

   c. Straightener: Straightens curves and improves the direction of the trail; this soldier forms a team with the breaker, and they will frequently exchange duties

   d. Right Cutter: Cuts obstructions from the right side of the trail

   e. Left Cutter: Cuts obstructions from the left side of the trail. The two cutters form another team, and are also responsible for widening the trail; the right cutter will move with his left foot in the right ski or snowshoe track of the straightener, and the left cutter will move with his right foot in the left track of the straightener

   f. Trail Packers: The remainder of the party constitutes the packing team; they improve the trail by filling in small holes and ditches, flatten the trail where it runs side-slope, and mark the route. As with the cutters, packers should alternate tracks to widen the trail

2. **Besides organizing the personnel within the breaking team, the party leader must ensure that the breakers are properly equipped. The following equipment should be carried:**

   a. Party Leader: Compass, map, route card, and any other navigational aids available (GPS etc.)

   b. Breaker/Straightener: Machete and wire cutters each

   c. Cutters: Ax and machete each

   d. Packers: Shovel each, as well as trail-marking material

C. Marking the Trail. A trail will usually need to be marked, especially if it crosses existing trails or if it will be used during periods of limited visibility. Any of the following methods may be used, as long as the main body is aware of what to look for.

1. Branches on trees and bushes broken in a predetermined manner

2. Flags, sticks, or guiding arrows placed in the snow

3. Markers made of rags or colored paper tied to trees

4. Cairns of stones or small piles of brush

5. Chem lights may be used, but should be shielded from enemy observation. Remember that chem lights, when cold, will illuminate weakly if at all

VII. Ahkio Pulling

At times, a commander may determine that the soldiers under his or her command must have their ahkio groups immediately available regardless of their location. If the terrain or weather preclude transportation assets accompanying dismounted soldiers, those soldiers will have to pull their ahkios along with them. Pulling ahkios over snow-covered terrain is a time-consuming and labor-intensive task, and commanders must allow for this in the planning process. At the level of the unit tasked to execute the movement, consideration should be given to the following:

A. Proper equipment. Ensure that each ahkio group to be pulled along is equipped with the following items:

1. Three 9 foot towing ropes

2. One 27 foot towing rope with snap-connector

3. Four towing harnesses

B. Movement technique. Select the movement technique most appropriate to the conditions and, most importantly, to your soldier's level of training. Towing an ahkio while on skis demands an extremely high level of proficiency. Snowshoes are usually the wiser choice insofar as movement techniques are considered. If skis are used, the personnel doing the actual towing should be equipped with climbing skins; wax will often not provide the necessary traction. If skins are not available, wax heavily or use snowshoes.

C. Towing arrangement. Utilize the correct towing arrangement for the terrain. Personnel may have to disconnect their tow-rope from the ahkio and reconnect it at a different attaching point as the terrain changes. There are different configurations for flat ground, ascending, descending, and moving side-slope (see figure 8-1).

D. General tips. The following apply regardless of movement technique

1. One team member coordinates the movements of the ahkio-pulling team

2. On steep slopes, a 120 foot rope may be used to raise or lower the ahkio

3. Ahkio-pulling teams must be rotated frequently to avoid exhaustion

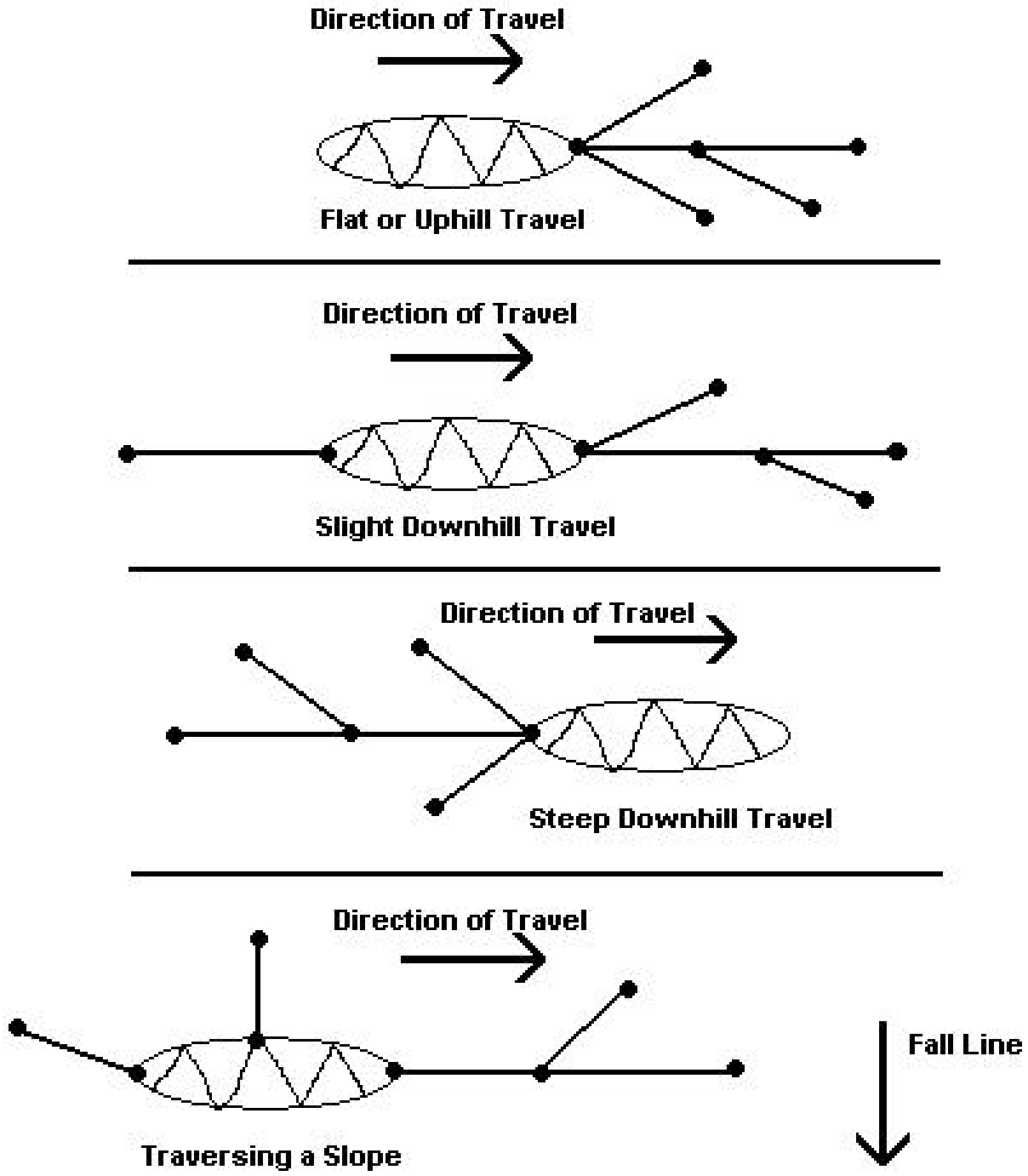

Fig. 8-1 Ahkio Pulling Configurations

Chapter 9

Nuclear, Biological, and Chemical

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Introduction

Cold weather and other severe climatic conditions create many new problems in individual protection. Such conditions may exist in the extreme northern regions of the continental United States, Alaska, northern Europe and Asia, as well as the high latitudes and elevations of the southern hemisphere. Generally, these conditions alter the planning and implementation of individual NBC defensive measures. The following paragraphs explain some of these particular situations and the procedures that individual soldiers should take to protect themselves.

I. Nuclear

A. Blast Effects

At subzero temperatures, the radius of damage to material targets may be increased by as much as 20%. However, irregular terrain features can break up the pressure wave, somewhat mitigating the blast effects. Blast effects can drastically interfere with troop movement. A blast can break up covers and cause rapid thaws. In mountainous areas, this may result in avalanches. In areas with permafrost, a blast may sufficiently disturb the permafrost to restrict or disrupt movement.

B. Thermal Effects

Ice and snow have a high reflectivity. This may increase the minimum safe distance by up to 50% for unwarned troops, as well as for warned, exposed troops. Reflectivity may also increase the number of personnel whose vision is affected by the brilliant flash, or light dazzle, especially at night. The pale colors normally used to camouflage personnel and equipment in snow-covered terrain do offer some advantages. Their low absorption properties make personnel less vulnerable to thermal effects. Cold temperatures also reduce thermal effects on materiel. Snow, ice, and even frost coverings on combustible material greatly reduce the tendency of these items to catch fire. However, thermal effects will dry out exposed tundra, and grass fires may result.

C. Radiation Effects

In cold regions, which are characterized by a lack of highly developed road networks, the weather conditions may further restrict accessibility to the existing roads. When radiological contamination is added, troop and resupply movements may become severely restricted. Seasonal high winds experienced in many cold regions may present problems when attempting to predict radiological contamination. Such winds may reduce dose rates at ground zero, while at the same time extending the area covered by contamination. Hot spots, or areas with concentrated accumulations of radiological contamination, may occur in areas of deep or drifted snow. All of these factors may present difficulties for survey/monitoring teams. In addition, since monitoring for radiological contamination is accomplished using battery-powered radiac equipment, cold temperatures make it difficult to maintain this equipment at maximum operating efficiency. Therefore, aerial survey is the most practical method of determining radiological contamination in cold environments.

D. Protection

In cold regions, troops operating in the field are particularly vulnerable to all of the effects produced by a nuclear detonation primarily because of the difficulties encountered in digging fighting positions and underground fortifications for protection. Shelters and fortifications constructed from snow and ice provide some protection, but, whenever possible, they should be constructed to take the maximum possible advantage of the existing protection provided by natural terrain features. Unfortunately, tents, which provide the heated shelter necessary for

operations in cold weather, provide no protection from radioactive fallout. Again, you should take the maximum possible advantage of natural terrain features to protect tents from fallout.

Although they are not as effective as earth when it comes to reducing radiation hazards, snow and ice are readily available, and can be used to provide shielding against radiation effects. Loose snow falling on contaminated areas has a half-thickness of about 24 inches; that is, 24 inches of loose snow covering the contamination will reduce the dose rate to about half of the original value. The half-thickness of hard-packed snow is approximately one foot. This information may be useful when constructing radiation shields over contaminated areas or around shelters.

II. Biological

A. Vectors

A vector is a carrier, especially the animal or intermediate host that carries a pathogen, or specific causative agent such as a virus or bacterium, from one host to another. One example of a vector is the malaria-carrying mosquito. Most vectors will not survive in a cold environment, and it is more difficult to aerosolize live biological agents in temperatures which are at or below freezing.

B. Toxins

Toxins are a class of biological poisons produced as a byproduct of living organisms. Toxins may be obtained naturally, or they may be synthesized. One example of a toxin is Anthrax. Toxins are much less susceptible to cold than are vectors; it has been found that the survival of microorganisms increases significantly when temperatures are below freezing. Temperature inversions, which often occur in low-lying areas during periods of cold weather, tend to prolong the integrity of an aerosolized biological cloud, causing it to disperse more slowly and remain a threat longer than it might do so otherwise.

C. Methods of Delivery

Biological warfare is a possibility in cold regions, and the most likely method of introducing such agents to the battlefield will be by covert means. Personnel operating in cold weather environments are more susceptible to live biological agents due to the rapid rate with which diseases will spread in warm crowded conditions, such as the tents and heated shelters required for sustained operations on the cold weather battlefield. The difficulties encountered with providing troops with adequate food, water, and rest, and in enforcing minimum standards of personal hygiene during operations in cold regions will result in soldiers who are particularly vulnerable to biological attack.

D. Protection

Since the best method of delivery for biological warfare agents in cold regions is by covert means, it is important for you and your soldiers to be alert for sabotage at all times. Ensure that adequate security procedures are established and enforced. The best way to protect yourself and your soldiers from the effects of biological weapons, other than inoculation, is to ensure proper hydration and nourishment, to establish and enforce rest plans, and to enforce high standards of personal hygiene.

III. Chemical

A. Blister Agents

When temperatures are at or below freezing, blister agents are usually not effective as casualty-producers because the agents themselves are frozen (see Table 9-1). However, some agents or combinations have very low freezing points, and can be effective as harassing agents; their vapors may produce eye irritation, causing troops to mask. The additional clothing required during cold weather greatly reduces the possibility of skin contact. The greatest danger posed by blister agents is that the

frozen agent may be carried into heated shelters by personnel whose clothing has been contaminated; once inside the heated area, the agent vaporizes, with predictable results.

B. Nerve Agents

Nerve agents remain liquid in all but severely cold temperatures. Agent evaporation takes longer than under ordinary conditions, forcing soldiers to remain masked for long periods. Significant contamination may remain for several days when both temperatures and wind speeds are low. Because nerve agents do remain liquid at low temperatures, they are easily absorbed by clothing and other porous materials. These absorbed agents may become both vapor and contact hazards when contaminated clothing is worn into a heated shelter.

STATE	**32F (0C)**	**-15F (-26C)**	**-70F (-57C)**
SOLID	Distilled mustard (HD)	All other chemical agents except those below	Hydrogen cyanide (AC)
	Phosgene oxime		Cyanogen chloride (OX)
	Mustard-lewisite (HN-3)		Nitrogen mustard (HL)
			Lewisite phenyldichloroarsine (PD)
LIQUID			Phosgene (CG)
			Distilled mustard (HN-2)
			Arsine (SA)
			Ethyldichloroarsine (ED)

Table 9-1 Chemicals Vs. Temperatures

C. Blood and Choking Agents

Blood and especially choking agents remain extremely hazardous, as well as non-persistent, throughout low temperature ranges, requiring soldiers to mask whenever they are present. Due to their extremely low freezing points, these agents may be delivered as liquids, solids or aerosols (see table 9-1). Although it becomes solid at –15°F, blood agent AC (hydrogen cyanide) remains extremely dangerous in temperatures as low as –65°F.

D. Individual Equipment-Related Problems

1. Protective Masks

Soldiers should add the M4 winterization kit to their masks for cold weather use. For both the M17 and M40 series masks, pull the hood voicemitter-outlet valve assembly cover opening to below the cover. This will prevent exhaled moisture from wetting inner clothing. Soldiers wearing masks with winterization kits installed will experience greater breathing resistance. This difficulty will increase with a soldiers' work-load, and becomes even more pronounced when the soldier becomes fatigued. During periods of extreme cold, hoods will be more likely to tear, and zippers to malfunction.

2. Fitting of masks for use in cold weather requires great care. Soldiers should adjust their mask only tight enough to provide a good seal; if a mask is too tight, it may result in restricted circulation to certain areas of the face, increasing the danger of frostbite. To prevent contact frostbite, have your soldiers place a small piece of tape over the metal rivets inside the face-piece; ensure that the tape is only large enough to cover the rivet, not so large as to prevent proper donning or operation of the mask.

3. To keep masks warm and flexible, soldiers should wear mask carriers beneath their outer garments. In extreme cold, soldiers may need to carry masks beneath the insulating layers of clothing. Carrying masks in this manner requires an adjustment to donning time, and makes early detection of the presence of chemical agents even more critical.

4. To don winterized protective masks, use the following eight-step procedure:

a. Stop breathing

b. Lower parka hood

c. Remove gloves or mittens as needed to properly don mask

d. Remove mask from under parka

e. Don the mask

NOTE: Do not clear the mask by exhaling a large quantity of air into it; this will frost the eye lenses. Instead, clear the mask by exhaling slowly and steadily. The outlet valve may stick to its' seat. If this occurs, lift the outlet valve cover and rotate the disc with a finger while *exhaling only.* Once the valve is free, reseat the valve cover.

f. Check the mask for leaks by pulling down the cheek flaps of the ice particle prefilter and covering the inlet valves with your hands.

g. Fasten the cheek flaps and breathe normally

h. Raise the parka hood and fasten outer garments

5. When removing the mask, the following five steps should be utilized:

a. Brush any snow or ice particles from your mask and hood

b. Remove gloves or mittens as necessary to remove mask

c. Remove mask and immediately dry face and inside of mask

NOTE: Use a small towel or cloth to thoroughly wipe inside the mask; this will prevent ice formation which could render the mask

temporarily unserviceable. Whenever possible, further dry the mask by placing it in a warm, heated environment (avoid drying the mask with direct heat, which could damage it).

d. Store mask in carrier

e. Put on gloves or mittens and close outer garments

6. In both the M24/25 and M43 series masks, cold weather causes the face pieces to become brittle, increasing the danger that they may crack. These masks should always be carried beneath outer garments to prevent this condition from occurring. In addition, the face-form should always be used to prevent creasing/cracking.

7. Battle Dress Overgarments

The BDO is not adversely affected by cold weather. However, leaders must take into consideration the increased risk of cold weather injury, particularly frostbite, when soldiers are in MOPP levels 3 or 4. Personnel will be more susceptible to frostbite of the fingers, hands, and any other areas where the elastic closures of the BDO may restrict circulation, as well as to frostbite of the face and ears due to the buildup of sweat inside the hood and mask. When an existing MOPP level is downgraded, there will also be an increased risk of hypothermia, due to the fact that clothing worn under the BDO may have become perspiration soaked while personnel were performing their duties at the higher MOPP level.

8. Chemical Protective Gloves

During cold weather operations in a chemical environment, the cotton glove liners, which are issued with the chemical protective gloves, should be replaced with the five-finger wool glove insert. Proper glove fit is critical to prevent the cold weather injuries which will result from restricted circulation. During periods of extreme cold, the Arctic mittens should be worn over the rubber gloves. Whenever mittens are removed, the glove surface should be decontaminated before redonning the mittens.

9. Nerve Agent Antidote Kit, Mark I & II

NAAK's freeze at about the same temperature as water (+32°F). Whenever temperatures drop below +40°F, the NAAK must be removed from the protective mask carrier and placed in a shirt pocket, where they can be kept as close to body temperature as possible. This will preclude the danger of severe muscle spasms or shock caused by injection of an extremely cold liquid into a muscle. If a kit freezes, do not use it; acquire a replacement.

NOTE: NAAK's must be protected from freezing and thawing during transit, storage, and resupply operations because **FREEZING AND THAWING RENDER NAAK'S UNSERVICEABLE.** When NAAK's are utilized during cold weather operations, personnel must ensure that the injector(s) will penetrate the additional layers of cold weather clothing they are wearing.

10. M258A1 Skin Decontamination Kit

The M258A1 kit should be warmed prior to use, or carried under the outer garments. If the kit is used during periods of extreme cold without first being warmed, the supercooled solution saturating the decontamination pads may cause contact frostbite, similar to spilling cold-soaked POL products on exposed skin. During extreme cold weather, the M291 kit is preferred over the M258A1, because it is a resin-based kit with no liquid contents.

11. M256/M256A1 Chemical Agent Detector Kit

a. These kits can give inaccurate indications when temperatures are –15°F or colder. The solutions in the capsules may freeze, and, even if they are thawed, they will no longer work. Also, during cold weather, it is difficult or impossible for the heat tab to heat the enzyme window to a reaction temperature. These kits should be stored at temperatures above +32°F, either by keeping them in a heated storage area, or by carrying them inside the insulating layers of clothing. Do not attempt to keep them warm by placing them on direct heat sources such as vehicle heaters.

b. One method to effectively use this kit is to collect a sample of a suspected agent on M8 or M9 paper, and place both the paper and a detector kit in an enclosed container such as an empty ammunition can. The can is sealed, and then heated with an external heat source such as a fire or heat tab. This will heat the sample enough to cause agent off-gassing, allowing the detector to function. Of course, soldiers should take the necessary protective measures prior to opening the can to determine the detector kit results.

12. M8/M9 Detector Paper

M8/M9 detector paper is not affected by cold temperatures. However, an agent must be in liquid form for the paper to be able to detect it. Therefore, suspected agents should be collected with a stick or scraper, and wiped onto the detector paper. The paper may then be heated on a heat source such as a vehicle or generator engine to stimulate thawing and subsequent identification of the agent. For obvious reasons, this task should not be performed inside a heated vehicle or tent.

E. Collective Protection

Chemical hazards pose a real challenge to collective protection on the cold weather battlefield. Most collective protection systems which operate on atmospheric overpressure have proven reliable and durable under conditions of extreme cold, however, pressure fluctuations may occur when these systems are exposed to high winds. In cold weather, indirect vapor absorption presents the greatest problems in entry and exit from the shelter. Because of this, it is important to have detection capability inside the shelter. If an agent is detected in the shelter, all personnel immediately mask. Soldiers inside the shelter are then monitored to determine who brought in the contamination. Once identified, that soldier exits the shelter, which is then purged. If follow-on detection proves negative, normal entry/exit may be resumed.

Chapter 10

Helicopter Operations

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Introduction

The helicopter is the single most valuable mobility asset available to soldiers during cold weather operations. It can move you farther and faster than any other means of transportation, but, it is not without its' limitations and the greatest of these is unreliability. Unpredictable weather and the difficulty of performing even routine maintenance in the cold will limit the helicopter's usefulness. What this means to you as a leader is that you must always have an alternate plan for movement which will get you to your destination in time to accomplish your mission. Use the helicopter whenever possible but ensure that you avoid becoming dependent upon it.

I. Landing Zones

Helicopter operations on ice and snow covered landing zones are characterized by a deliberate reduction of the tempo of the operations. Loading, unloading, approaches and departures, seat belt hookups, crew chief directions, and passenger and aircrew coordination regarding the flight, will all require more time, which must be taken into account during the planning process. Plan for additional time delays during cold weather helicopter operations.

A. Selection

You will probably never have the perfect LZ available when you need it. Listed below are some of the LZ selection factors peculiar to snow-covered environments that you should consider when you plan for air assault operations:

1. Minimum size- 150m x 150m for CH-47, 100m x 100m for the UH-60 and UH-1. These increased sizes are designed to compensate for the hazards posed by rotor-wash induced white-out. In areas where snow cover on the LZ/PZ has been firmly packed/frozen, and you are sure that there is no hazard from blowing snow, they may be reduced. In areas where there is a danger of white-out, multiple landing points should be spaced 150m apart, in all directions.

2. Approaches and Exits- should be clear of obstacles over 25ft. tall on the perimeter of the LZ, otherwise the size of the LZ must be doubled

3. Wind Direction- determines approach and departure direction; helicopters normally land and take off into the wind

4. Ground Surface- should be smooth and flat

5. Ground Slope- 10° maximum

6. Concealment- preferably concealed from enemy observation. Select LZ's that will conceal both the aircraft and its "snowball" signature from enemy observation. The "snowball" signature, caused by rotor-wash-blown snow, may be visible up to 20 km away. Remember that helicopters must spend more time in both LZ's and PZ's, due to the increased amount of time required for loading and unloading.

7. Obstacles- Not to exceed 18 inches in height; could be hidden under snow, suspicious lumps and dips should be investigated

8. Snow- Blowing snow causes reduced visibility; depth and consistency will have a major impact on difficulty of LZ operations. Remember that loose snow will blow; hard or crusted snow may or may not blow, but if crusted snow does break up and blow, it may create a danger to both personnel and aircraft.

B. Preparation

Whenever possible you should walk through the LZ area to determine an appropriate location for the helicopter to touch down and to determine both the depth and consistency of the snow and whether or not obstacles are present.

1. If possible, pack the entire LZ, if not, try to pack an area at least 50m square at each actual landing point. The area should be uniformly packed so that one ski will not sink causing the helicopter to land unevenly, possibly resulting in a dynamic rollover. Use over snow vehicles as the most efficient way to pack LZ's/PZ's, if they are not available, soldiers on snowshoes, skis, or foot will work, but not as efficiently. Remember that packing takes time, and may increase the chance of the enemy detecting the LZ.

2. Probe the area for obstacles that could puncture the underside of the helicopter if it sinks into the snow. All obstacles within the LZ/PZ should be clearly marked.

3. Packed trails from the landing area to the assembly area should be established so that the helicopter can be approached without snowshoes.

4. If more than one helicopter will be using the LZ simultaneously, the landing points should be at least 150m apart due to blowing snow. Landing formations should maximize lateral as well as longitudinal separation; in other words, **staggered trail, echelon, and heavy formations are best, because trailing aircraft will be less affected by the "snowball" created by aircraft ahead of them.**

5. Frozen lakes and rivers make excellent LZ's since they are level and have little loose snow due to wind scouring. Ice thickness must be checked: 8 inches is required for a UH-1 and 15 inches for a CH-47 or UH-60, (both measurements are for one time use only, see Appendix A). Beware of helicopters skipping on the ice during landing and takeoff and from wind gusts while on the ground.

C. Marking the LZ and Landing Points

Effective markings are critical to the safe and effective use of the LZ. Particular attention must be paid to the local “white out” effect caused by "rotor wash" when the helicopter lands. It is very important to provide the pilot with a visible reference point on the ground within the rotor-arc of his aircraft. Any markings outside of the rotor arc will probably become invisible to the pilots, due to blowing snow, especially as airspeed slows to near zero in a hover.

1. The LZ can be marked using conventional panels, lights, etc. It can also be marked in the snow by using rescue survival dyes, dirt sprinkled in the snow or any dark material that is heavy enough that it does not pose a FOD (Foreign Object and Debris) danger. If dirt is used, pour water on it to freeze it into position and prevent it from being blown away. When VS-17 panels are used, the cerise (red) side of the panel provides better contrast against a snowy background.

2. Colored smoke grenades can be used to mark the LZ and indicate wind direction, but must be placed on a flotation device to prevent them from sinking into the snow. Do not use white smoke! Smoke may be used to mark LZ's but avoid using it to mark individual landing points; smoke may enter the cockpit and interfere with the pilots if placed too close to the landing point.

3. The ahkio huddle is the easiest and best way to mark individual landing points. Remember that the huddle must contrast in color to its background; soldiers should remove overwhite camouflage if this technique is used. Ahkio huddles should be positioned within the rotor arc of the aircraft that they are going to load, to the right front of the aircraft when it is on the ground. As long as prior coordination is conducted with the lift unit, this position may be modified to keep huddles from being located on the uphill sides of aircraft. Ahkio huddles should

maintain as low a profile as possible, to reduce any danger that may occur if the aircraft if settles in the snow.

To form an Ahkio huddle, a single loaded and securely laced Ahkio is placed where the light or panel marking the HLP would normally be, and the squad, with overwhite tops removed, crouches around the Ahkio. During limited visibility, the group leader may use a strobe or chemlite to help mark the landing point.

4. To help guide the pilot to the landing point, and to help his depth perception, one technique is to bury a snowshoe into the snow, with only a few inches sticking out, and tie a dark cloth securely to the end. Even with a snow cloud the pilot can see objects within his or her aircraft's rotor arc. Remember that regardless of what is used to mark the LZ, it must both contrast with the snow and be firmly anchored.

5. If a signalman is used at the landing or sling load point, he or she must remove overwhite camouflage, wear a protective face mask and goggles, and ensure that no bare skin is exposed to the rotor wash. Because the helicopter may slide forward on landing, or settle in the snow, the signalman should stand outside the rotor arc, and at least 50m forward of the touchdown point.

6. If loose snow covers the LZ, be prepared to provide enough room for the helicopter to land with a slight forward creeping motion to ensure better visibility for the pilot.

D. Landing Zone Brief

The pre-landing brief from the LZ to the pilot should include the following:

1. Description of LZ

2. Wind direction and estimated speed in knots

3. Depth of snow, packed or not

4. Obstacles or suspected obstacles

5. Any special consideration that will delay embarkation significantly

6. Last known enemy location

II. Preparation of Personnel and Equipment

A major hazard to personnel operating around helicopters in cold weather is the wind chill generated by the rotor wash. Exposed skin should be kept to a minimum, and goggles should be used as required.

A. Personnel

1. If a long wait is expected warming tent(s) should be erected. At the very least some form of protection from the elements should be provided, even if it is only a windbreak.

2. Prepare a manifest of each chalk. One copy should be given to the crew chief and the other left with the personnel on the ground.

3. Soldiers waiting to board helicopters should be positioned near the landing point, within the rotor arc. All soldiers should ensure that their personal gear is firmly secured. Chalk leaders must ensure that group equipment is secure, and that the ahkio is laced tightly shut.

B. Equipment

1. If an Ahkio huddle is not used the ahkio should be staged as near to the landing area as possible. To prevent the ahkio from being moved by the rotor wash it may be necessary to stake it down.

2. Weapons will be unloaded

3. No equipment should be allowed to protrude above the height of a man, (skis, radio antennae, etc.).

4. When using the CH-47 packs should be worn while approaching the aircraft; you may stage the packs with the ahkio when using the UH-1 or UH-60.

III. Embarkation and Debarkation

The embarkation and debarkation drills described below are designed to get your personnel onto and off of the helicopter as soon as possible with the minimum exposure to wind chill. These procedures must be practiced so they can be performed efficiently during periods of extreme cold weather and reduced visibility.

A. Embarkation

In planning chalks, the tent group must be used as the basic unit. It is essential that all of the tent group equipment be on the same aircraft as the personnel it belongs to.

NOTE: This may not be possible with the UH-1 due to lift limitations of the aircraft.

Failure to observe this rule may result in soldiers and their equipment landing in different locations. As mentioned earlier the ahkio huddle is the best
method for marking PZ's and for loading aircraft. The benefits of this technique include reduced danger of soldiers walking into rotor blades, reduced exposure to windchill, reduced fuel consumption by aircraft, reduced delays when loading/unloading, reduction of signature by, and exposure of, helicopters on LZ's/PZ's.

1. When the helicopter approaches, all personnel should crouch and face away from the aircraft. After touch down there will be a noticeable decrease in rotor wash; this will indicate to the team leader to face the helicopter.

2. The signal to approach the helicopter is when the ramp is lowered on the CH-47 or when the door is opened on the UH-1 or the UH-60.

3. If the LZ is on a slope do not approach the helicopter from up slope.

4. Use extreme caution when approaching the helicopter. If the helicopter sinks into the snow the plane of the rotor blade will drop much closer to the surface than normal.

5. Snowshoes should be hand-carried parallel to the ground at waist level and are held between the knees along with the weapon once seated.

6. In deep snow, where proper LZ preparation has been difficult, personnel may have to approach the helicopter while wearing snowshoes. This will slow down loading since they must be removed prior to entering the aircraft; remove them while sitting on the ramp of the CH-47 or the edge of the door of the UH-1 or UH-60. In this situation only a minimum of personnel should approach the aircraft at a time to reduce exposure to rotor wash.

7. If loading a CH-47, two soldiers should be designated to load equipment. All others should enter the aircraft, move forward, and take their seats. The chalk leader will supervise loading the ahkio and any other equipment. These items should be near the ramp because they will be the first items unloaded.

8. Generally, packs are placed with the other tent group items or in an area designated by the crew chief.

9. As soon as possible after entering the aircraft, each soldier should brush all ice and snow from his uniform and then open his clothing to prevent overheating.

The crew chief will maintain the inside temperature at approximately +45°F. This is important, and should be pre-coordinated with the lift unit; if not, your soldiers may arrive at the LZ sweat-soaked, which will greatly increase their likelihood of becoming environmental casualties

B. Debarkation

As with embarkation procedures, the objective during debarkation is efficiency and safety. The following procedures are for a worst case situation, i.e., extreme cold, deep snow, and possible enemy in the area.

1. The ahkio and any other equipment items should be unloaded first.

2. All personnel then exit the starboard side, rear on a CH-47. If on a UH-1 or UH-60 exit both sides.

3. Do not attempt to move away from the aircraft as you would on firm ground. Move a short distance, staying within the rotor diameter, lie down, and allow the helicopter to move away from you.

4. Some personnel should be designated to lie on top of the equipment to prevent it from being blown away by the rotor blast.

5. It is important to understand that during the period when your personnel are debarking, visibility may be poor. Ensure each soldier knows where he or she is to go.

6. The snow cloud created by the helicopter upon landing may be seen from a considerable distance. Therefore you should move away from the LZ as soon as possible. You should also consider planning for false insertions to confuse the enemy as to your intentions. These false insertions should last long enough to be plausible and to create a noticeable signature.

Chapter 11

Effects of Cold on Military Equipment

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Introduction

In cold regions, climatic conditions will greatly affect the operation and employment of different types of military equipment. Every soldier must be aware of the limitations and special considerations imposed upon his equipment by cold weather. Failure to educate your soldiers on the effects of cold on military equipment may result in failure to accomplish your mission.

I. Effects of Cold on Military Vehicles

Movement in cold weather environments can be one of the most difficult tasks that a unit may encounter. Vehicles are the most preferred method of movement, but, with cold weather comes a higher maintenance requirement and incidence of problems. Some of the most commonly encountered problems are listed below, along with some useful problem-solving tips, which may assist you in accomplishing your mission:

A. Standard Winterization

1. Ensure that proper antifreeze/water mixture is utilized. Generally a 60% antifreeze, 40% distilled water mixture offers the best protection against extreme cold temperatures

2. Inspect all belts and hoses for cracks, dry-rot, or breaks, and replace as necessary

3. Ensure vehicles have correct thermostats installed

4. Install winterfronts or radiator shutters

5. Ensure that the vehicle personnel heater is mounted and operational

6. Ensure that tire chains, swingfire heaters (see Appendix G), ice scrapers, and other equipment required for operation in cold/icy/deep snow conditions is present, and that vehicle crews are thoroughly trained in their use. Tire chains should be pre-fitted to vehicles, and their mounting/dismounting should be a crew drill.

B. Lubrication

1. Check applicable TM's and FM 9-207 for recommended lubricants

2. Store lubricants in warm place

3. OEA (oil, engine, arctic) is generally best for cold weather operations, and can be used for short periods of time in temperate conditions. This will allow you to winterize vehicles prior to load-out when deploying from a temperate to a cold region.

C. Tires

1. Tires become more rigid and develop flat spots when parked in extreme cold temperatures.

2. Inflate tires, in a warm environment such as motorpool, to 10PSI above normal. This allows for contraction and pressure loss once vehicle is out in the cold.

3. Place barrier materials(spruce branches, cardboard) under tires to prevent freezing to ground when parked for long periods of time.

D. Batteries

1. Batteries are adversely affected by the cold, available power decreases as battery temperature decreases.

2. Ensure weak or dead batteries are not frozen; they can explode when attempting to “jump start”.

3. A fully charged battery will not freeze.

E. Fuels

1. Mogas in not significantly effected by cold temperatures.

2. Diesel Fuel Arctic (DFA), is recommended for use when temperatures are –10 or colder.

3. Clouding, (formation of waxes), occurs in diesel fuel at low temperature.

4. Additives can greatly inhibit icing and fuel line freeze-up.

F. Vehicle Starting

1. Always PMCS vehicle before, during, and after vehicle operation. Follow the TM when doing so.

2. Start engine and allow vehicle to idle for approximately 3 minutes before moving.

3. Drive slowly at first, allow time for moving parts to reach operating temperatures before increasing engine speed.

4. Downgrade all hoist and winch capabilities. Certain metals will lose up to 50% of their shockload tensile strength at temperatures of –20°F or colder.

5. Ensure that correct engine idle is set for proper battery charge (usually 1100-1200 rpms). This may increase for vehicles that operate as a command or communications vehicle.

(For detailed procedures regarding the SUSV, see Appendix F)

II. Cold Weather Related Weapon Problems

A. Care and Maintenance

Weapons will function under extreme cold conditions, if given proper care. Lubricants that are normally used under temperate conditions, such as CLP, thicken in cold weather and stoppages or sluggish weapon action will result from their use. CLP will freeze at –35F To eliminate this problem, the weapon must be completely stripped, thoroughly cleaned, and lubricated with LAW (Lubricating oil Arctic Weapons). As a minimum, the camming surfaces of the bolt should be lightly oiled with LAW. The rest of the weapon can be left dry. LAW is not available in the refillable half ounce bottles normally found in weapons cleaning kits, but is available in larger sized one quart containers (NSN 9150-00-292-9689). If LAW is not available, use a dry graphite lubricant or fire weapon dry.

B. Condensation on Weapons

1. Condensation forms on weapons when they are taken from a cold into a warmer environment. This is called "sweating". If weapons are taken back into the cold without removing the condensation this "sweat" can turn to ice, which will result in stoppages. For this reason, it is best to leave weapons outside when temperatures are below freezing. When left outside, weapons should be readily accessible, but sheltered, so that ice and snow will not get into the working parts of the weapon (sights, barrel).

2. If necessary, weapons may be taken inside for cleaning. The condensation or “sweating” will continue for approximately one hour after introduction of the weapon into a warm shelter. Wait until the “sweating” process has concluded,

then, begin to thoroughly clean the weapon. If weapons are to be kept in heated shelters, they should be kept near, but not on, the floor to minimize condensation.

> **NOTE: To prevent condensation from forming on objects moved from a cold to a warm environment, place the object in a sealed non-breathable container. A plastic trash bag will suffice. This prevents exposure of the object to the warmer environment. The condensation will form on the container instead of the object. When the object is “room temperature,” remove it from the container.**

C. Snow and Ice

To keep snow and ice out of a weapon, some type of cover is needed. Request muzzle caps from the unit armorer, they are expendable and will do the job. If none are available, you may have to improvise. Some ways of doing this are: using plastic bags, tape, or condoms.

D. Ice Fog

A visibility problem can be encountered when weapons are fired in still air conditions where temperatures are below –30°F. As the round leaves the weapon, the hot

propellant gases cause the water vapor in the air to condense. These droplets of condensed water vapor then freeze, creating ice particles which produce a cloud of ice fog. This fog will hang over the weapon and follow the path of the projectile, obstructing the gunner's vision along his line of fire, as well as revealing his location to the enemy. When faced with this problem, fire at a slower rate and/or relocate to an alternate firing position.

E. Breakage and Malfunctions

1. Extreme cold causes metal and plastic to become more brittle than it is at warmer temperatures.

2. Breakage generally occurs early when a cold weapon is fired; the metal is heating and rapid and unequal expansion of parts is occurring. Begin firing small arms at a slow rate of fire in extreme cold weather, if the tactical situation permits. This will greatly reduce the likelihood of the weapon malfunctioning .

3. Freezing of moisture produced by sweating or the accumulation of snow or ice in the weapon will also cause malfunctions and stoppages.

4. After a weapon has been fired, the heat it has generated can cause any snow or ice it comes into contact with to melt. This water will then re-freeze and may cause the weapon to malfunction.

III. Tips To Remember For Organic Weapons

A. 9mm Pistol (Beretta)

1. Breakage of moving parts is rare, but some breakage of the extractor and the firing pin does occur.

2. This weapon is affected by condensation more than other weapons, due to the fact it is most often carried by personnel whose duties require them to frequently enter and exit heated shelters and vehicles. Freezing generally occurs around slide and magazine well

B. M16A2/M4

1. Little breakage will occur if the weapon is fired at slow rate of fire until warm.

2. Breakage usually occurs around the extractor, ejector, and firing pin.

3. The buffer group's ability to absorb shock is decreased, thus increasing the chance of breakage.

4. Re-zero the weapon when deploying from a temperate to a cold environment. Cold temperatures may cause a decrease in the burning rate of propel- lants, which can significantly change projectile trajectories. In effect, this will nullify the zero of the weapon.

C. M2, M60, M240, M249 Machine Guns

1. High rate of breakage due to the large number of moving parts.

2. Unit armorers should carry plenty of spare parts, especially those most prone to failure (firing pins, extractors, feed pawls, etc).

3. Buffer groups are affected in the same manner as the M16A2 buffer assembly.

4. A common malfunction is “short recoil” (bolt does not recoil fully to the rear) which occurs early in firing. Apply immediate action procedures until metal warms.

5. Never place a hot barrel directly in the snow when changing barrels. Not only will this clog the barrel with ice, it may cause the barrel to warp as a result of sudden and uneven cooling.

6. When temperatures are –30°F or colder, automatic weapons may be affected by ice fog. Ice fog is formed as a result of the hot propellant gases produced by the weapon contacting the cold air. The resulting cloud of ice crystals may limit the gunner's observation, and will betray the weapons' position to enemy observation. 2-3 alternate firing positions must be prepared.

7. A firing platform may be constructed from ration boxes or other available materials.

8. Semi- permanent platforms may be constructed by attaching ski pole baskets or snowshoes to the bipod. Ski pole baskets only work well in hard or compacted snow; issuing an extra snowshoe without bindings to weapons crews is preferable.

9. The M-249 Saw safety selector switch is extremely difficult to move when cold soaked.

All weapons are more difficult to operate in extreme cold, if only because of the bulky handgear which is part of the cold weather uniform. As a leader, you must ensure your gun teams not only practice crew drills, but that they do so under real-istic conditions; make your teams practice while wearing arctic mittens, snowshoes, etc.—it will pay dividends for you!

D. M203 Grenade Launcher

1. Not as susceptible to breakage due to the small number of moving parts. If breakage or malfunction does occur, it is most often the result of snow and ice accumulating on the breach face, in particular in the firing pin opening.

2. 40mm projectiles loses some effectiveness due to the shock absorbing effect of snow and resulting increase of the number of dud rounds.

3. Some reduced range is noticeable due to slower burning propellant in cold weather. As with other weapons systems, re-zero the weapon to compensate for the lower temperatures.

E. MK 19 Automatic Grenade Launcher

1. Use GMD lubricant at low temperatures.

2. Use cloth covers rather than plastics to protect the weapon from the elements. In addition, plastic or rubberized covers can become stiff or brittle in the cold. This may result in difficulty removing them (especially when you must do so in a hurry) or in damage to the cover.

F. Mortars

1. Hand protection must always be worn (contact gloves). 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.

2. Breathing on sites, or on the mortar ballistic computer will cause fogging and freezing of equipment.

3. Muzzle and sight covers should be used when not firing the weapon to prevent snow and ice from entering the tube. The Mortar Ballistic Computer is programmed to accept temperatures down to –50°F. This automatically compensates for cold-induced slow burning of charges when computing firing data. The MBC is not programmed for temperature inputs colder than –50°F.

4. Aiming stakes will become loose when placed in snow. Utilize sandbags or an anchoring device to keep them in place once set.

5. Baseplates become brittle when exposed to the extreme cold, this, coupled with the decreased ability of frozen ground to absorb shock, results in baseplates being more prone to breakage than normal.

6. Baseplates must be dug in if possible, to prevent the baseplate from skipping. Shock absorbing materials such as spruce branches, sandbags, etc should be used for absorbing recoil during firing, but not to an extent which will allow the baseplate to bounce out of the hole that has been dug for it.

7. Swab bores thoroughly after each mission to remove any excess propellants.

G. M136 (AT-4) Antitank Weapon

1. Plastic and rubber components become brittle and can crack in extreme cold.

2. Ice fog and vapor trails will occur when weapon is fired.

3. Gunner must wear a facemask or scarf when temperatures reach –15°F to prevent icing of sight .

4. Backblast danger and caution area sizes should be doubled at temperatures below 0°F.

H. M47 Dragon Medium Antitank Weapon

1. Can be used down to –40F; operational temperature for Dragon with thermal sight is-25F.

2. At –40F, the effective range is 800m.

3. Colder temperatures increase the frequency of broken wires and lost rounds.

4. Winds in excess of 15 knots have a noticeable affect on tracking.

5. If taken into warm area condensation can form inside both sights.

6. Below –15°F the gunner must wear facemask to prevent icing of sight from breath (protective masks with M4 winterization kit installed work well).

7. Activation of launch motors after initial firing will create ice fog at temperatures of -30°F or colder that may hinder the gunner's ability to track targets

8. Double the backblast danger/caution area size if the temperature is below 0°F.

I. M220 Series TOW Weapons System

1. Can be effectively used in temperatures down to –25°F.

2. Experiences the same temperature-related problems as M47 Dragon

3. Double the backblast danger/caution area size if the temperature is below 0°F.

J. MANPADS (Stinger)

1. Additional interrogation/tracking time will be required due to temperature-related diminished battery performance.

2. The Nickel-Cadmium battery must be fully charged.

3. Double the backblast danger/caution area size if the temperature is below 0°F.

Emplacement

Most crew served weapons require a stable base or platform to be fired with accuracy. In cold climates, the snow often settles with the recoil of the weapon and causes it to dig in. If the weapon is employed on the frozen ground, the shock of firing is absorbed by the weapon instead of the ground, and may result in breakage or reduced accuracy. If the snow is not too deep, and time is available, tripods and/or baseplates should be dug in. To solve this problem in the deep or soft snow, firing platforms may be improvised by using snowshoes, skis, and/or ahkios. Mortar baseplates must be dug in due to the heavy recoil that they must absorb. This will prevent their "skipping" when the mortar is fired.

I. Ammunition

1. Cold weather can materially affect the accuracy of weapons and the performance of ammunition. The ammunition should be kept as the same temperature as the weapon and should be carried in bandoleers, with additional ammunition stored in its shipping containers, covered and stored off the ground. Magazines must be clean of all oil and preservatives and checked frequently. All ice and condensation must be removed.

2. The burning rates of various types of propellant charges are affected by the severe cold. When cold-soaked ammunition is fired from a weapon that was

zeroed under temperate conditions, the zero will change. Weapons that will be used in extreme cold temperatures should be zeroed in similar conditions.

3. VT (variable timed) fuze type ammunition is better than point detonating fuzed munitions in snow-covered terrain. Impact or delayed fuze ammunition will penetrate the snow decreasing its bursting radius and possibly cause the fuze to fail to function and detonate. However, VT fuzed munitions are prone to detonating at higher altitudes over snow covered terrain due to higher radio reflectivity of the snow. Therefore mechanical time fuzing may be best, under some circumstances where height of burst is critical.

J. Cold Weather Hand Gear

When wearing mittens the speed in handling, firing and reducing weapon stoppages will be decreased slightly. However, this is not an excuse for not wearing hand protection. Under extreme cold conditions bare flesh will freeze instantly to cold soaked metals.

K. Grenades

1. Fragmentation grenades suffer a reduced causality-producing radius due to energy dissipation in the snow.

2. Smoke grenades are useless unless placed on a platform to prevent them from sinking into the snow. Taping or wiring a grenade to a stake which can be driven into the snow works well.

CAUTION: SOLDIERS USING GRENADES MUST ENSURE THAT THEIR GLOVES OR MITTENS ARE DRY. FAILURE TO DO SO MAY RESULT IN AN ARMED GRENADE FROZEN TO THE THROWER'S HAND.

IV. Effects Of Cold On Communication Equipment

The extreme cold in the arctic areas affects communication equipment both by reducing the efficiency of certain components and by making operating conditions particularly difficult. The need for regular and careful maintenance must therefore be combined with intelligent siting and a particularly high standard of operation.

A. Radios

1. Auroral activity has little effect on tactical FM radios, and on occasion has increased their range. The same phenomenon can, however, severely limit the range of high frequency communications. To obtain the best performance from your HF communications gear, consult your Signals Officer, who can provide you with the most effective frequencies. These frequencies are determined from a frequency propagation chart.

2. All flexible cables and some metal parts become brittle at low temperatures; power connectors and cables are easily broken by rough handling. If a radio is dropped or jarred when it is cold soaked, it is more likely to be damaged than a warm radio.

3. All moving parts may become stiff or may jam because of the varying contraction or different metallic parts and because of frozen condensation.

4. All cables should be handled carefully. Before connection they should be warmed so that they can easily be used without damage, particularly between a vehicle and a dug in position, or between two vehicles. RG 213 Coax is recommended because it is thickly insulated and a highly pliable cable designed for use in extreme cold weather conditions.

B. Condensation

1. Radio equipment is susceptible to the same dangers from condensation (sweating and re-freezing) as are weapons, with the added problem of internal condensation, which may take a long time to dry, and which may damage circuits.

2. Moisture from breath will freeze onto handsets and quickly clog them with ice; the push-to-talk switch may also become ice covered. Handsets should be protected by a cover which can be improvised from plastic or cloth.

3. Manpack radio sets should not be brought into a warm shelter, if the radio needs to be used, the radio should be placed outside in the rucksack, and the handset placed under the tent flap so that the operator can monitor it. If the radio is to be

brought inside, it should be kept away from heat sources to prevent overheating and minimize sweating, and it should be kept away from the doorway where cold air can enter, to prevent overcooling and rapid temperature changes. Remember, you can't fieldstrip a radio like you can a weapon to get at that condensation on the internal parts.

> **NOTE: To prevent condensation from forming on objects moved from a cold to a warm environment, place the object in a sealed non-breathable container. A plastic trash bag will suffice. This prevents exposure of the object to the warmer environment. The condensation will form on the container instead of the object. When the object is "room temperature," remove it from the container.**

C. Batteries

1. Batteries of all types give less power at lower temperatures, and the conventional dry cell battery loses efficiency very rapidly as the temperature falls. Magnesium batteries are 0% effective at –40°F. Lithium batteries are 18% effective at –40°F with an expected life of 25 to 30 hours at that temperature.

2. Dry batteries should be stored at a temperature above –10°F, and they should be gently warmed before use. Immediate exposure of a warm battery to extreme cold temperatures could cause internal damage.

3. The batteries of vehicle-mounted radio sets should be placed in warmest area possible, and well insulated on those sides that are against the cold metal of the vehicle body. It will often be necessary to balance the need to conserve battery life by switching off sets against the advantage of keeping the sets warm by running them.

4. Battery maintenance is important; lead acid batteries should never be allowed to drop below 2/3 full charge or charged below 15°F. A fully charged battery will not freeze at extreme cold temperatures (as low as –90°F). However, the specific gravity of batteries should be checked at a minimum of once a week, using a view type battery/antifreeze tester.

5. Alkaline batteries are better than carbon batteries, because they have a longer life expectancy and are less effected by colder temperatures. Batteries with a specific gravity of less than 1.250 should be recharged.

6. Spare batteries for manpack radios, NYG's, etc., should be carried inside of clothing to help retain heat for optimum performance.

D. Antennas

1. Antennas may be difficult to erect in deep, soft snow, or on frozen ground. They are also more likely to become iced up, and they are susceptible to a

phenomenon called precipitation static. This is a condition that occurs when charged particles of snow or ice blow against the antenna; the particles discharge when they contact the antenna; the electrical discharge is heard as static by radio operators.

2. Telescopic antennas are particularly unmanageable because of their weight and icing of securing rings. Internal moisture may freeze the sections together during storage. Antennas, and the supports of wire antennas, should be jarred frequently to dislodge any ice that may form on them. Wire antennas should be erected so that the wire is attached to a single post, either by string (of a tensile strength that will break before the antenna does), or by a pulley and counterweight system that will give under the weight of the ice.

3. An antenna can be given additional height in an area where there are saplings by bending one over, attaching the antenna, and then slowly releasing the branch.

Chapter 12

Offensive Tactical Considerations

CONTENTS

PAGE

Introduction

There is little difference between the tactical procedures utilized in a cold environment and those employed in other climates. The principles of tactics remain the same but are affected by conditions peculiar to cold climates. Obviously the conduct of offensive operations will necessitate a clear understanding of all sections of this handbook. It should be remembered that the outcome of the majority of cold weather combat has been decided more by environmental factors than by one of the opposing forces.

I. Tactical Aims in Cold Weather

The main tactical aim in cold weather continues to be the destruction of enemy forces. The tactical objectives which, if achieved, will best enable you to do this on a cold weather battlefield are disruption of the enemy's command, control, and communications, which are exceptionally difficult to establish in any cold region, and depriving the enemy of his essentials for existence. Units can be rendered ineffective through destruction of shelters and equipment, as well as interdiction of logistical assets.

Combat superiority will belong to the unit that is best trained in cold weather fieldcraft and mobility. The more poorly a unit is trained and equipped for cold weather operations, the more dependent that unit will be on road networks for support and mobility. The well-trained unit knows how to move away from roads, expand its' space for maneuver, and take advantage of the road-bound weakness of the enemy.

As on any other battlefield, the terrain in the area of operations will determine how these aims are achieved. Generally speaking, operations that take place in cold regions, often characterized by a lack of developed road networks as well as mountainous areas where high ridges and plateaus are cut by numerous deep valleys, are best suited to small units. Troop formations must be highly mobile, with high combat power to size ratios. Where possible, the infantry should be ski trained to give them greater mobility. If not, they should be mounted on snowshoes. Helicopters help overcome mobility problems and allow for the rapid deployment of troops when roads are nonexistent or are dominated by the enemy.

Existing friendly lines of communication must be protected to assure success in winter operations. Severe winter weather hastens a unit's destruction after its supply lines are cut.

Effective analysis of the weather conditions peculiar to cold regions may increase opportunities for surprise attacks. These include the exploitation of falling snow, blizzards, ice fog, low cloud cover, and natural illumination. Imaginative use of what appear to be weather obstacles may turn them into major advantages. However, conducting offensive operations during adverse weather conditions such as snowstorms, extreme cold, or high winds may restrict the use of aviation and other support assets and increase control problems and reconnaissance requirements. History has shown that units conducting offensive operations in cold weather are most likely to incur cold weather injuries.

When conducting an assault on a snow-covered objective, the time elapsed between the cessation of field artillery fire on enemy forward positions and the arrival of the infantry at the objective may significantly increase. This period of slow movement caused by weather or terrain conditions must be considered in planning fire support for the assault.

After seizing an objective, immediate attention must be given to consolidation. The assaulting troops may be fatigued and overheated/sweat-soaked from the exertion of the attack. Mission planning must include measures to prevent them from becoming cold weather casualties. Remain wary of counter attack (remember that you are now sitting on the enemy's means of survival), while balancing sustainment requirements.

II. Control Measures

An axis of advance is normally used to control forward movement during offensive operations. Easily distinguishable terrain features may be used to provide discernible boundaries between units. In barren, flat terrain, an azimuth may be used to indicate the direction of attack. Intermediate objectives and phase lines are assigned as necessary to control the attack or a unit's movement. Planning tips are:

A. Position fire support assets closer to objectives than normal, and the assault position within danger-close of the objective. If this presents an unacceptable level of risk, you may have to place greater reliance upon organic fire support.

B. Plan to use more ammunition than normal, due to increased dud rates of HE Fuze Quick/Superquick/Delay, unreliable (higher) functioning of VT-fuzed munitions, and decreased bursting radius/fragment absorption caused by snow..

C. Plan for larger reserves at every level, held more closely than normal.

D. Use over-snow vehicles when available to move follow on forces.

E. The line of departure should be closer to the objective.

F. Conduct detailed terrain analysis; attempt to capitalize on fog, poor visibility or snow to mask unit movements.

G. Use surprise whenever possible.

H. During daylight employ control measures normally used for night attacks to limit number of trails necessary and ease movement during approach to objective and deployment for attack.

I. Weather changes rapidly—don't let your plan rely exclusively on sole-source assets.

J. Detailed uniform and equipment guidance is a must for soldiers moving independently of transportation assets. Enforce PCI's and leader supervision throughout movement.

K. Route selection is vital to offensive operations. Consider trafficability (snow depth, density, and surface conditions) along with cover and concealment, and control.

L. Build redundancy into plans to allow for adverse weather.

III. Contact Drills in Snow

Training time must be allocated to conduct reaction to contact drills while moving on either skis or snowshoes. The techniques for firing will, obviously, remain much the same regardless of mode of movement. However, these techniques should be practiced during live fire exercises. The increased amount of cold weather clothing, coupled with the cumbersome nature of moving on skis or snowshoes, complicates the routine adoption of firing positions. A small unit's ability to quickly react to an enemy situation will be largely dependent upon the training time spent in the conduct of reaction type drills.

IV. Task Organization

Full consideration must be given to the ability levels of each element of the force to perform the skills required to support or conduct offensive operations in cold regions. The following paragraphs provide guidance relative to the employment of supporting/attached elements.

A. Fire Support

1. The limitations imposed by the terrain will generally restrict the movement of towed artillery to roads and cleared tracks. The scarcity of adequate roads and tracks make alternative

approaches extremely difficult to find. The few existing roads tend to channelize approaches to deployment areas and make the movement of artillery particularly vulnerable to air attack. As far as possible, artillery units should move and deploy under cover of darkness, poor visibility or snowfalls. Towed artillery with wheeled prime movers is restricted to movement along cleared roads and deployment in prepared positions beside these roads. Artillery units equipped with over-snow vehicles obtain a greater degree of mobility, but are still restricted by the limitations imposed by the terrain.

2. Because of the nature of the terrain there are few suitable firing positions which are accessible. This also applies to units having over-snow capability. The areas that are both suitable and accessible are often treeless, narrow, and close to main roads, have restricted areas of fire, and may face immense crest clearance problems. The selection of areas by map reconnaissance is not practical unless accompanied by visual reconnaissance to confirm suitability. It is vital that potentially suitable areas are noted, and that information concerning them is passed to higher HQ, for use by follow on elements.

3. During extremely cold periods or when temperature changes are sudden, the ballistic characteristics of weapons and ammunition are affected. During extremely cold periods, a range factor of 100 meters of more per 1,000 meters of range is not uncommon. Fuze quick is ineffective in deep snow, as up to 80 percent of the fragmentation is absorbed by the snow cover; however, such fires may often be used to effectively initiate avalanches in enemy areas. An airburst with either a Variable Time (VT) or mechanical time fuze is most effective against personnel in the open. The VT fuze will function slightly higher over snow, and, although VT fuzes are adversely affected by extreme cold, with a corresponding increase in the number of malfunctions, it is one of the most effective fuzes for use in cold regions.

B. Mobility/Countermobility/Survivability

The scarcity or lack of roads increases the need for road or trail construction, and will probably encourage your opponent to make extensive use of mines and booby-traps on the existing networks, necessitating mine-clearance teams and equipment. At the same time, the lack of maps and the climatic extremes increase the manpower and equipment requirements for both road construction and maintenance, especially when establishing improved roads/trails across the numerous streams, swamps, and lakes characteristic of cold regions. Cross-country movement requires greater engineer support. Conditions that may hamper ground mobility place increased importance upon air mobility. Engineers may be required to construct and maintain helicopter pick-up and landing zones. Unless a deliberate defense that will be occupied for an extended period of time is being constructed, survivability efforts should be focused on construction of above-ground fighting positions, due to the extreme difficulty you can expect to encounter in any attempt to dig into firmly frozen ground. Snow-covered terrain will cause problems with the reliable functioning of mines; this needs to be considered in both the planning and execution of counter-mobility operations .

C. Close Air Support

1. Preferred Methods for Marking Targets. In addition to standard techniques such as panels, signal mirrors, or using terrain features as reference points, the following methods are particularly adapted to cold and snow-covered environments:

a. Using dark colored smoke is a viable method of marking targets in snow-covered terrain. Burning houses, vehicles, POL products, or tires all produce smoke which will stand out well against a white background.

b. Illumination suspended from a parachute above the target provides a distinct mark, both day and night. The height of the illumination must be such that it does not interfere with attacking aircraft.

c. Colored smoke is available in artillery munitions in yellow, green, and red. Because these rounds are equipped with mechanical time fuzes, and base-ejecting smoke canisters, the

height where the round activates can be adjusted to provide colored smoke streamers from a point above the target down to it. The activation height should be as low as possible, while still achieving the desired effect. If the round activates too high, the dispersion of the canisters will be too great to pinpoint the target. Activation should be timed so that it occurs just before the aircraft reaches the peak of its pop-up, prior to rolling over to acquire the target.

d. Colored smoke grenades may be used to mark friendly positions and establish common reference points. Smoke grenades must have a flotation device to prevent sinking in the snow, and must be activated early enough to create a signature visible to the pilot.

e. During periods of extreme cold, high explosive rounds with VT or mechanical time fuzes may be set to airburst over target locations. The explosion will create a cloud of ice fog, which, though it may not be very distinct, may be adequate to mark the target in the absence of other means.

2. Methods degraded by cold and/or snow. Some problems are:

a. White smoke from HC canisters or white phosphorous munitions does not contrast with snow and cannot be seen.

b. Smoke canisters/grenades quickly melt into the snow. If the snow is deep enough, the smoke will be smothered.

c. If illumination rounds activate at or just above the surface of deep snow, they may melt into the snow before they can be observed.

d. Laser systems may require increased warm-up time, and optical components must be shielded from snow as well as icing caused by the operator's breath. Extreme care should be taken when operating lasers in snow-covered terrain; ice and snow are highly reflective, and eye damage to friendly troops may result.

D. Aviation

1. Vulnerability. Anticipated delays at LZ's will make helicopters particularly vulnerable to enemy indirect fires. Landings in hot LZ's will be especially hazardous.

2. Weight/bulk of loads. In temperate regions, a combat-loaded soldier may weigh 225 pounds. In cold weather, the same soldier may weigh as much as 300 pounds due to the additional clothing and equipment necessitated by the environment. A single soldier may require one-and-a-half times the normal amount of seating space, thus reducing the space available, and the ACL, aboard aircraft (for additional information, see chapter 10 of this handbook).

E. Medical Support

1. Aid and litter teams, ahkios, and over-snow vehicles must be identified ahead of time for moving casualties to collection points.

2. Planning must include the use of organic tents and vehicles as aid stations and casualty collection points.

3. If aeromedevac support is planned, detail personnel to establish and pack a suitable PZ.

V. Camouflage

In snow-covered terrain, the stark contrast between light and dark colors accentuates any items that do not blend with their surroundings. If you are going to take maximum advantage of the element of surprise, your soldiers must be able to practice effective camouflage techniques. The following are some tips for increasing your ability to remain invisible to the enemy:

A. Wear of Winter (Overwhite) Camouflage. The overwhite camouflage issued to your soldiers is designed to be worn in varying combinations that will change as your unit moves from one type of terrain to another.

1. In thickly wooded areas with dense undergrowth, wear darker (woodland pattern) camouflage uniform.

2. In forested areas with limited undergrowth, wear the overwhite camouflage trousers with a woodland pattern camouflage top and helmet cover.

3. In areas covered by low brush or light scrub, wear the overwhite parka and helmet cover with woodland pattern trousers.

4. When operating above the tree line or in large open areas, wear full overwhite camouflage.

5. Some additional considerations for the wear of individual camouflage are:

a. Avoid selecting routes that will require repeated changing of your soldiers' camouflage pattern.

b. Have your soldiers keep their camouflage garments handy so that when a change is necessary, it can be made quickly.

c. Avoid using camouflage face paint; it will hide signs of frostbite.

B. Camouflage of Weapons and Equipment. When camouflaging weapons and equipment, ensure that soldiers do not do such a thorough job that the camouflage interferes with moving parts and normal weapon/equipment function.

1. Use only enough white to break up patterns and blend with surrounding snow cover. Snow-covered terrain is rarely solid white. For example, leaving some black exposed on your rifle will generally allow it to blend in better than it would if it were completely white.

2. Camouflage tape tends to crack at very low temperatures; strips of white cloth or white paint can be used instead of tape.

Chapter 13

Defensive Tactical Considerations

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Introduction

The principles of the defense do not change dramatically in a cold weather environment, however, the defender has advantages in the cold that may not exist, or may be of relatively negligible impact, in temperate environments. These advantages will generally accrue from the mobility restrictions caused by deep snow, the survival problems associated with cold temperatures, and the deception and concealment opportunities afforded by the dense forests and long periods of limited visibility typical of cold regions.

In cold, snow-covered terrain, the principle weapons in the defense will be machine guns and engineer assets. Mortars, artillery, and grenades lose much of their effectiveness in deep snow; although it may be time-consuming to construct stable firing platforms for them, the machine gun's performance is not degraded by snow. When added to the difficulties posed by the environment, carefully orchestrated counter-mobility operations by engineer assets can easily tip the balance in favor of the defender.

I. Defense of the Temporary Bivouac

The following is a guideline to assist you in defending a tactical bivouac. Few sites will fill all these needs but they should always be considered. Degree of preparation of the site will vary with the duration of the halt.

A. Terrain Conditions

1. Take advantage of high ground. The enemy is forced to attack uphill which is extremely difficult in deep snow; armored vehicles may have difficulty climbing even moderate slopes.

2. Select positions that will force the enemy to attack through obstructions such as deep snow, thickets, fallen timber, or other natural obstacles.

3. Defend from areas where snow is deepest. The snow will hamper any attacking force and reduce the effects of weapons fire, as well as the bursting radius of artillery and mortar rounds and grenades.

B. Concealment/Deception

1. Forested areas, particularly coniferous forest, provide excellent concealment.

2. Rigidly enforce track discipline.

3. Use decoy camps, deceptive tracks and camouflage tracks to conceal your position. Pay particular attention to the threat of aerial observation.

4. Short and long range patrolling may give the position away since the enemy can find the tracks and follow them to camp.

5. Do not alter the natural character of the area by cutting too much wood or clearing fields of fire.

6. Sound carries considerable distances in cold still air. Enforce strict noise discipline.

7. Place shelters so terrain and snow mask their thermal signature.

C. Security

1. Establish all around defense.

2. Fighting positions should be relatively close to shelters. Ensure that positions are constructed to accommodate all of your soldiers.

3. Trails to the fighting positions should enter from the flanks.

4. If snow is deep, trenches should be dug from shelters to fighting positions.

5. Communications between sentry and tent must be designed so that the sentry can alert personnel in the tent silently. A string or wire from the sentry's position attached to the tent works well. A similar system may be established between positions.

6. Sentry watches should vary in duration based upon the temperature/weather.

7. Incoming tracks should be mined or have early warning devices emplaced.

8. The enemy will attack with the wind to his back if possible. Establish your strong fighting positions facing the prevailing wind direction, particularly if wind direction and a likely avenue of approach coincide. Likely avenues of approach will include areas where the snow is shallow, or where it is dense enough to support foot movement.

9. Use thermal sights during periods of limited visibility, such as ice fog. Any heat source stands out against the cold background of snow (see figures 13-1a and 13-1b). Image-intensifying devices (NVG's, etc.) work well in snow-covered terrain, but will not penetrate ice fog. Remember to provide extra batteries to STANO device operators, so that they will be able to keep a set warm to replace the batteries in the device when they become cold, and their performance becomes degraded.

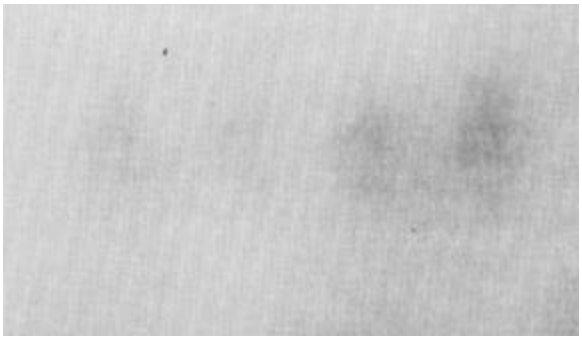

Fig. 13-1a Visible Image of Troops Advancing in Ice Fog

II. The Defensive Position

Once the decision is made to establish a deliberate defense, the details of organizing sectors, designing the strongest fighting positions possible with available materials, and actual construction of positions must be considered.

A. General

1. The general considerations concerning defense of a bivouac apply.

Fig. 13-1b Thermal Image of Troops Advancing in Ice Fog

2. Construction of alternate, possibly even multiple alternate positions should be considered mandatory if the temperature is, or may become, colder than –30°F at any time while the defense is occupied. Firing weapons during periods of extreme cold will result in clouds of ice fog that can quickly obscure gunners' observation, as well as reveal your location. Soldiers must be prepared and able to rapidly relocate along prepared trails to alternate firing positions.

3. Clearing fields of fire may leave tracks that will indicate where fighting positions are located. You must decide which will be more important, concealment of a position or an unobstructed field of fire.

4. Obstacles may be utilized to channelize the enemy into areas of deep snow, as well as into kill-zones.

5. Use of wire as primary means of communication. Not only do radios have an electronic signature, they rely on batteries which can freeze up and fail you at inopportune times.

6. Back-blast danger areas are doubled in cold weather. Anti-tank/recoilless weapon positions must allow for this increase.

7. Fighting positions should be insulated using the best materials available. (Old ration cases and spruce boughs work well.)

8. Trails should be established between alternate, supplementary, and primary positions to allow quick displacement.

9. When emplacing either antipersonnel or antitank mines in deep snow, remember that they will need a firm base, such as a board or brush-wood mat, underneath them to prevent their settling into the snow, instead of detonating, under the weight of their intended victim. In wet cold, or anywhere a freeze-thaw cycle may occur, consider protecting fuzes with plastic bags or some similar material to ensure that the do not become frozen or ice-coated to the point that they will not function. Trip wires should be above the surface of the snow. A heavy snowfall that buries trip wires may result in M.A.'s/EWD failing to function.

B. Construction of Fighting Positions

Cold weather operations present some unique problems when constructing fighting positions. Ideally, positions should be dug into the ground, but in very cold climates the ground may be frozen to depths which make digging almost impossible with hand tools. Earth defenses of the conventional type are difficult to build without engineer assistance or demolitions. Consider the following when determining what type fighting positions to build, but always remember that, ultimately, there is no substitute for traditional defensive positions. Defenses constructed of snow and ice will eventually disintegrate under sustained fire, and are subject to the vagaries of

the weather. Commanders should ensure that their soldiers are trained in the necessary skills to use demolitions to construct fighting positions in frozen ground.

1. Ground not frozen/light snow cover – construct conventional earth defense.

2. Ground not frozen/deep snow cover – use combination of conventional positions and snow defenses.

3. Ground frozen/light snow cover – if engineer support/demolitions are available, construct conventional defenses; when engineer support/demolitions are unavailable, positions must be built up.

4. Ground frozen/deep snow cover – if engineer support/demolitions are unavailable, construct snow defenses. Otherwise, use combination of conventional positions and snow defenses.

C. The types of walls or forms shown below are not the only options available. They simply introduce some of the construction methods, as well as some of the materials that can be used. The only limits to the type of wall or form are the availability of material and your imagination. No measurements are shown since the size of the positions will depend on how many men will man them, what material is used for fill, the depth of the snow and whether or not the ground can be dug. However, you should use the Small Arms Penetration Table, (Appendix C), as a general guide to attain the necessary degree of protection, and remember that any position constructed entirely of snow and ice will eventually disintegrate under sustained fire.

1. Snow defenses

a. Tree Supported Wall - logs are laid on top of one another and lashed to trees. (See Fig 13.2a and 13.2b) Snow is then piled against them.

b. Tripod Supported Wall - Construct tripods as in Fig 13.3a and 13.3b. This type of structure provides a limited degree of overhead protection.

c. Anchor Supported Wall - Requires two short logs for uprights, one long log for anchor and two lengths of rope or communications wire. Construct as in Fig. 13.4a and 13.4b. Before securing lines, adjust uprights to lean slightly toward anchor, then bank snow to hold logs in place.

d. Snow Trench - Dug into any deep snow, ideally should be deep Enough to stand erect in (see fig. 13-5)

2. Ice-Crete Defenses Using Containers: Ice-crete is made by mixing gravel, sand, pebbles, or dirt with snow and water. Once frozen, ice-crete is very similar to Portland cement. When well mixed the ice-crete is shoveled into any of the forms listed below.

a. Ration Cases - Use any type of cardboard box filled with snow, gravel, dirt, sand, etc. When stacking, wet the top and sides of each layer so the adjacent layers will freeze to it. If water is scarce, use short stakes and peg the layers together.

b. Ammunition Boxes - Use only wooden boxes, metal boxes will increase ricochet danger. Build up walls the same as with ration cases. Freeze or use stakes to peg together.

c. Sand Bags - Fill with available material. Wet bags so they will freeze together.

d. Snow blocks - If snow is hard enough, snow blocks can be cut and used to build walls or forms.

3. Ice-crete Defenses Using Forms- If containers are not available, Ice-crete defenses can be built by filling in forms.

a. Tree and log forms - Construct a form as shown in Fig. 13.6a and 13.6b so that the space to be filled is at least one foot wide. Fill with ice-crete.

b. Log Form - Lash logs together as shown in Fig. 13.7a and 13.7b to form a rectangular shaped box with an internal space one foot wide. Fill with ice-crete.

4. Construction Tips

a. Use branches trimmed from logs, as part of the snow fill for added strength.

b. Metal ammunition boxes can be filled with any of the described substances and used as a part of the fill, not on the exterior of a position.

c. Icing of position adds greatly to their strength.

d. If possible, forms should be left in place as part of the position.

e. Positions should be sloped in front and at the sides and covered with snow as an aid to camouflage.

f. If ground is soft or snow hard, pickets can be used in place of bottom lashing on walls or forms.

g. If hammers and nails are available, use them instead of lashing; lashing can be cut by fire or fragments.

III. Patrolling

A. General

Long periods of reduced visibility favor patrolling activities; however, extreme cold and deep snow will further complicate an already hazardous and difficult task. The following points should be considered:

1. Patrols must be prepared for bad weather.

2. Carry minimum equipment necessary.

3. Plan to bivouac in expedient shelters if necessary. Tent group equipment is seldom carried.

4. If ahkio is used, it is generally employed to haul mission essential equipment.

5. Whenever feasible, patrols are inserted and extracted by air.

6. It is impossible to move in snow without leaving tracks. Track discipline must be strictly enforced.

7. Rear security is particularly important because of your track.

8. To prevent ambush, the temptation to backtrack over packed trails must be resisted.

B. Ambush Patrols

Ambushes are the most difficult of all combat patrols in cold weather. They require men to remain immobile for long periods of time, which increases the danger of cold weather injury. Some techniques for successful ambushes in cold weather are:

1. Always employ men in pairs. One man is alert and exposed to weather at all times. The other warms himself in a sleeping bag dug into a hasty position.

2. Leave ambushes in position no longer than 24 hours without relief. In extreme cold this period may be greatly shortened.

3. Be especially careful not to track up the ambush site. Concealed access routes in and out of the site should be carefully selected and all marks erased as much as practicable.

4. No heat sources should be used in the ambush site.

5. Select ambush positions to provide maximum protection from the wind.

Fig. 13-2a Tree Supported Wall (side view)

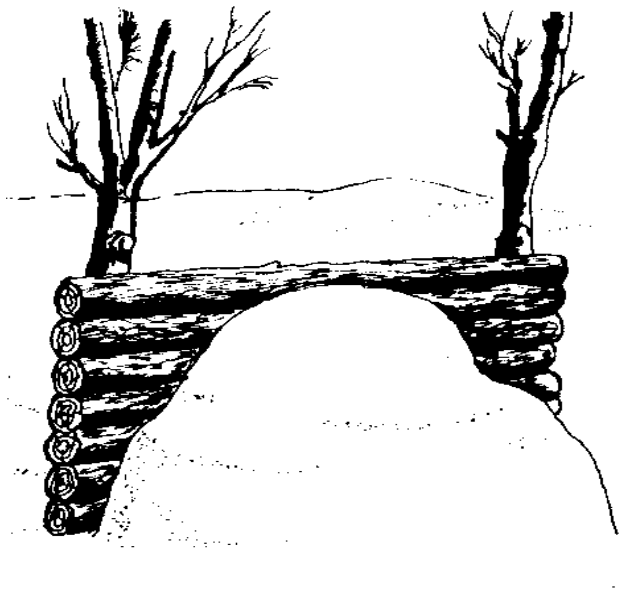

Fig. 13-2b Tree Supported Wall (oblique view)

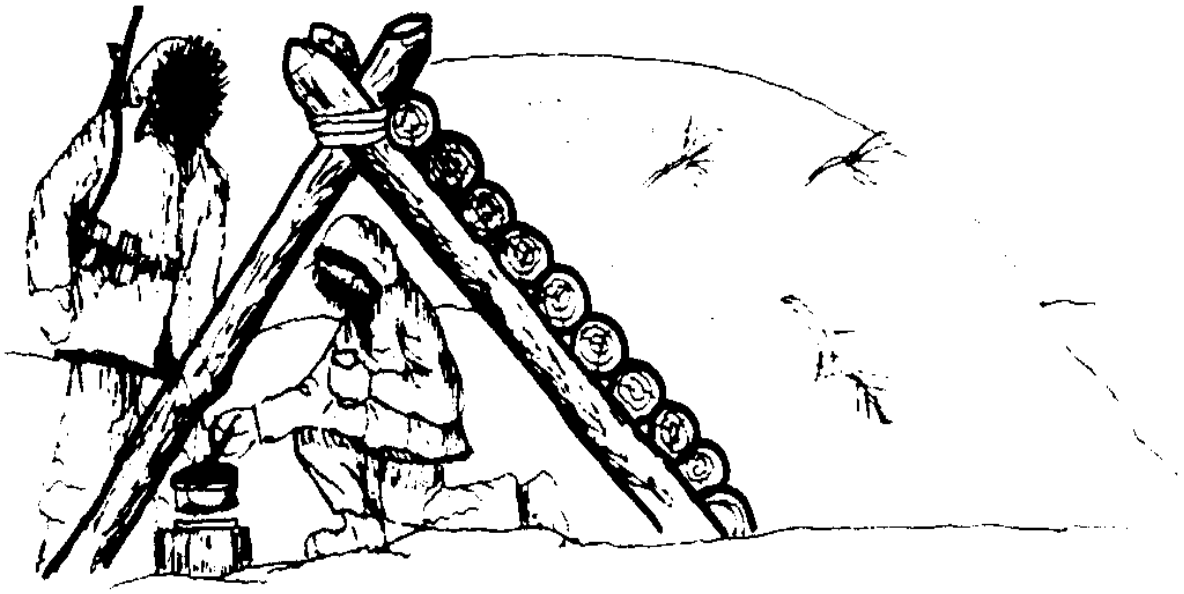

Fig. 13-3a Tripod Supported Wall (side view)

Fig. 13-3b Tripod Supported Wall (rear view)

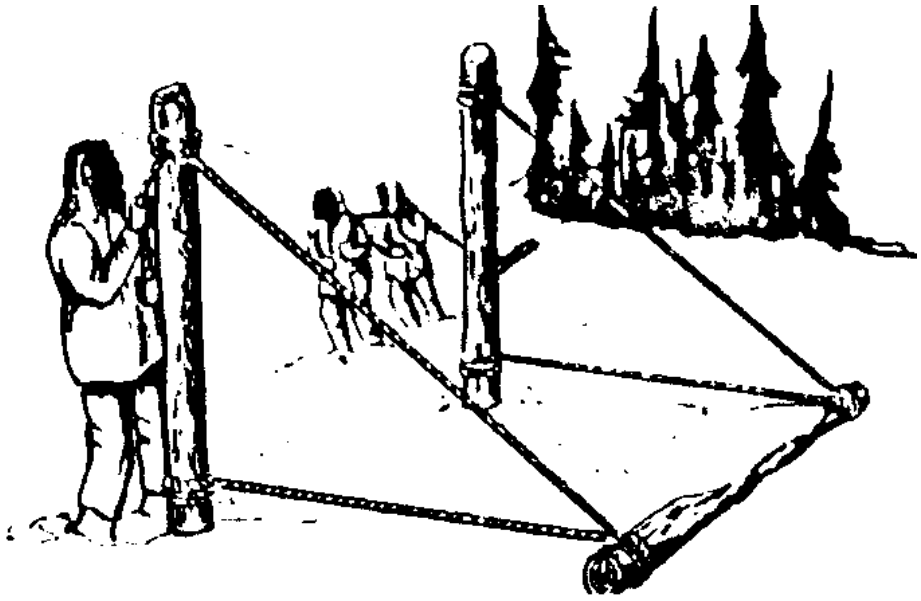

Fig. 13-4a Anchor Supported Wall (oblique view)

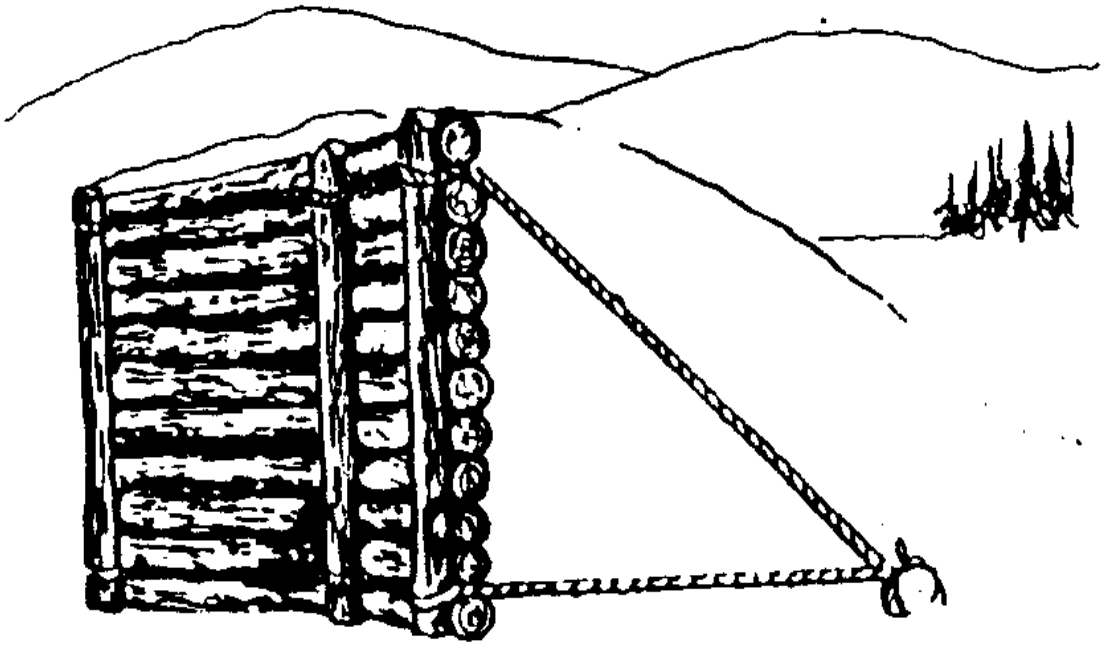

Fig. 13-4b Anchor Supported Wall (side view)

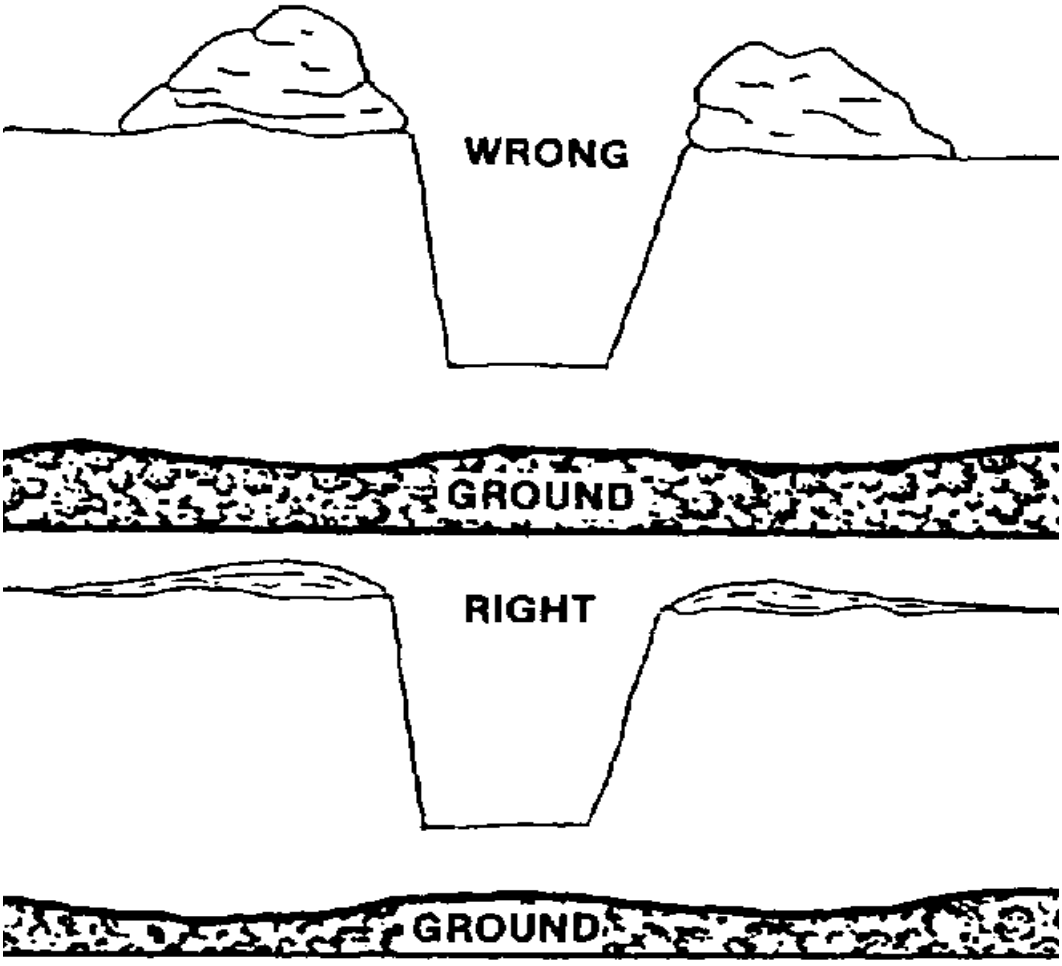

Fig. 13-5 Snow Trench

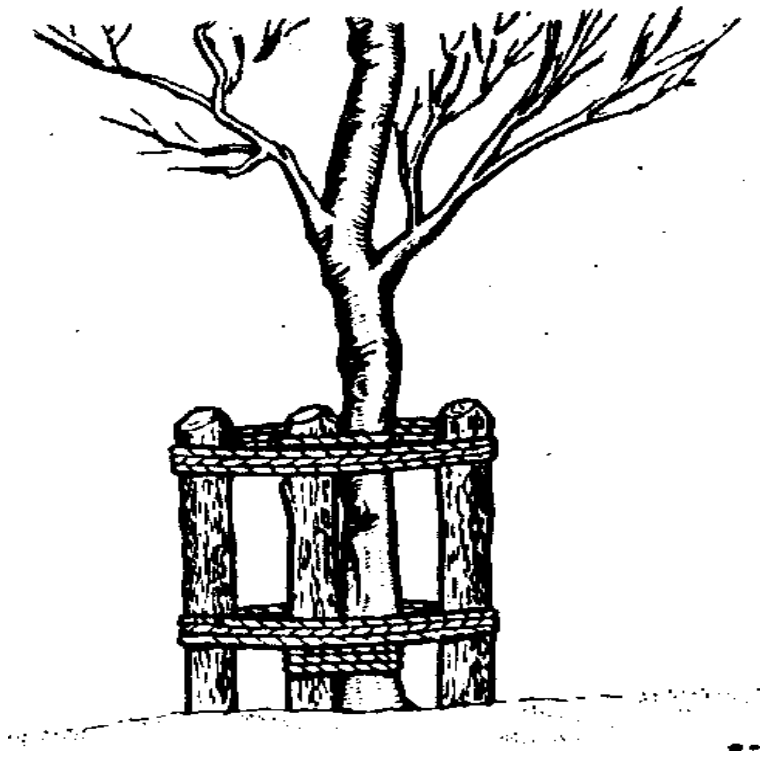

Fig. 13-6a Tree and Log Form (side view)

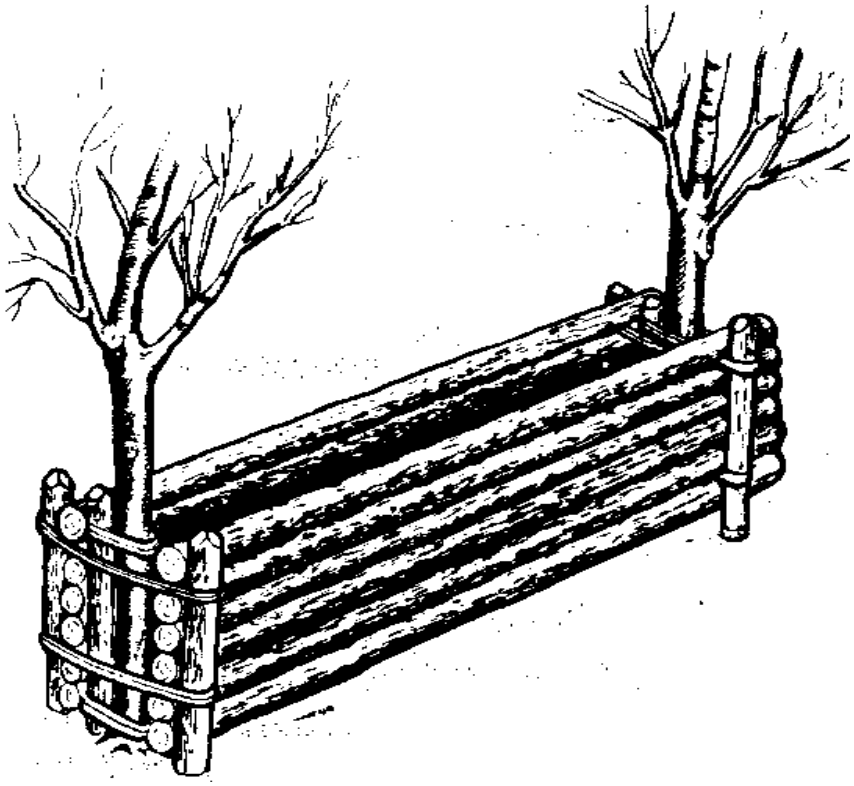

Fig. 13-6b Tree and Log Form (oblique view)

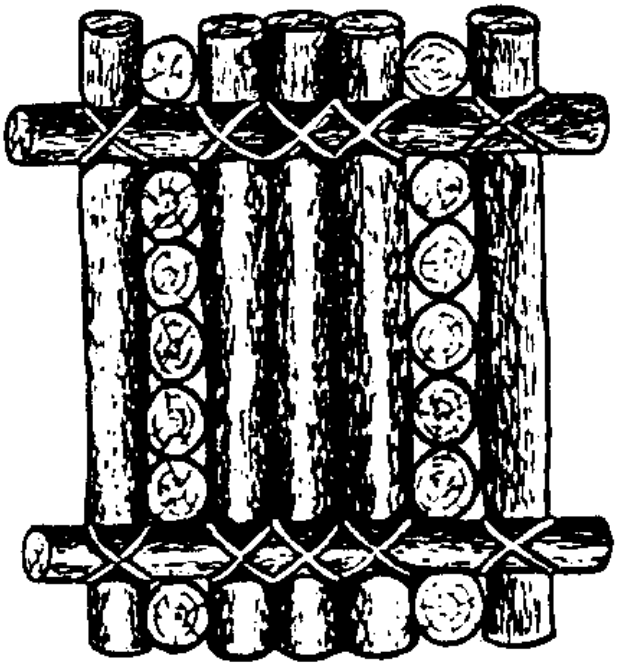

Fig. 13-7a Log Form (Side View)

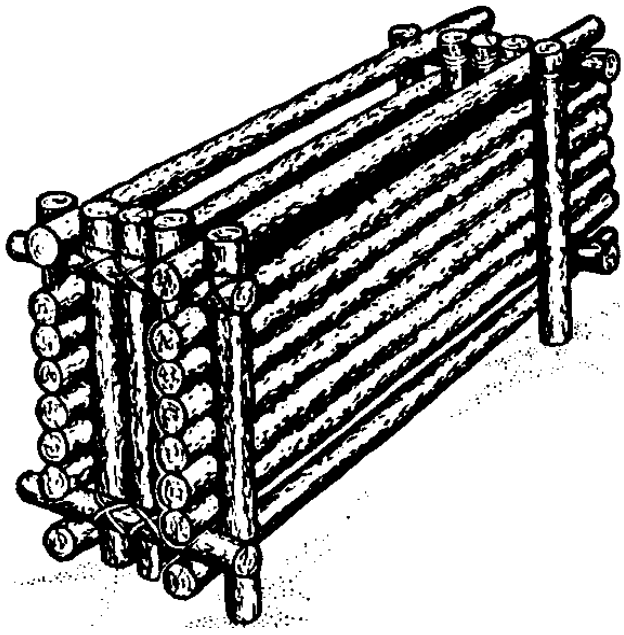

Fig. 13-7b Log Form (Oblique View)

Appendix A
Load Bearing Capacity
of
Fresh Water Ice

MINIMUM ICE THICKNESS

LOAD UNITS	MINIMUM *ONE TIME ONLY*	NORMAL REPEATED USE	DISTANCE BETWEEN
Soldier on Skis	1 ½ inches	2 inches	5 meters
Soldier on Foot	**3 inches**	**4 inches**	**5 meters**
¼ Ton Truck	5 inches	8 inches	16 meters
HMMV/CUCV	10 inches	13 inches	27 meters
SUSV	10 inches	13 inches	27 meters
UH-60/CH-47	15 inches	18 inches	80 meters

NOTE: Rule of thumb for armored vehicles: 16 inches of waterborne ice supports 16 tons, and each additional inch supports one additional ton. This applies only to increasing loads and does not apply to decreasing loads.

If ice is not supported by water because the water level has dropped, it will be too weak to support heavy loads.

In temperatures above 14°F, add 25% to all required ice thickness'.

Appendix B
Movement Mode and Speed

MOVEMENT	UNBROKEN	BROKEN TRAIL
On foot- less than one foot of snow	1.5 to 3 kph	2 to 3 kph
On foot more than one foot of snow	.5 to 1 kph	2 to 3 kph
Snowshoeing	1.5 to 3 kph	3 to 4 kph
Skiing	1.5 to 5 kph	5 to 6 kph
Skijoring	N/A	8 to 24 kph

NOTE: Expected rates of march for troops carrying rucksacks over gently rolling terrain.

Movement Planning Guide

for Skis or Snowshoes

A. DISTANCE

1. **Draw the route on the map**
2. **Measure the map distance and add:**
   a. **15% for easy terrain**
   b. **20% for normal terrain**
   c. **25% for steep terrain**

Example: A platoon is moving a map distance of 10 km. The leader determines the terrain is

normal. The total distance is 12 km.

B. SPEED

Rules of Thumb:

A. Add 1 hour to movement time for each 500m descended.

b. Add 1hour to movement time for each 300m ascended

Appendix C

Small Arms Penetration Table

SNOW CHARACTERISTICS	MINIMUM THICKNESS FEET	CENTIMETERS
Newly Fallen Snow	13	400
Firmly Frozen	8 to 10	245 to 300
Packed Snow	6 ½	200
Frozen Snow- Water Mixture	4 to 5	120 to 150
Ice	3 ¼	100
Ice Crete	1	30

NOTE: Based on penetration of a single 7.62 NATO round

Snow Density (lb per ft3)	*Projectiles*	*Muzzle Velocity (ft per sec)*	*Penetration (ft)*	*Required Mini. Thickness (ft)*
18.0-25.0	grenade fragments	-	2.0	3.0
11.2-13.0	5.56 mm	3250	3.8	4.4
17.4-23.7	5.56 mm	3250	2.3	2.6
11.2-13.1	7.62 mm	2750	13.0	15.0
17.4-23.7	7.62 mm	2750	5.2	6.0
25.5-28.7	7.62 mm	2750	5.0	5.8
19.9-24.9	12.7 mm	2910	6.4	7.4
	14.5 mm		6.0	8.0
28.1-31.2	70 mm HEAT	900	14.0	17.5
31.2-34.9	70 mm HEAT	900	8.7-13.0	10.0
27.5-34.9	90 mm HEAT	700	9.5-11.2	14.0

Notes:

-Snow walls degrade under sustained fire. Penetrations given for 12.7 mm or smaller are for sustained fire (30 continuous firings into a l x 1-ft area).
-Penetration characteristics of Warsaw Pact ammunitions do not differ significantly from U.S. counterparts.
-Figure given for HEAT weapons are for Soviet PRG-7 (70-mm) and U.S. M67 (90-mm) fired into machine-packed snow.
-High explosive grenades produce small, high-velocity fragments that stop in about 2 ft of packed snow. Effective protection from direct fire is independent of delivery method, including newer machine guns like the Soviet AGS- 17 (30-mm) or U.S. MK 19/M75 (40-inm). Only armor penetrating rounds are effective.

Snow wall construction for protection from grenades, small-caliber fire and HEAT projectiles

Appendix D
Wind Chill Chart

Estimated Wind Speed (in MPH)	ACTUAL THERMOMETER READING (Degrees Fahrenheit)											
	50	40	30	20	10	0	-10	-20	-30	-40	- 50	- 60
	EQUIVALENT CHILL TEMPERATURE (Degrees Fahrenheit)											
Calm	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	16	4	-9	-24	-33	-46	-58	-70	-83	-95
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-124
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125	-140
35	27	11	-4	-21	-35	-51	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148
Wind speeds greater than 40mph have little addi-tional effect	LITTLE DANGER Under 5 hours with dry skin. Maximum danger of false sense of security				INCREASING DANGER Flesh may freeze within one minute			GREAT DANGER Flesh may freeze within 30 seconds				
	Danger from freezing of exposed flesh											
	Immersion foot (trenchfoot) may occur at any point on this chart											

REV 000823

Appendix E

NAME: _____ **UNIT:** _____ **DATE:** _____

SQUAD #: _____ **INSTRUCTOR:** _____ **CLASS #:** _____

GRADER

	GO/NOGO	*RETST*	*SIGN/INIT.*
1. PITCH AN ARCTIC TEN-MAN TENT _____	☐	☐	_____
2. STRIKE AN ARCTIC TEN-MAN TENT _____	☐	☐	_____
3. SET UP A YUKON STOVE _____	☐	☐	_____
4. LIGHT & OPERATE A YUKON STOVE _____	☐	☐	_____
5. LIGHT & OPERATE A SQUAD STOVE _____	☐	☐	_____
6. DISASSEMBLE & PACK A YUKON STOVE _____	☐	☐	_____
7. PACK A 200 LB. (CAPACITY) AHKIO SLED _____	☐	☐	_____

PASS FAIL

Instructor Signature _____

TASK(S): Pitch an Arctic Ten-man tent; Set up a Yukon Stove

CONDITION: Given a serviceable Ahkio group, complete with the standard equipment load, and an area large enough to correctly set up the tent and stove group. This task will be performed by a squad/team of no less than 5 personnel and evaluated collectively.

STANDARD: The tent/stove group must be properly set up within 30 minutes. All critical performance standards must be met.

REFERENCE: NWTC Winter Operations Manual (December 1999), Chapter 3

EVALUATION: (Tent)	**Yes**	**No**
1. Floor area flat; dug down to earth or snow packed down.....	☐	☐
2. Tent pins used in hard/frozen ground; trees, logs, or deadmen in deep snow.....	☐	☐
* 3. Tent apex 6 to 8 ft. high.....	☐	☐
* 4. Base-plate used to support center pole (only in snow or mud).....	☐	☐
* 5. Doors zipped shut prior to tightening tent lines.....	☐	☐
6. Six corner eave lines anchored approx. 6.5 feet from tent eave.....	☐	☐
7. Four intermediate eave lines anchored approx. 6.5 feet from tent eave.....	☐	☐
8. Six corner lines anchored approx. 1.5 feet behind corner eave lines..... *(or to same anchor as corner eave)*	☐	☐
* 9. Top of tent doors approx. 5 feet high; door poles (or tree) min. 3 feet from tent.....	☐	☐
* 10. All tent lines anchored in-line with corresponding tent seams.....	☐	☐
*11. Snow cloth placed to the outside of tent.....	☐	☐
*12. Evergreen boughs, brush, or other suitable material placed beneath snow cloth to prevent material from freezing to the ground.....	☐	☐
*13. Snow, dirt, or other suitable material placed on top of snow cloth for high wind conditions (must not inhibit ability to escape under tent skirt)..... *(Required in exposed, high wind areas)*	☐	☐

TASK(S): Pitch an Arctic Ten-man tent; Set up a Yukon Stove

CONDITION: Given a serviceable Ahkio group, complete with the standard equipment load, and an area large enough to correctly set up the tent and stove group. This task will be performed by a squad/team of no less than 5 personnel and evaluated collectively.

STANDARD: The tent/stove group must be properly set up within 30 minutes. All critical performance standards must be met.

REFERENCE: NWTC Winter Operations Manual (December 1999), Chapter 3

EVALUATION: (Stove)	**Yes**	**No**
1. Stove board placed on flat surface	☐	☐
* 2. Stove door facing main entrance	☐	☐
* 3. Burner placed into stove body opening w/ lugs on outside/retainers on inside	☐	☐
* 4. Wire loop secures retainers in place	☐	☐
* 5. Burner plate is level	☐	☐
* 6. Drip valve is in the *"OFF"* position	☐	☐
* 7. Drip valve & fuel line routed away from stove body and fuel line routed over bottom drying line	☐	☐
* 8. Vent tube placed into fuel can adapter w/ cross holes opposite adapter	☐	☐
9. Lowest part of inverted fuel can is between 1 and 5 feet above drip valve	☐	☐
*10. Lowest part of inverted fuel can is the fuel can adapter	☐	☐
*11. Drip interceptor loop within 1 foot of fuel can adapter	☐	☐
*12. Fuel can secured to tripod	☐	☐
13. Stove pipes connected in sequence w/ seams aligned	☐	☐
*14. Draft diverter guy lines secured to tent from 3 separate, opposing points	☐	☐
*15. Stove pipe opening in tent must be serviceable	☐	☐
*16. Stove pipe opening flaps rolled up and tied off away from stove pipes	☐	☐

TASK: Light & Operate a Yukon Stove

CONDITION: Given a Yukon stove, set up and ready for operation, and liquid fuel. This task will be performed and graded individually.

STANDARD: Stove must be properly lit and burning steady within 5 minutes.

REFERENCE: NWTC Winter Operations Manual (December 1999), Chapter 3

EVALUATION:	**Yes**	**No**
1. Drip valve opened enough to allow fuel to saturate the burner plate…….	☐	☐
* 2. Drip valve is turned to the *"OFF"* position once burner is saturated……	☐	☐
* 3. Burner plate lit w/ the drip valve in the *"OFF"* position……	☐	☐
* 4. Stove door is open during lighting……	☐	☐
* 5. Once burner is lit, stove door is closed……	☐	☐
* 6. Draft gate on door is in the *"closed"* position……	☐	☐
7. Drip valve reopened *<u>after</u>* burner is lit……	☐	☐
* 8. Stove is not allowed to burn too hot (e.g. cherry red)……	☐	☐
* 9. Drip valve must be turned *"OFF"* prior to changing fuel can……	☐	☐
10. Burner plate must be to *"cool-to-touch"* prior to refueling/re-lighting……	☐	☐
*11. All tent occupants awake & prepared for emergency exit during refueling & re-lighting operations……	☐	☐
*12. Fire guard alert and monitoring fuel flow rate and adjusted as necessary, when stove is in operation……	☐	☐
*13. *Excessive liquid fuel buildup:* Wipe excess fuel from stove & vent stove w/ door open for at least 2 to 3 minutes prior to lighting burner……	☐	☐

TASK: Assemble and Operate a Squad Stove

CONDITION: Given the squad stove and the fuel bottle filled to the proper level with white gas, or other appropriate fuel. This task will be performed inside the ten-man tent, or outside in an area sheltered from the wind.

STANDARD: The stove must be placed into operation within 5 minutes. All critical performance standards must be met.

REFERENCE: NWTC Winter Operations Manual (December 1999), Chapter 3

EVALUATION: (Assembly)	**Yes**	**No**
* 1. Pump assembly inserted into fuel bottle & tightened snugly……	☐	☐
2. Heat reflector properly positioned on stove body……	☐	☐
3. Stove legs positioned properly into notches of burner housing……	☐	☐
4. Fuel line moistened before insertion into fuel pump……	☐	☐
5. Fuel line inserted into pump w/ gentle pressure & twisting motion……	☐	☐
* 6. Fuel line retaining wire secured to pump assembly at notch……	☐	☐
* 7. Stove & fuel bottle placed on a level, non-flammable surface……	☐	☐

EVALUATION: Re-lighting the squad stove after cooling

1. Fuel bottle pressurized with 5 to 15 pumps……	☐	☐
* 2. Fuel valve opened - wick saturated (burner cup partially filled) with fuel……	☐	☐
3. Fuel valve turned *"OFF"* during lighting & warm-up……	☐	☐
* 4. Wick lit; allowed to burn until flame begins to diminish & generator tube warms……	☐	☐
5. Valve opened & adjusted to desired setting (do not exceed 2 full turns)……	☐	☐
6. Additional 3 to 4 pumps added when necessary to maintain bottle pressure..	☐	☐

NOTE: Too much pressure in fuel bottle causes stove to function poorly w/ sporadic flame. Avoid over-pressuring the fuel bottle with too many pumps.

NOTE: Before removing pump assembly from fuel bottle, insure flame is out and stove has cooled. Release pressure by inverting the bottle with stove attached over a Hazardous Material Pad and opening the fuel valve. This allows all pressure to escape with minimal fuel loss.

TASK: Disassemble and Pack a Yukon Stove

CONDITION: Given an arctic 10-man tent and Yukon stove, properly set up with the stove in operation. This task will be performed by two individuals and evaluated collectively.

STANDARD: The stove must be disassembled and packed so that all stove components fit inside the stove body with the stove door closed. All critical performance standards must be met.

REFERENCE: NWTC Winter Operations Manual (December 1999), Chapter 3

EVALUATION:	**Yes**	**No**
* 1. Drip valve placed in the *"OFF"* position……	☐	☐
* 2. Fuel can removed from tripod; adapter & vent tube removed……	☐	☐
* 3. Fuel line removed from adapter & burner assembly……	☐	☐
* 4. Fuel line is purged of excess fuel……	☐	☐
* 5. Stove is allowed to cool……	☐	☐
* 6. Burner assembly & stove pipes removed……	☐	☐
7. Stove pipes nested in sequence with seams side by side……	☐	☐
8. Excess soot or ashes removed prior to packing……	☐	☐
9. Stove body opening (for burner plate) closed……	☐	☐
10. Draft gate on stove door closed……	☐	☐
11. Stove door closed & secure……	☐	☐

TASK: Strike an arctic 10-man tent

CONDITION: Given a 10-man arctic tent, properly set up with the stove removed, and the necessary tools for removing tent pins or other tent anchors.

STANDARD: The tent must be folded for stowage in the ahkio sled so it is immediately ready for pitching. Tent lines must be managed so they do not become entangled.

REFERENCE: NWTC Winter Operations Manual (December 1999), Chapter 3

EVALUATION:	**Yes**	**No**
1. Center pole removed and adjusted to shortest length……	☐	☐
2. Tent and liner doors zipped shut……	☐	☐
* 3. Corner eave lines extended to full length……..	☐	☐
* 4. All other tent lines extended to full length, rolled and secured……..	☐	☐
5. Tent pins (or other anchor material) & door poles retrieved/accounted for…..	☐	☐
6. Snow, ice, and/or dirt removed from tent……	☐	☐
7. Tent folded *accordion-style*……..	☐	☐
* 8. Six corner eave lines *chained* together……..	☐	☐
9. Wide portion of tent (skirt) folded in half, lengthwise…….	☐	☐
10. Tent folded into thirds ready for stowage in case or ahkio……	☐	☐

TASK: Pack an Ahkio Sled

CONDITION: Given a properly folded 10-man arctic tent, Yukon stove packed with all components, remaining standard equipment and the ahkio sled.

STANDARD: The ahkio must be packed so it has a low profile and the center of balance is low and to the rear. All critical performance standards are met.

REFERENCE: NWTC Winter Operations Manual (December 1999), Chapter 3

EVALUATION:	**Yes**	**No**
1. Sled is cleared of snow and debris……	☐	☐
2. Tent pins, machete, saw, & ax placed in bottom, covered by stove board…	☐	☐

NOTE: If trail-breaking, place machetes, saw, and ax on top, just inside the cover.

3. Yukon stove placed on top of stove board……	☐	☐
* 4. Water & bagged fuel cans placed in the rear; lids up and opposed……	☐	☐
5. Tent is spread on top of all equipment from front to rear……	☐	☐
* 6. Load adjusted so center of balance is low & rear of center……	☐	☐
7. Shovels placed inside of folded tent……	☐	☐
8. Cover is folded, ropes hooked together, tightened & tied off……	☐	☐

TASK: Light and Operate a Gas Lantern

CONDITION: Given the lantern filled to the proper level with white gas, or other appropriate fuel, and an 18-24 inch length of chain for hanging the lantern.

STANDARD: The lantern must be placed into operation within 5 minutes. All critical performance standards must be met.

REFERENCE: Manufacturer's instructions

EVALUATION:	**Yes**	**No**
* 1. Ensure fuel valve is *"OFF"*……	☐	☐
2. Open pump 1 turn, cover hole in pump end, pump approx. 30 strokes……	☐	☐
3. Close pump (turning clockwise)……	☐	☐
4. Hold lit match near mantle(s), turn fuel valve to *"HIGH"* …… (It may take a few seconds for the mantles to light.)	☐	☐
5. Adjust fuel valve to obtain desired brightness……	☐	☐
6. Pump additional air into tank as necessary to maintain tank pressure……	☐	☐
* 7. Lantern is hung w/ chain minimum 18 inches below tent apex……	☐	☐

NOTE: Once burning properly, mantle(s) should glow brightly with no additional flames. If there are additional flames, close the fuel valve, (this indicates a fuel leak). Service the lantern as required. Before packing, release pressure in the fuel tank.

NOTE: Clean burner tip- **ENSURE FLAME IS OUT,** *turn fuel valve "OFF" to "HIGH" several times.*

Appendix F
Cold Weather Operation Of The Small Unit Support Vehicle

The Small Unit Support Vehicle (SUSV) has experienced a high engine failure rate since it was fielded in the 1982-1983 time frame. There are differences of opinion as to what caused these failures, because the specific sources of failure have been difficult to pinpoint. However, most personnel familiar with the problem agree that overheating and thermal stress are the most likely causes. With the exception of this problem, the SUSV**'**s overall reliability is comparable to that of the majority of tracked vehicles in the Army inventory. The following tips are meant to be used as supplements to the PMCS and operating procedures described in the appropriate TM's; **all before, after and during PMCS requirements must still be performed**.

Before starting the vehicle, check all fluids; the coolant-tank cap must loosened, to relieve pressure, in order to get a correct reading.

CAUTION: NEVER LOOSEN THE CAP WHEN THE ENGINE IS HOT!

The engine compartment covers must be removed to check for any fluid leaks that may render the vehicle unserviceable. Vehicle operators should be equipped with flashlights; it is difficult, at best to see into the bottom of the engine compartment, even in bright daylight conditions. Next, check the outside of the vehicle for ice/snow buildup, and remove ice and snow as necessary. Remove and properly stow both front and rear grill covers.

The procedures you use to start the vehicle will vary with the ambient temperature. At temperatures above –4°F, hold the ignition key at the pre-glow position for 15 seconds, then turn the key to the start position. If the engine does not start, this procedure may be repeated two more times, for a total of three attempts. If, after the third attempt, the vehicle has not started, turn the key off and contact organizational maintenance. In temperatures from –4°F to –25°F, the ignition key should be held in the pre-glow position for 30 second; again, if it does not start on the third attempt, notify organizational maintenance.

When in the field, and temperatures are below –25°F, you must use the Swingfire heater (see Appendix G) prior to starting the vehicle. Once the Swingfire is operating, install it into the Swingfire tube, located on the outside rear of the front car. Turn the ignition key to the on position, and turn on the circulating pump. Allow the Swingfire to run for 45 minutes, or until the coolant temperature reaches +70°C – +80°C. The vehicle is now ready to start.

When parking vehicles in the motor pool, or any place electrical power is available, the block heater should be used to warm them prior to start-up. The block heater required for the SUSV must be ordered through a Mercedes-Benz dealer; the part number is A 606-200-00-96.

The use of "off-the-shelf" starting fluids (ether and other commercially available fluids) will cause an explosion that will result in damage to the cylinder head gasket, pistons, and cylinder head. **The use of ether and/or commercial starting fluids is prohibited**.

After the vehicle has started, the engine must be allowed to warm up; let it idle for three to five minutes before roll-out. As the temperature becomes colder, idle time will increase; ten to fifteen minutes may be required in extreme cold. In cold temperatures the steering may become stiff, due to thickening of the steering (hydraulic) fluid. To warm the fluid, gently turn the steering wheel back and forth while the vehicle is moving forward. It may take a while before the steering loosens up; don't force it! Damage to the steering system may result.

While driving the SUSV, you must match your technique to the terrain. When crossing a berm, slow down and creep across the berm at a right angle to it. If the berm is covered with snow more than approximately six inches deep, come to a complete stop and shift the transfer case into low range; this

will put less stress on the engine. When climbing a hill, you may need to shift into low range. If you don't know whether or not to slow down, or to shift the transfer case from high to low range, listen to the engine; if it sounds like it's straining, slow down and/or shift. Always keep an eye on the tachometer; you should never allow the engine speed to exceed 4000 RPM.

Anytime you leave an improved trail, shift the transfer case into low range. The SUSV was designed as a cross-country vehicle. Travel on paved roads will cause the transfer case, differential and tracks to overheat, generally due to the higher speeds attainable on a hard paved surface, and will place undue stress upon the suspension system.

Do not attempt to swim the SUSV. In the event that you must ford a stream or small body of water, ensure that the water is shallow enough that the vehicle will remain firmly in contact with the bottom, and ensure that the drain plugs are in.

When shutting down the vehicle, the engine must be allowed to idle down for three to five minutes before shutdown. Failure to idle the vehicle prior to shutdown will result in damage to the engine. If the vehicle has been operating with a full payload, and the temperature gauge indicates that engine temperature is higher than normal, idle the engine at approximately 1400 RPM for 30 seconds before allowing it to idle three to five minutes at approximately 900 RPM; then shut down.

NOTE: Failure to follow the correct shut-down procedures may result in extensive engine damage!

While the vehicle idles prior to shut-down is a good time to inspect the outside of the vehicle for damage/leaks, as well as to remove the engine covers and check the engine compartment for leaks. When parking the vehicle for an extended period of time (overnight or longer), or during inclement weather, ensure that both front and rear grill covers are properly installed. These will prevent snow, rainwater, leaves, and other material from accumulating in the engine compartment.

When cleaning the SUSV, ensure that the correct cleaning products are used, especially inside the engine compartment. Maintaining a clean engine compartment is critical because any dirt, leaves, etc. in the engine compartment will absorb any leaking diesel fuel or lubricating oil, becoming a fire hazard. PD-680 solvent, gasoline, and simple green are not approved for use. PD-680 and gasoline both produce flammable vapors that are a fire hazard when present in the engine compartment. Simple green presents environmental problems, and is banned for this reason. The only agent authorized for cleaning the engine compartment of the SUSV is Microbial soap.

SUSV MAINTENANCE CHECKLIST

BUMPER#_____
OPERATOR:_____**DATE**_____

CHECK PERFORMED	**GO**	**NO GO**	**CORRECTIVE ACTION**
ENGINE OIL LEVEL			
TRANSMISSION OIL LEVEL			
STEERING FLUID LEVEL			
RADIATOR FLUID LEVEL			
BRAKE FLUID LEVEL			
DRIVE BELTS			
AIR CLEANER			

BATTERIES			
STARTER BOLTS			
LEAKS (CLASS I, II, III)			
HORN			
LIGHTS (ALL)			
WINDSHIELD			
WINDSHIELD WIPERS			
SEAT BELTS			
GAUGES			
MIRRORS			
FIRE EXTINGUISHER			
FIRST AID KIT			
WARNING TRIANGLES			
LICENSE AND –10			

ADDITIONAL CHECKS TO PERFORM

CHECK PERFORMED	**GO**	**NO GO**	**CORRECTIVE ACTION**
TURBO OIL LINES			
TURBO HEAT SHIELD			
ENGINE OIL LINES (ALL)			
BATTERY CABLES			
BELLY CLEAN			
FUEL RETURN LINES			
OIL COOLER LINES			
OIL FILTER HOUSING			
FIRE SUPPRESSION SYSTEM			

Appendix G
Swingfire Heater Use

The following procedures are used to start/operate the Swingfire heater.

1. Insure the swingfire has no leaks and that the power connector is on hand.

2. Plug one end of the power connector into the Swingfire, and the other end into the power source on the vehicle.

3. Squeeze pump lever, which pushes starting button, and listen for a humming noise.

4. Turn regulator knob fully closed (clockwise).

5. Preheat swingfire by pressing and holding start button using the table below for times:.

0°F to –20°F	hold button 2 minutes
-20°F to –30°F	hold button 3 minutes
-30°F to –40°F	hold button 4 minutes
-40°F and colder	hold button 5 minutes

6. Move pump handle back and forth three or four times.

7. With one hand open regulator knob one-half to one turn (if temperature is above 0°F), or one to one-and-a-half turns (if temperature is below 0°F). Continue pumping lever with other hand.

8. When pulsating sound is heard, continue pumping and adjust regulator until pulse sound comes at normal intervals.

9. Stop pumping.

10. Allow heater to operate for three to five minutes while fine-tuning fuel/air mixture with regulator knob.

11. Once heater is running properly, disconnect and stow power cable.

12. Swingfire is ready to use; install in vehicle's receptacle, and warm vehicle IAW applicable TM.

NSN's of Cold Weather Equipment

Ahkio Group

NSN	ITEM DESCRIPTION	UNIT OF ISSUE
5110-00-340-3276	BOW SAW	EA
7240-00-089-3827	CAN, WATER	EA
8340-00-242-7872	CLIP, LINER	EA
8305-00-926-6171	CLOTH, DUCK, 5 YARDS	EA
7630-00-272-2485	COOK SET, FIVE MAN	EA
5390-00-260-1414	D-RING, ONE INCH BRASS	EA
4210-00-165-4703	FIRE EXTINGUISHER	EA
5120-00-203-4656	HAMMER, 2 ½ POUND	EA
8465-00-255-8413	HARNESS, MAN'S, SLED	EA
5120-00-Z27-0001	LANTERN WITH CASE	EA
8340-00-262-3698	LINER, TENT	EA
5110-008-13-1286	MACHETE, WITH CASE	EA
8340-00-965-4432	PEAK PLATE	EA
8340-00-823-7451	PIN, TENT, STEEL	EA
8340-00-188-8413	POLE, TENT	EA
5120-00-188-8446	SHOVEL, COAL	EA
8920-00-273-8211	SLED, SCOW	EA
8340-00-205-2759	SLIP, TENT LINE	EA
7130-00-Z27-1824	STOVE, WHISPERLITE	EA
8340-00-262-3684	TEN MAN TENT, ARCTIC	EA
8340-00-262-3658	TENT LINE, 12' 6"	EA
8340-00-262-6911	TENT LINE, 19'	EA

Heater, Space, M1950 Yukon

NSN	ITEM DESCRIPTION	UNIT OF ISSUE
7240-21-912-7162	ADAPTER, GRAVITY, NATO	EA
7240-00-360-0094	ADAPTER KIT, GRAVITY	EA
4520-00-540-0098	BURNER ASSEMBLY	EA
4520-00-360-0098	CAP, FLUE	EA
4520-00-233-6555	CORD, COTTON	RL
5330-01-271-7621	GASKET, GRAVITY FEED	EA
4520-00-272-7692	GRATE, HEATER	EA
4520-00-287-3353	HEATER, SPACE, M1950 YUKON	EA
4720-00-303-4995	HOSE ASSEMBLY	EA
4520-01-202-4520	KIT, REPAIR, BURNER	EA
4520-00-277-8342	PIPE, AIR CONDITIONING	ST
4520-00-386-3774	VALVE, DRIP	EA
7240-00-203-9735	VENT TUBE	EA
4730-01-230-3602	¼ INCH HOSE BARB (AGF)	EA

Lantern

NSN	ITEM DESCRIPTION	UNIT OF ISSUE
288-4411	BALL NUT	EA
290-5341	BURNER ASSEMBLY	EA
290-763	CARRYING CASE	EA
200-6381	CHECK VALVE SYSTEM	EA
290-5291	COLLAR	EA
290-5231	FEED TUBE ASSEMBLY	EA
290-6151	FOUNT	EA
290-5301	FRAME ASSEMBLY	EA
220C1401	FUEL CAP	EA
290-5891	GENERATOR	EA
690A048	GLOBE	EA
288-5491	KNOB	EA
290-700	LANTERN	EA
288-1641	NUT	EA
242D5201	PLUNGER ASSEMBLY	EA
530A5071	PUMP CLIP	EA
216-1091	PUMP CUP	EA
220-C175	SCREW	EA
290-1251	U-CLIP	EA
290A6571	VALVE ASSEMBLY	EA
290-4851	VENTILATOR	EA

Oversnow Mobility Equipment

NSN	ITEM DESCRIPTION	UNIT OF ISSUE
8465-01-334-9509	BINDING, NATO, 120L	PR
8465-01-334-9508	BINDING, NATO, 120M	PR
120-IC-003(OVERSIZED)	BINDING, NATO, 120 w/ OVERSIZED CABLES	EA
8465-01-334-9510	BINDING, NATO, 120XL	PR
8465-00-965-2175	BINDING, SNOWSHOE	ST
8465-00-985-7427	CLIMBER, SKI, w/ BUCKLE	PR
8465-01-170-7299	SKI, 180 CM	PR
8465-01-170-7300	SKI, 190 CM	PR
8465-01-170-7301	SKI, 200 CM	PR
8465-01-170-7302	SKI, 210 CM	PR
8465-00-753-6145	SKI POLE, w/ BASKET, 54 INCH	PR
8465-00-753-6142	SKI POLE, w/ BASKET, 58 INCH	PR
8465-00-965-2174	SNOWSHOE	PR
8465-00-753-5962	SNOW RING, SKI POLE	EA

SPACE HEATER, ARCTIC

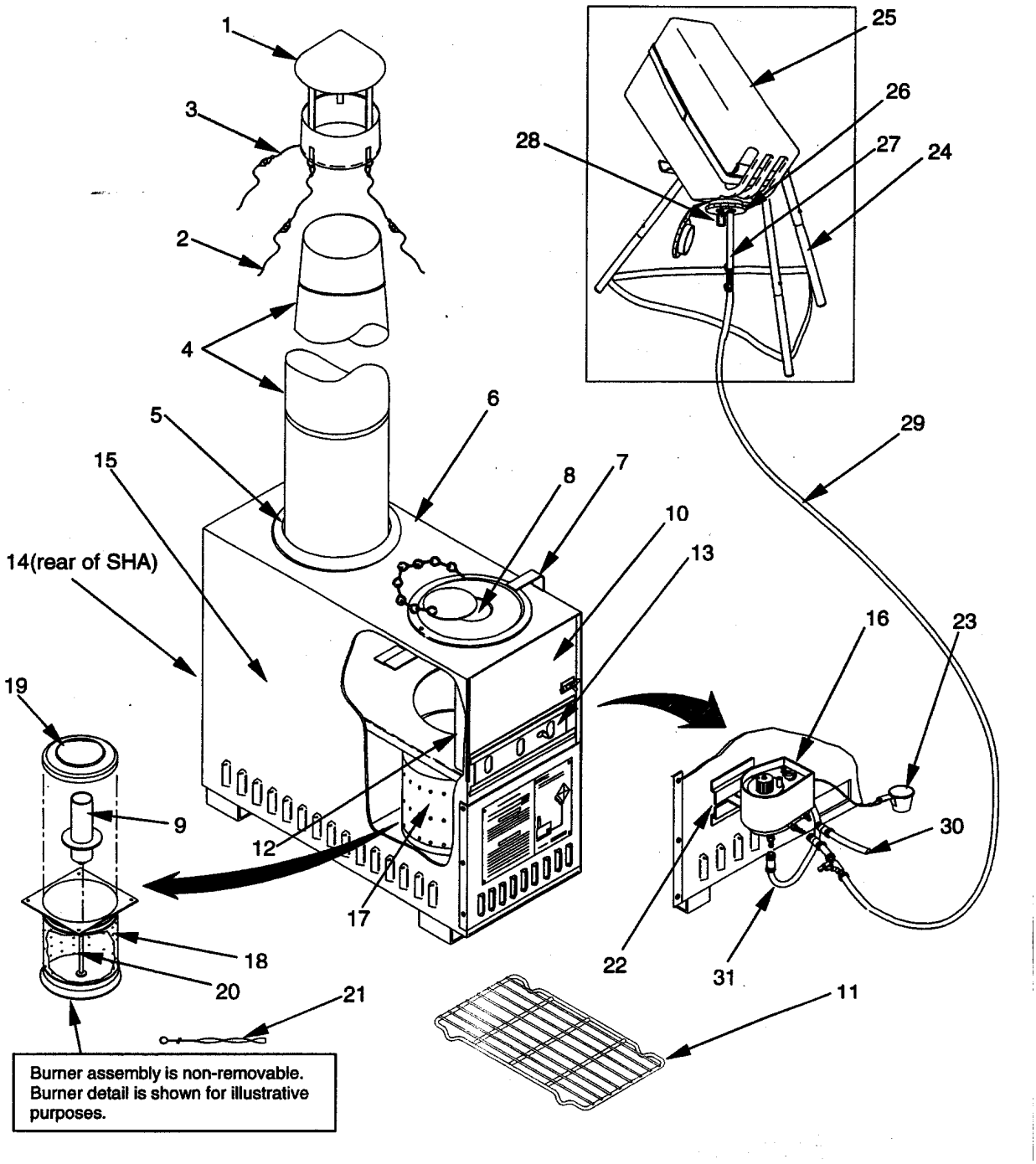

Figure 1 Space Heater Arctic

I. Location and Description of Major Components

Stack cap assembly (1). The Stack Cap Assembly is installed on the top of the nested stack assembly **(4)** to prevent down-drafts from entering the heater during operation. It also prevents rain, leaves, and other debris from entering the stack assembly. Guy lines **(2),** secured to three wire ropes **(3),** lead to tent lines that stabilize the entire stack assembly **(4)** in an upright (vertical) position during heater operation.

Nested stack assembly (4). Consists of six pipe sections (middle sections not shown) of decreasing diameter. When assembled, the sections form a cone-shaped stack with the largest diameter section at the base and the smallest diameter at the top. Each section is flanged on its smaller end in order to fit into the next higher section. The assembly **(4)** seats in the stack adapter assembly **(5),** allowing combustion gases to discharge outside the tent during operation. When disassembled, the sections fit inside each other for storage in the upper portion of the heater body **(6).**

Heater body assembly (6). Basic shell of the heater. **Lid assembly (7).** The lid assembly **(7)** fits into a circular opening on the top surface of the heater. The built-in sight glass **(8)** allows the user to monitor the burner flame. It also permits access to the burner down tube assembly **(9)** when igniting liquid fuel. The lid assembly **(7)** is stored in the upper portion of the heater body **(15).**

Door assembly (10). Hinged door is secured with a slide latch. When opened, it allows access to install and remove the solid fuel grate (1 1) and burner cover assembly (1 **2).** It permits adding and igniting fuel in solid fuel operation. A built-in sliding draft gate **(13)** allows burn rate control during solid fuel operation only.

Burner cover assembly (12). During solid fuel operation, this cover **(12)** is positioned on top of burner shell **(18)** to prevent ashes, coals, and embers from falling into the burner shell. During liquid fuel operation, the cover **(I 2)** is positioned in the frame of the door assembly, and held in position by the closed door **(10),** to achieve a tight air seal.

Solid fuel grate (11). Elevates solid fuel while it burns to allow for air circulation and to provide an area for ash deposits. The Solid Fuel Grate MUST be removed prior to liquid fuel operation.

Rear door (14). The Rear Door fits on the rear of the heater and acts to contain the parts which may be stored in the storage enclosure **(15)** while the heater is not in use.

Rear storage enclosure (15). Accessed through the rear door **(14)** and used to stow all loose parts that will not fit inside the heater body during transport of the heaters. Items stored in this area include the Fuel Flow Control Valve **(16),** Stack Cap Assembly **(1),** and Gravity Feed Adapter **(26).**

Burner shell assembly (17). Area of combustion in liquid fuel mode. Consists of a perforated burner shell **(18),** high fire ring **(19),** and up-tube **(20)** which is welded into the base of the burner shell **(18).** It permits fuel vapors to flow into the down-tube assembly (9) during operation.

Down-tube assembly (9). A capped down tube which is positioned on the up-tube **(20)** and removable through the lid assembly **(7).** A super-heater ring is located on the exterior for heat transfer. During operation, fuel flows into the up-tube **(20)** where its level is gravity-maintained with the fuel flow control valve **(16).** Fuel vaporizes due to combustion heat and fuel vapor is expelled from the up-tube **(20),** down through the down tube and into the burner shell **(18)** where it ignites. The down-tube **(9)** and up-tube **(20)** are cleaned with the reaming tool **(21),** which Is kept inside the heater body during storage (**15).** The reaming tool **(21)** should be stored in an accessible yet protected location when not in use.

Fuel flow control valve (16). Mounts to a 'T" shaped bracket **(22)** and slides into position on the right side of the heater body **(6).** The valve **(16)** functions safely with the liquid fuels specified in this work package. When set properly, internal orifices match the viscosity of the fuel being used to meter the correct fuel flow to the burner. The cup/cable assembly **(23)** is attached to the bracket and is used for measuring fuel to prime the heater in liquid fuel mode.

Fuel can stand, collapsible (24) (optional item). Allows the fuel can **(25)** to be mounted in an inverted position to permit gravity fuel ' feed to the fuel flow control valve **(16).** (Note: The Fuel Can Stand is available as an Additional Authorized Item as detailed in WP 0045).

Gravity feed adapter (26). Threads onto fuel can **(25).** Hose **(27)** allows fuel flow from the fuel can **(25)** during operation. The automatic vent **(28)** permits air to vent into the can for proper fuel flow to the heater.

Fuel hoses (29)(30). Fuel supply hose **(29)** allows fuel flow from fuel can **(25)** through the gravity feed adapter **(26)** to the fuel flow control valve **(16)**, through the hose to the burner up-tube **(20)**. An overflow hose **(30)** drains fuel outside the tent in the event of a malfunction of the Fuel Flow Control Valve **(16).** Hoses, **(29)** and **(30)**, connect with quick-disconnect couplings. The fuel control outflow hose **(31)** delivers fuel from the control valve to the burner assembly. The fuel supply hose **(29)** and overflow hose **(30)** are both stored in the upper portion of the heater body **(15)**.

II. Installation and Assembly

This section outlines the siting requirements of the SHA, as well as the installation, preparation, and operation of the SHA under usual conditions. Read all warnings and cautions within this section and follow procedures outlined herein to ensure safe operation of the SHA and associated equipment.

A. Unpacking The SHA System Components

The Space Heater Arctic utilizes the area inside its shell for the storage of components during movement and storage. Some components are stored behind the front door while others are stored behind the rear door.

CAUTION

BEFORE THE SHA CAN BE USED, ALL COMPONENTS MUST BE REMOVED FROM THEIR RESPECTIVE STORAGE AREAS.

1. To unpack the SHA, press down on the spring-tensioned Rear Door **(1)** and remove the Fuel Flow Control Valve **(2)**, Stack Cap Assembly with Tent Lines **(3)**, and Gravity Feed Adapter **(4)**.

2. Reinstall the Rear Door **(1)** by placing the bottom edge of the door in the slot at the bottom of the heater frame. Press down on the door and swing it into position in the heater frame until the pin on the frame engages with the small slotted hole on the top edge of the rear door. Release the Rear Door.

3. Slide the front door latch **(5)** to the left and open the front door **(6)**. Remove the Burner Cover Assembly if it is installed in the door frame.

4. Remove the Fuel Overflow Hose **(7)** (stored inside the Nested Stack Assembly), Fuel Supply Hose **(8)**, Nested Stack Assembly **(9)**, Burner Reaming Tool **(10)**, Lid Assembly **(11)** and Solid Fuel Grate **(12)**.

5. Install the Burner Cover Assembly (refer to next section for details). Close and latch the Front Door **(6)**.

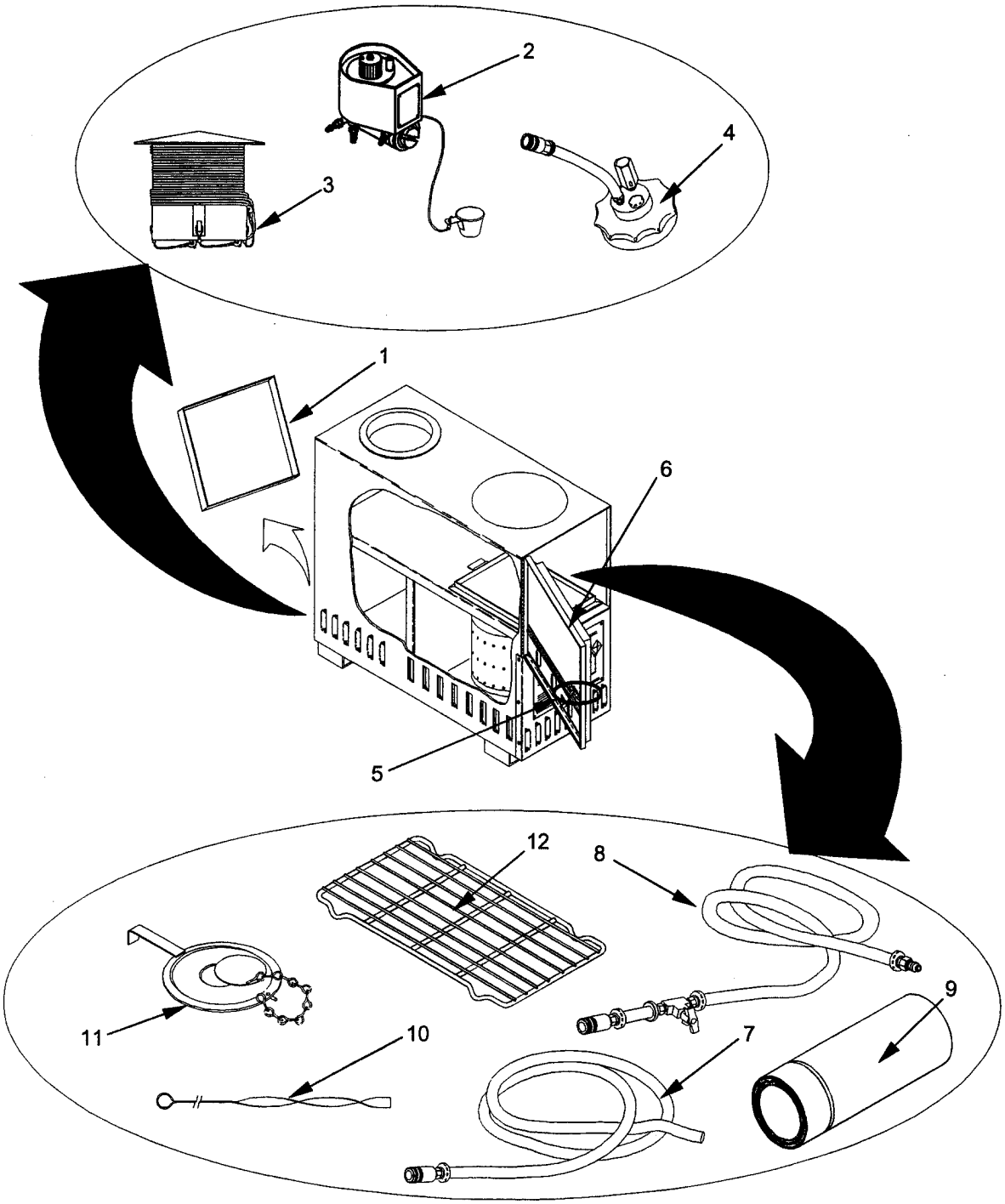

Figure 2

B. Installing The Burner Cover Assembly And Solid Fuel Grate- Before the SHA can be operated, the Burner Cover Assembly **(1)** must be installed according to the type of fuel being used.

1. For Liquid Fuels, (See Figure 3)

If the heater will be operated in Liquid Fuel mode, the Burner Door Assembly **(1)** must be installed in the door frame **(2)** located behind the Front Door **(3)**. This is to prevent any air from entering through the front door of the heater. To verify proper installation of the Burner Cover Assembly, slide the front door latch **(4)** to the left and open the front door **(3)**; ensure that the solid fuel grate **(10)** is not installed. The Burner Cover Assembly **(1)** must be installed in the door frame **(2)**, blocking the area behind the front door **(3)**. When the Burner Cover Assembly **(1)** is installed, close and latch **(4)** the front door **(3)**.

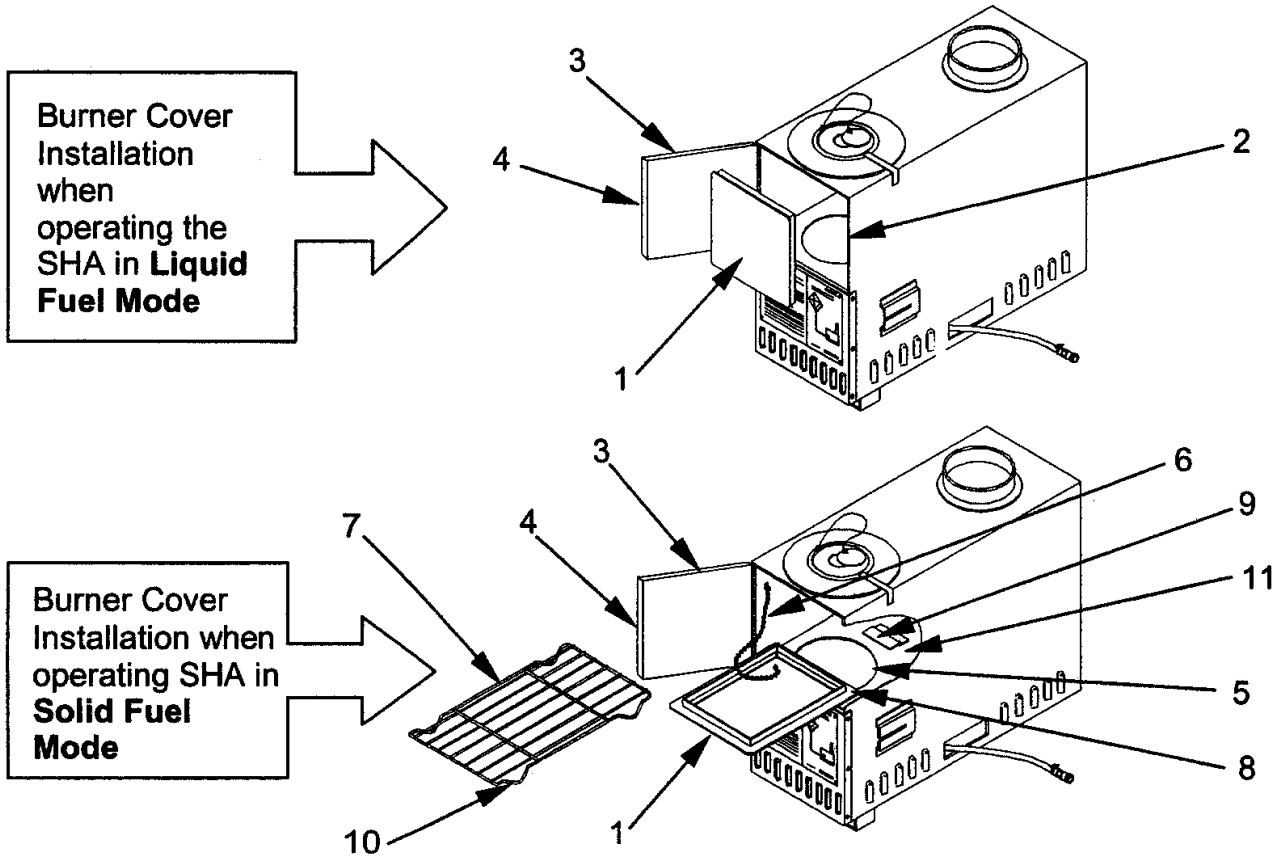

Figure 3

2. For Solid Fuels, (See Figure 3)

When preparing to use the heater in solid fuel mode, the Burner Cover Assembly **(1)** should be installed over the Burner Assembly opening **(5)**. To install the Burner Cover Assembly for solid fuel operation, slide the front door latch **(4)** to the left and open the Front Door **(3)**. If the Burner Cover Assembly is currently installed in the door frame **(2)**, remove it and allow it to hang from its retaining chain **(6)**. If the Solid Fuel Grate **(7)** is installed, remove the grate and install the Burner Cover Assembly **(1)** smooth side down over the Burner Assembly opening **(5)**. Slide the cover back toward the rear of the heater until its back edge **(8)** engages in the Burner Cover retaining clip **(9)**. Install the Solid Fuel Grate **(7)** in position over the installed Burner Cover Assembly **(1)** making sure to install the grate with its feet **(10)** down on the deck **(11)** of the upper heater area.

WARNING DO NOT USE UNAUTHORIZED FUELS

ONLY APPROVED LIQUID AND SOLID FUELS MAY BE USED. USING UNAUTHORIZED FUELS IN THE SHA WILL CREATE A FIRE DANGER AND POTENTIAL FOR EXPLOSION.

IF FUEL FLOW CONTROL VALVE ASSEMBLY IS IMPROPERLY POSITIONED OR IF BRACKET IS BENT, A FUEL OVERFLOW COULD OCCUR INSIDE BURNER SHELL ASSEMBLY AND CAUSE A FIRE OR EXPLOSION.

FOR SAFE OPERATION, BE SURE TO ALLOW AT LEAST TWO FEET OF SPACE BETWEEN THE HEATER AND THE SHELTER WALL. NEVER RE-LIGHT A HEATER WHEN IT IS STILL HOT. BE SURE TO ALLOW THE HEATER TO COOL COMPLETELY BEFORE ATTEMPTING TO RE-LIGHT. DO NOT ATTEMPT TO REPLENISH THE FUEL SUPPLY WHILE THE HEATER IS IN OPERATION.

Before operation perform the "Before Operation PMCS" on all SHA system components as outlined in WP 001 0, prior to preparing the heater for use. All scheduled maintenance must be performed on the heater and its associated equipment prior to use.

3. Set up the heater inside its operating space (shelter). The area selected must be level and free of debris and flammable materials.

4. Assembly of the stack assembly

a. (See Figure 4) Securely roll and tie exhaust opening closure flap **(1)** so it will not touch stack assembly during heater operation.

b. (See Figure 5) Tie one end of each shelter line (1) to each wire rope (2) on stack cap (3). Set this assembly aside.

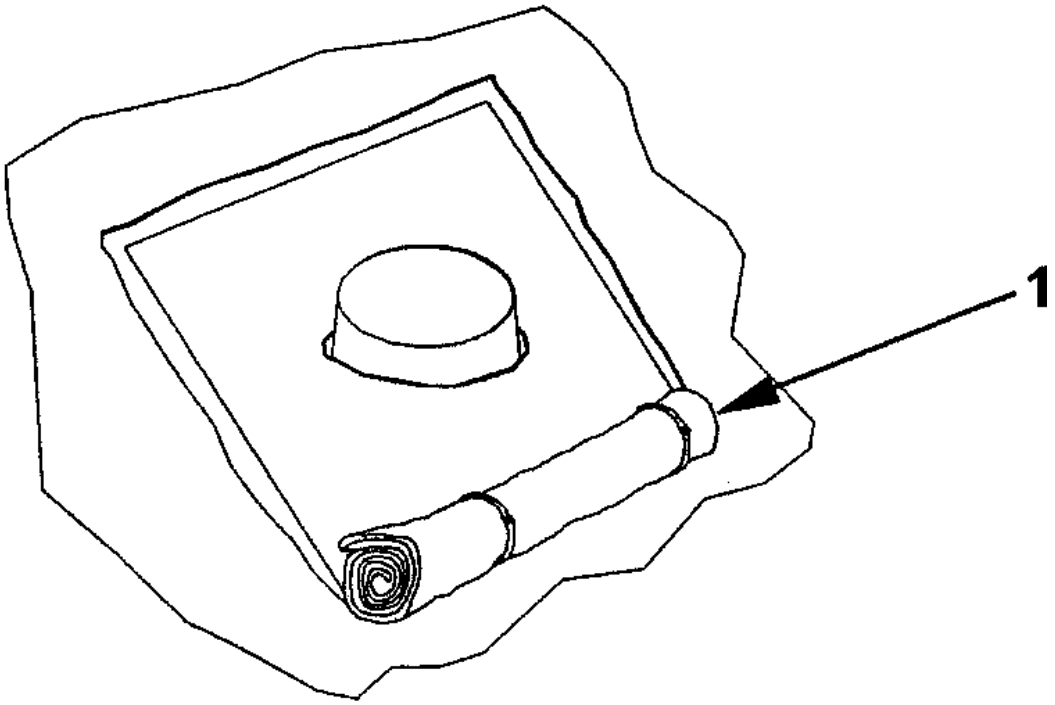

Figure 4

c. Separate the stack assembly and assemble stack sections (4-9), in order of decreasing size, onto the crimped end of each adjoining stack section. Each stack section is stamped on the side with a number. The largest diameter stack section is stamped "1" and installs in the heater body. The smallest diameter stack section is stamped "6" and is the topmost stack section. Lift the assembled exhaust stack (10) and pass it through the exhaust opening (11).

d. As the stack assembly passes through the exhaust opening (11), have a person on the outside of the shelter install and fully seat the stack cap (3) with attached lines (1) onto topmost stack section (4). Inside the shelter, raise the stack assembly and position the bottom stack (9) into the stack adapter opening (12). This completes the assembled exhaust stack (10).

e. Making sure that the assembled exhaust stack (10) is positioned straight, tie the stack cap guy lines to the closest corresponding tent line, where the tent line attaches to the tent eave.

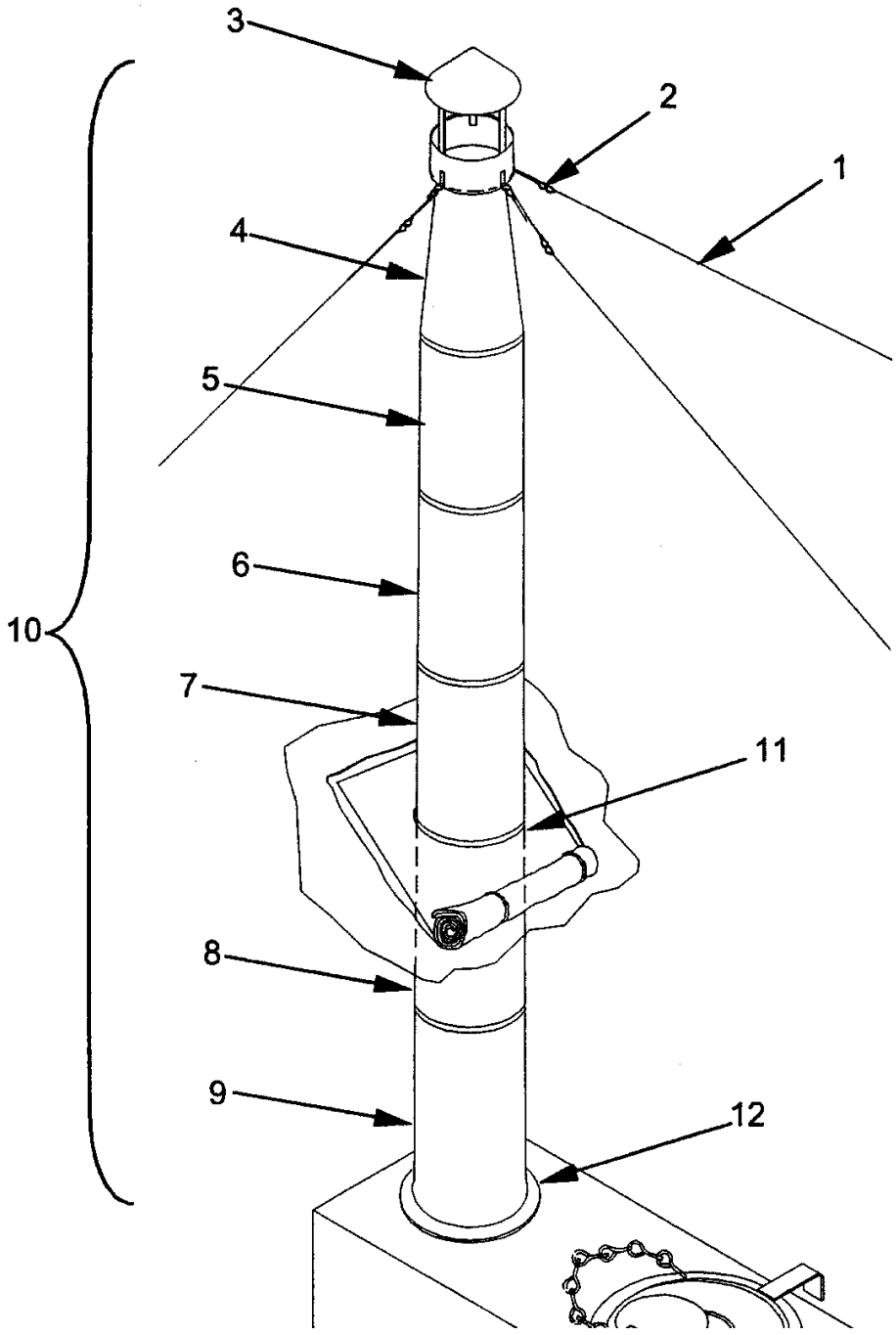

Figure 5

III. Operation In Liquid Fuel Mode

A. Instructions (For Detailed Operating Instructions refer to TM 9-4520-XXX-12&P)

WARNING FIRE OR EXPLOSION

IF FUEL FLOW CONTROL VALVE ASSEMBLY IS IMPROPERLY POSITIONED OR IF BRACKET IS BENT, A FUEL OVERFLOW COULD OCCUR INSIDE BURNER SHELL AND CAUSE A FIRE OR EXPLOSION.

1. Slide fuel flow control valve from front to back fully into the sleeve on the right side of the heater. Be certain that the control valve is fully seated in the sleeve, does not bind in the sleeve, and is level with heater when installed.

2. Reach into the cutout area on the right side of the SHA and pull out the overflow hose.

3. Connect overflow hose QD to fuel discharge fitting on base of control valve.

4. Connect fuel supply hose to fuel inlet fitting.

B. Preparing A Fuel Supply Site

Fuel hoses (29)(30). Fuel supply hose **(29)** allows fuel flow from fuel can **(25)** through the gravity feed adapter **(26)** to the fuel flow control valve **(16)**, through the hose to the burner up-tube **(20)**. An overflow hose **(30)** drains fuel outside the tent in the event of a malfunction of the Fuel Flow Control Valve **(16).** Hoses, **(29)** and **(30)**, connect with quick-disconnect couplings. The fuel control outflow hose **(31)** delivers fuel from the control valve to the burner assembly. The fuel supply hose **(29)** and overflow hose **(30)** are both stored in the upper portion of the heater body **(15)**.

1. Select a level fuel supply site, free of debris and open flame, at least seven feet from shelter.

NOTE: Open end of overflow hose should discharge to a safe, outside location along a downslope and below the level of the fuel flow control valve. A piece of commercial petroleum absorbent material, such as New Pig's Stat-Mat roll, will be placed under the end of the overflow hose to catch any fuel that may spill. Additional commercial products are available to contain large spills, such as New Pig's Absorbent Sock.

2. Route the overflow hose and fuel supply hose outside the shelter to the fuel supply location. The overflow hose should discharge to a safe, downward sloping, outside location below the level of the fuel flow control valve. Place a petroleum absorbent mat under the open end of the hose.

WARNING FIRE OR EXPLOSION

DO NOT USE ANY UNAUTHORIZED FUEL. USE OF UNAUTHORIZED FUEL MAY RESULT IN FIRE AND/OR EXPLOSION.

C. Install Gravity Feed Adapter In Fuel Can

1. At the fuel supply site, install a gravity feed adapter on a full fuel can as follows:

WARNING FIRE OR EXPLOSION

GRAVITY FEED ADAPTER KIT MUST BE FULLY SEATED TO PREVENT FUEL LEAKAGE AND FIRE.

2. Set fuel ON/OFF control on the fuel flow control valve to the OFF position.

3. Remove cap from mouth of fuel can and replace with gravity feeder adapter. Screw the adapter into the fuel can securely.

4. Attach male end of fuel supply hose to gravity feed adapter fitting. Set the assembled fuel can aside.

5. At the fuel supply site, set up fuel can stand with fuel can level or slightly above heater as detailed in the next section.

NOTE: If fuel can stand is unavailable, invert fuel can with installed gravity feed adapter on a stable support so that the bottom of the fuel can is two feet (61 centimeters) to three feet (91.5 centimeters) above fuel flow control valve.

D. Setting up the Fuel Can Stand

1. If liquid fuel is to be used, the fuel can stand (optional item; the fuel can stand is available as an Additional Authorized Item) must be assembled in order to mount the fuel can in the proper position. The fuel can, outfitted with a fuel can gravity feed adapter, must be mounted to the stand with the gravity feed adapter facing down.

2. Insert the bottom leg assembly into the top leg assembly until each leg is locked in place. Be sure to orient each bottom leg so that the stabilizing straps are positioned toward the inside of the stand. Ensure that the straps are not twisted.

3. Spread the assembled leg assembly until the stabilizing straps are fully extended and the stand is stable. The leg assembly straps are designed to ensure the stand is stable, but are also designed to prevent the stand from sinking into snow.

4. Lower the left and right support arms so that each is at a right angle to its attached leg. Place the tripod brace under the top bracket of the stand and clip into position over the front of the top bracket.

NOTE: Ensure that the Fuel Can Gravity Feed Adapter is fully seated and secured to avoid leaking.

5. Invert the fuel can with installed gravity feed adapter and mount on the assembled fuel can stand so that the gravity feed adapter faces the ground. Slide the right support arm through the handle of the fuel can. Wrap the left support strap over the bottom of the fuel can. Feed the right support strap through the fuel can handle up across the front of the fuel can body, and over the left support strap. Secure the right strap to the left strap . The strap helps secure a partially filled fuel can to the fuel stand during windy conditions.

WARNING FIRE OR EXPLOSION

NEVER ATTEMPT TO LIGHT A HEATER THAT MAY STILL BE HOT. ALLOW THE HEATER TO COOL SUFFICIENTLY BEFORE LIGHTING. LIGHTING A HEATER THAT IS STILL HOT MAY RESULT IN FIRE/EXPLOSION.

E. Setting The Fuel Flow Control Valve

1. Lift fuel selector control knob on the Fuel Flow Control Valve and set in accordance with the outside temperature. There are two positions, ABOVE -25º F and BELOW -25º F. Pull the knob and rotate it to the desired position. Release the control knob, making sure that the knob locks in the indentation for the desired position.

2. Set fuel ON/OFF control to ON.

3. Set flow adjustment knob to HI; wait 2 to 5 minutes in order to allow the fuel flow control valve and burner up-tube to fill with fuel.

4. Shake or tap hoses to clear any air bubbles that may be trapped in the hoses.

5. Open the door assembly and verify that the Burner Cover Assembly has been installed in the door frame. Shut and latch the door.

F. Priming The Burner

1. Open the heater lid.

2. Be sure that the down-tube is securely fitted over the up-tube inside the burner.

3. Hold the priming cup under priming valve on fuel supply hose. Open the valve slowly and fill the cup with fuel. Shut valve when cup is full.

4. Pour fuel into the bottom of burner. If the outside temperature is below -25º F (-32º C), pour an additional cup of fuel into the bottom of the burner.

5. Take a short length of tissue or paper, rolled into a ball, and soak up any excess fuel that may remain in the cup. Do not discard the paper.

6. Light the fuel soaked toilet tissue and toss it into the bottom of the burner.

7. Use the cleaning tool, if necessary, to make sure that the burning tissue reaches the bottom of the burner where it can ignite the priming fuel. Make sure that the burning tissue remains down in the burner. Close the Lid Assembly.

8. When the heater has warmed up sufficiently and begins to give off heat (approximately 5-10 minutes), gradually adjust the flow adjustment knob to desired heat output.

NOTE: In extremely cold conditions, if the firing rate on Hi setting is not generating sufficient heat output, tap the control valve and shake the hoses to eliminate any air that may be trapped. If output is still insufficient, turn the heater control valve to LO for 5-10 minutes, which will heat the bottom of the burner. Then turn the control valve back to the Hi position.

9. Be sure to perform "During Operation" Preventive Maintenance Checks and Services (PMCS) as while the heater is in operation.

G. Operating The Thermoelectric Fan (TEF)

CAUTION

DO NOT BLOCK THE FLOW OF AIR OUT OF THE FAN BY PLACING GLOVES OR OTHER ARTICLES ON THE GRILL OF THE FAN.

1. The Thermoelectric Fan (TEF) helps to circulate the heat generated by the space heater to the floor and throughout the shelter. The TEF is self powered and generates its own power directly from the heat radiated by the space heater. As the TEF base plate heats up, that heat is converted into electrical energy to operate the fan. The TEF is an optional piece of equipment.

2. To unpack the TEF from its storage container, release the latches that secure the cover and remove. Grasp the TEF by the handle mounted on the grill and lift out of the container.

3. To operate the TEF, remove the sight glass cover from the top of the lid assembly and allow it to hang over the left side of the heater. Place the TEF in position on the lid assembly of the SHA. Within 5-10 minutes, the fan will reach full operating capacity.

4. To repack the Thermoelectric Fan, allow it to cool completely, pick it up by its top handle and lower it into the TEF storage container. Place the cover in position on the top of the storage container. Engage and secure the cover side latches.

H. Refueling

1. Set fuel ON/OFF control to OFF to shut down heater.

WARNING FIRE OR EXPLOSION

DO NOT ATTEMPT TO REFUEL A HOT SPACE HEATER. ALLOW THE SHA TO COOL COMPLETELY BEFORE HANDLING OR REFUELING.

2. Remove fuel can from fuel can stand and replace with a full fuel can as detailed earlier in this work package.

3. Restart heater.

I. Shutdown From Liquid Fuel Operation

1. Set fuel ON/OFF control to OFF.

2. Remove fuel can from fuel can stand.

3. Allow equipment to cool down.

IV. Using Solid Fuels

A. Preparation For Solid Fuel Operation

1. Ensure that all components have been unpacked as discussed earlier in this work package. Ensure that the heater is positioned properly in the shelter and that the stack assembly has been installed as described in the section entitled "Assembling the Stack Assembly" found earlier in this work package.

2. Open front door and verify that the burner cover assembly is installed over the burner. If the burner cover assembly is installed in the door frame, remove it
from the door frame, lift the solid fuel grate and put the burner cover in position over the burner.

3. Make certain that the solid fuel grate is in position on it's feet.

B. Preheating The Flue

To help ensure that no smoke blows back into the shelter on heater startup, the flue should be preheated by opening the door and placing 2 or 3 crumpled pieces of paper on the solid fuel gate. Ignite the paper with a match, close and latch the front door and open the draft gate. When the paper has burned completely, add solid fuel and start the heater as described below.

C. Adding Solid Fuel And Starting The Heater

WARNING FIRE OR EXPLOSION

DO NOT USE ANY TYPE OF ACCELERANT (GAS, KEROSENE, JET FUEL ETC.) TO HELP IGNITE SOLID FUEL. EXPLOSION OR UNCONTROLLED FIRE MAY RESULT.

WARNING

STACK FIRE POSSIBLE. WHEN OPERATING THE HEATER IN SOLID FUEL MODE, A BUILDUP OF CREOSOTE CAN ACCUMULATE ON THE INSIDE SURFACE OF THE STACK ASSEMBLY THAT MAY RESULT IN A FIRE INSIDE THE STACK. TO PREVENT

CREOSOTE BUILDUP WHEN OPERATING WITH SOLID FUEL, THE STACK ASSEMBLY SHOULD BE CLEANED DAILY. FAILURE TO DO SO MAY RESULT IN A FIRE CAUSING SEVERE INJURY OR DEATH.

CAUTION

WARPING OF HEATER. HEATER COMPONENTS MAY WARP FROM EXCESSIVE HEAT CAUSED BY AN OVER FUELED FIRE. WOOD AND COAL CAN BURN EXTREMELY HOT DEPENDING ON THE TYPE AND SIZE OF FUEL USED. DO NOT OVER-FUEL FIRE AND CLEAN ASHES FREQUENTLY. IF COAL IS BEING USED AS A FUEL, ADD ONLY A SMALL AMOUNT OF COAL AT A TIME. COAL IS VERY DENSE AND PROVIDES HIGH HEAT OUTPUT. OVERFILLING THE HEATER WITH COAL WILL CAUSE THE HEATER TO RUN EXTREMELY HOT AND IT WILL BE VERY DIFFICULT TO CONTROL THE HEATER'S TEMPERATURE OUTPUT.

1. After preheating the flue as described above, open the front door and position enough crumpled paper on solid fuel grate to cover it. If using wood as asolid fuel, stack four to five pieces wood approximately ¼ to ½ inches in diameter (kindling) in a crisscross fashion on top of paper. If using coal as a solid fuel, place 10 to 12 pieces of coal that are approximately 2 inches in diameter on top of the paper.

2. Light the paper with a match. When kindling begins to burn steadily, place 2 to 3 larger pieces of wood or a small amount of additional coal on top of kindling. Fuel may be fed either through lid or front door assembly.

3. Shut/latch door. Keep door and lid assemblies shut except when fueling fire or removing ashes.

4. Adjust sliding draft gate (open more to increase burn rate and close more to decrease burn rate). Monitor flame through the sight glass on the lid.

5. Remove ashes frequently with a small pack shovel or scoop (not included with SHA) so that the ashes do not accumulate up above the solid fuel grate.

D. Adding Additional Solid Fuel

1. Open door. Using a piece of wood or the cleaning tool, push the live burning fuel back into heater and position new fuel in front. Allow the new fuel to ignite before adding more. Add fuel until desired burn rate is reached, but do not over-fuel. It will take 5 or 10 minutes for the heater to operate at maximum after adding additional fuel. It may take some time to become familiar with the heater's burner rate as different types of wood and coal have varying moisture levels.

2. After adding fuel, shut and latch door. Keep lid and door assemblies shut except when fueling fire or removing ashes.

E. Shutdown From Solid Fuel Operation

1. Shut sliding draft gate on door until fire is extinguished.

2. Allow the equipment to cool down. Perform "After Operation" PMCS.

F. Removing Ashes And Unburned Fuel

1. After operating the SHA in Solid Fuel mode, any ashes and/or unburned fuel must be removed from the heater. To remove ashes from the interior of the heater, slide the latch to the left and open the front door.

2. Remove the solid fuel grate and empty any ashes and unburned fuel into an approved container with a small pack shovel or scoop (not included with SHA). Clean all ashes that have accumulated on the burner cover assembly or upper deck; empty into the container. Dispose of all ashes in an approved manner.

G. Disassembling The Stack Assembly

1. Untie shelter lines from ground stakes. Remove ground stakes and stow.

2. Lift exhaust stack with stack cap assembly and attached lines from stack adapter opening. Pull through shelter exhaust opening, and set on piece of wood to prevent gouging of shelter floor. Pull in shelter lines and close the exhaust opening closure.

3. Disassemble and nest the stack assembly. Set stack cap with attached shelter lines aside for re-packing.