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***FM 31-71**

FIELD MANUAL

No. 31-71

HEADQUARTERS
DEPARTMENT OF THE ARMY
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FM 31-71

NORTHERN OPERATIONS

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*This publication supersedes FM 31-71, 10 January 1963, including all changes.

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FOREWORD

This revision provides commanders and staff officers with basic doctrine for northern operations. The doctrine contained herein is generally applicable to operations below division level. The manual provides guidance on the effect of the environment on personnel, equipment, organization and operations. This revision contains the latest doctrinal information available applicable to military operations in any cold weather area of the world.

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CHAPTER 1

GENERAL

Section I. INTRODUCTION

1-1. Purpose and Scope

a. This manual provides doctrinal guidance to commanders and staffs for operation and administration of combat, combat support, and combat service support units in the northern regions of the world. The material contained in this manual is directed primarily toward operations below division level. Operations at division level and above will be essentially the same as those in other areas of the world. It is the forward elements of divisions or task forces that must overcome the many summer and winter problems inherent in northern operations. Commanders and staff officers at all levels must understand and appreciate the effects of the northern environment on the operations of these foward units and carefully consider them when planning each operation. The reader should refer to FM 31-70 and FM 31-72 and to other manuals of the arms and services for further information concerning northern operations (app A). The contents of this manual are applicable to--

(1) General war, to include a consideration of the employment and protection from nuclear munitions and chemical, biological, and radiological agents; and operations in nuclear, chemical, or biological environments.

(2) Limited war.

(3) Cold war, to include stability operations assistance in internal defense and internal development operations.

b. The provisions of Standardization of Operations and Logistics (SOLOG) Agreement 23R, Arctic Doctrine are implemented in this manual.

c. Users of this manual are encouraged to submit recommendations to improve its clarity or accuracy. Comments should be keyed to the specific page, paragraph, and line of text in which the change is

recommended. Reasons should be provided for each comment to insure understanding and complete evaluation. Comments should be prepared on DA Form 2028 (Recommended Changes to Publications) and forwarded direct to the Commanding General, United States Army, Alaska, APO Seattle 98749. Originators of proposed changes which would constitute a significant modification of approved Army doctrine may send an information copy, through command channels, to the Commanding General, United States Army Combat Developments Command, Fort Belvoir, Virginia 22060, to facilitate review and followup.

1-2. Area of Northern Operations

a. The area of northern operations (fig 1-1), for purposes of this manual, is defined as those northern areas of the Northern Hemisphere which lies north of the temperate zone where environmental conditions require the application of special techniques and equipment that normally are not required for operations in a more temperate climate. Included in both summer and winter operations are the considerations of mountain operations and inadequate land lines of communications. Although the area of northern operations is graphically described, the doctrine and techniques put forth in this manual may be applicable in any area of the world that has snow and cold weather.

Figure 1–1. Area of nothern operations.

Figure 1–1. Area of nothern operations.

b. The term northern operations, as applied to this manual, includes both the Arctic and subarctic. About 45 percent of the North American continent and 65 percent of the Eurasian land mass lie in these regions.

c. For purposes of this manual, the terms, cold weather operations, operations in the subarctic, arctic operations, operations in the far north, operations in northern latitudes, polar operations, and operations on polar ice, will be considered synonymous and will be combined under the all encompassing term, "northern operations." This term embraces operations in both summer and winter and is applicable to North America and Eurasia.

1-3. Basic Considerations

a. The northern environment is a dynamic force. He who recognizes and understands this force can use it; he who disregards or underestimates this force is threatened with failure or destruction. Because of the demanding requirements on the individual solider, leadership must be of the highest caliber. Leaders at all levels down to the squad, must make decisions far surpassing the scope of their usual responsibilities. In the north the human element is all-important. The effectiveness of equipment is greatly reduced. Specialized training and experience are essential. The climate does not allow a margin of error for the individual or the organization.

b. The ground mobility of all units is restricted. Movements must be carefully planned and executed with the knowledge that distance can be as difficult to overcome as the enemy. Momentum is difficult to achieve and quickly lost. All available means of transportation must be considered and used to maximum advantage.

c. Because of the stresses imposed by the northern environment, maintenance of equipment is difficult and of great importance.

1-4. Organization

With modifications, the current Army divisions, and other combat, combat support, and combat service support units are suited for operations in the north. The MTOE changes in personnel structure and equipment authorizations are the result of added emphasis on mobility, maintenance, communications, and additional logistical support. Certain items of equipment are eliminated or added based on their suitability to the terrain, the environment, and the concept of operations.

1-5. Command Leadership

Because of severe environmental conditions leadership in the north is highly demanding. Emphasis is on small unit operations. Command is decentralized to insure maximum flexibility for leaders at all levels. Resourcefulness and initiative are requisites for unit commanders. Forceful and personal leadership is the

key to success in the north. Commanders at all echelons must plan and prepare their operations in great detail, actively supervise, keep themselves and their subordinates informed, and maintain close coordination with adjacent and supporting units.

1-6. Tactics

a. Tactical principles for operations in the north are the, same as those employed in other areas. However, because of the environment, emphasis may be placed on principles which are less important in areas of milder climate.

b. Mobility is a cardinal principle of operations in the north. Mobility can only be obtained through proper integration and use of all appropriate transportation, including aircraft, wheeled and tracked vehicles, water craft, and individual means. The fundamental principles and techniques of airmobile and riverine operations, prescribed in FM 57-35 and FM 31-75, with special considerations discussed in this manual, are applicable to combat in northern areas.

c. Operational planning emphasizes the use of envelopments to exploit the principle of surprise. The attack may be conducted as an envelopment to seize objectives from which the enemy position may be dominated by fire or from where he may be attacked from the rear. With the proper use of airmobility most operations will be in the form of reconnaissance and security missions with the objective of finding the enemy and destroying him in place with all available means of firepower.

d. Where predominantly ground forces are employed, movement to contact is conducted under cover of a highly mobile force. The force should contain aviation, combat support and combat service support elements, and sufficient fire power to eliminate minor opposition.

e. In winter operations during the long periods of darkness, night movement and night operations should become the rule rather than the exception. An attack has a better chance of succeeding during the night because during daylight columns of troops and equipment are easily located and are extremely vulnerable.

f. Lines of communications are the life blood of forces in the north. Enemy forces may be defeated by severing his air and ground lines of communication since the terrain and climate may deny the availability or use of alternate routes.

g. Lack of adequate ground lines of communications requires more emphasis on the use of aircraft and low ground pressure cross-country vehicles for supply, resupply, and troop movement.

h. Deception is vital in all operations because of vulnerability of forces in the north brought on by problems of concealment, slow movement of troops, and limited land lines of communications.

i. In winter, denial of adequate shelter to a force can cause casualties as surely as the delivery of fire power. This fact can work for or against the field unit.

1-7. Logistics

a. The unusual weather and terrain conditions that are found in northern areas make problems of supply, evacuation, transportation, and services more difficult and more time consuming. Time and space factors vary with the terrain, the climate, and the season. More time must be allowed for movement of supplies and troops because of the environment. Distance is measured in time rather than space.

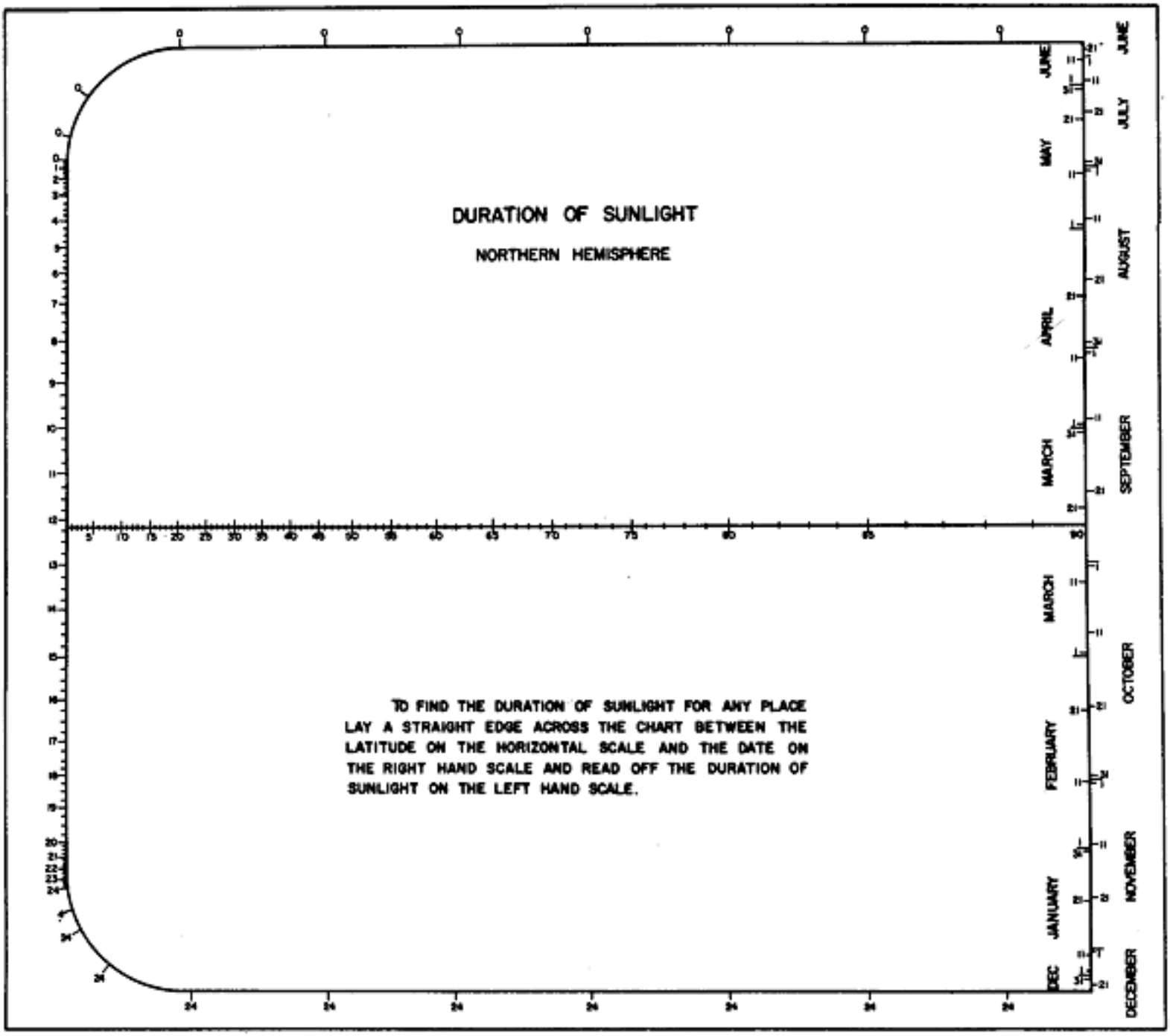
b. Commanders must issue their orders early to allow adequate time for subordinates to move supplies and equipment. Logistical support planning is required in great detail, even for small unit operations. Adequate support must be provided to troops to insure survival and comfort as well as combat resupply. Plans should include considerations for food, fuel, clothing, sleeping gear, tentage, mountain gear, winter equipment, repair parts, and ammunition or nuclear weapons, as appropriate. All means of transportation, to include aircraft, boats, wheeled and tracked vehicles, and individual means, must be considered in movement of supplies and equipment.

c. The capacity of the combat service support units to provide adequate logistical support may be the determining factor in evaluating the feasibility of a planned operation. The commander must be ready to alter the plan when environmental stresses make it impossible for the combat service support units to provide necessary support.

Section II. EFFECTS OF ENVIRONMENT ON MILITARY OPERATIONS

1-8. General

In northern areas, the conduct of military operations is greatly affected by considerations foreign to more temperate regions. These considerations include the long hours of daylight (fig 1-2) and dust of summer, the long nights and the extreme cold of winter, and the mud and morass of the transition periods of spring and autumn. The disrupting effects of natural phenomena, the scarcity of roads and railroads, the vast distances and isolation (fig 1-3), and occasionally the lack of current maps combine to affect adversely but not totally restrict mobility, fire power, and communications. In spite of these conditions, operations are feasible through employment of aggressive leadership, a high state of training, and adequate logistical support.


DURATION OF SUNLIGHT
NORTHERN HEMISPHERE
TO FIND THE DURATION OF SUNLIGHT FOR ANY PLACE LAY A STRAIGHT EDGE ACROSS THE CHART BETWEEN THE LATITUDE ON THE HORIZONTAL SCALE AND THE DATE ON THE RIGHT HAND SCALE AND READ OFF THE DURATION OF SUNLIGHT ON THE LEFT HAND SCALE.
JUNE
JULY
AUGUST
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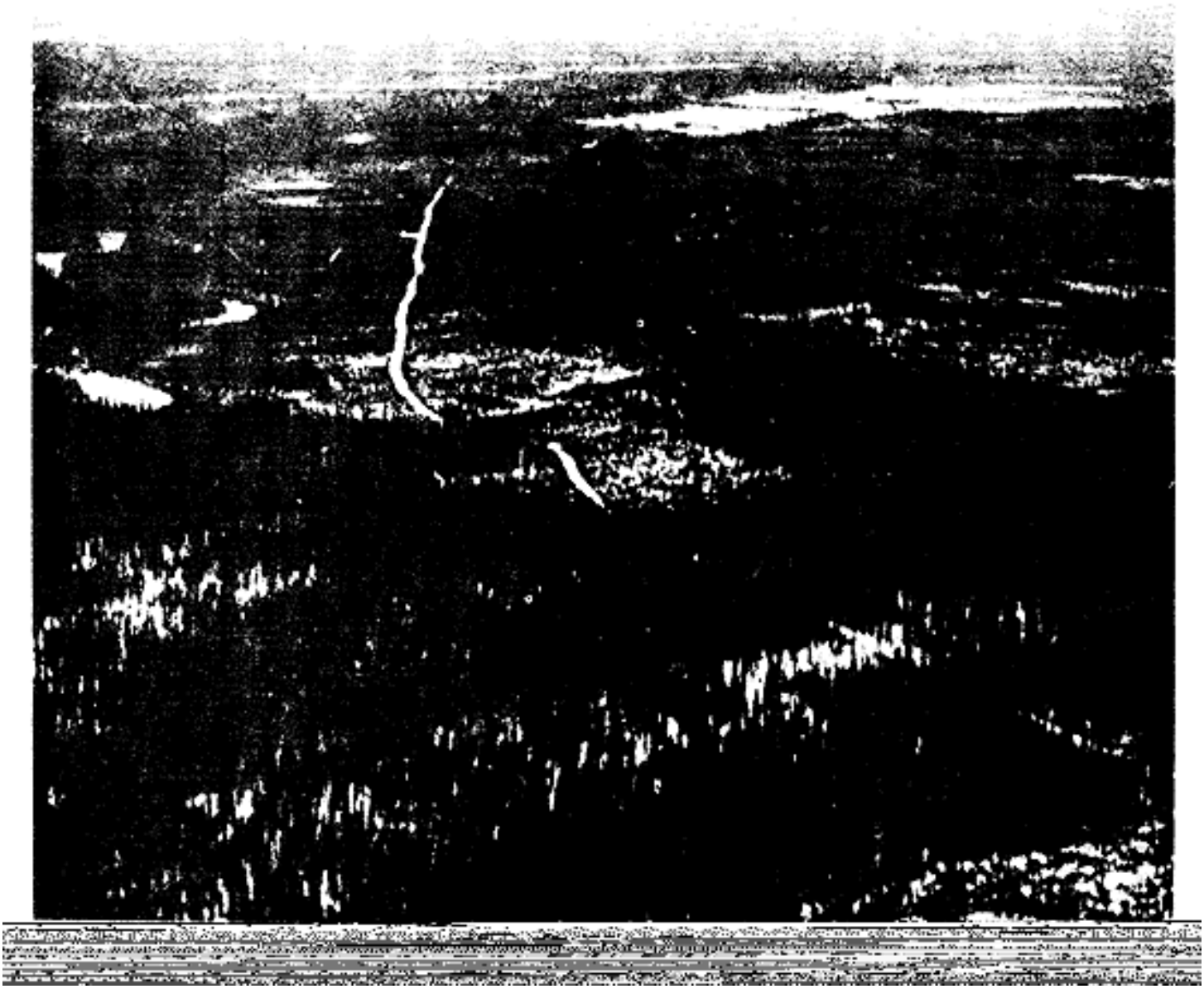

1-9. Operating Conditions

a. The most suitable time for ground operations is from midwinter to early spring before the breakup period. The snow is "settled," giving well-trained and supported troops an excellent opportunity for oversnow mobility. During this period, operations are possible even in a roadless wilderness. Early winter, after the formation of ice, is also favorable; however, it does not afford well-trained troops the same oversnow and cross-country mobility as midwinter. The winter cold requires the use of special cold weather clothing and equipment and places a premium on fuel for warmth. Tracks in the snow, and fog created by a heat source, complicate the camouflage of positions. The blending of terrain features, lack of navigational aids, fog and blowing snow all combine to make land navigation exceedingly difficult. High

obtained from organic support means. In mountainous terrain or in glacier operations, air strikes may be the only fire support means available other than mortars or recoilless weapons.

(2) Movement of forward air controllers (FAC) to points where they can control air strikes is a problem in northern operations. Light aircraft, particularly helicopters, are the best means for placing the FAC in a position to see the target and direct the fighter aircraft. Ground transportation for the FAC is inadequate as he cannot move rapidly from the area of one air strike to the area of another.

2-4. Additional Considerations

a. Lack of large population densities and industrial complexes in the north have direct impact on unconventional warfare activities. Low subsistence levels, lack of shelter, and primitive communications also are of importance in designating unconventional warfare operational areas. The impact of terrain, extended frontage, extreme weather conditions, and extended periods of darkness on the logistical operations of regular forces is highly favorable to guerrilla operations. Extended lines of communication restrict ground movement to a few routes which are highly vulnerable to such operations.

b. Psychological warfare opportunities inherent in the environmental extremes, isolation, and personal discomfort present in northern operations are exploitable. Winterization of loudspeaker equipment and printing presses is a requirement. Low troop density, difficulty in positive identifications, and relatively limited movement of troops in tactical localities make accuracy in leaflet dissemination and radio broadcasting critical. Enemy psychological warfare operations may be expected to utilize all available propaganda media, (radio, printed matter, loudspeaker, rumor, etc.) to emphasize discomfitures due to the environment in attempting to reduce the morale of our forces.

c. The strategic location of certain remote northern areas and their characteristically severe climate, low population density, possible governmental neglect or disinterest resulting in antipathy, ignorance, or restlessness of the inhabitants, provides a target or breeding ground for subversion. Although generally not regarded likely areas for insurgency, control of northern areas within the context of a larger plan, may be a cold war objective. If insurgency occurs, internal defense operations must take place to maintain control of those areas for friendly forces exploitation of their strategic value (FM 31-16 and FM 31-22).

Section II. ORGANIZATION

2-5. Forces

a. Infantry, Airmobile, and Airborne Divisions.

(1) The combined arms brigade task force is the basic building block for the infantry division in

northern operations. The division can conduct limited airmobile operations with organic Army aviation but should be trained to conduct total airmobile operations by the attachment of nonorganic Army aviation.

(2) The airmobile division is employed in furtherance of the ground combat effort under the guidance and doctrine contained in FM 57-35 and chapter 6 of this manual.

(3) Airborne divisions conduct conventional airborne operations in furtherance of the ground combat effort. Techniques are modified as indicated in chapter 6 of this manual.

b. Armored and Mechanized Divisions. The closely integrated combined task force is the basic building block for armored and mechanized division operations. These task forces as an optimum are highly mobile and include Army aviation, engineer, and signal units. They are supported logistically by a mobile direct support element. The task forces must be capable of conducting independent operations at extended distances from higher headquarters, adjacent units, and logistical bases.

2-6. Command and Control

a. Mission type orders are the rule.

b. Command posts and control facilities are sometimes mechanized. Vehicles and shelters require either self-contained or associated heating and lighting.

c. The use of highly mobile signal equipment with a cross-country or airborne/airmobile capability is an absolute requirement for the task force in northern operations. Relay capabilities are frequently required both within the task force and between the task force and higher headquarters.

d. Reduced ground visibility, lack of navigational aids, and extended distance require the use of Army aviation as a means of command reconnaissance, liaison, and communications relay.

Section III. COMBAT INTELLIGENCE, PATROLLING, COUNTERINTELLIGENCE AND SECURITY

2-7. Combat Intelligence

a. In addition to the essential elements of information required for other types of operations, answers to at least two important questions are necessary to successful winter operations in the north. The questions are--

(1) What is the enemy capability for moving cross-country?

(2) What is the enemy capability for living and fighting for prolonged periods in extreme cold?

b. A checklist to assist in determining the answers to these two questions might include--

(1) Is the enemy equipped with skis or snowshoes?

(2) What is the enemy status of training in their use?

(3) Does the enemy have oversnow or through the snow vehicles? What kind?

(4) Does the enemy have any snow removal equipment? What kind?

(5) What types of artillery are being used by the enemy (SP or towed)?

(6) Are guns ski-equipped?

(7) Is the enemy using sleds or some other type of oversnow transport to move unit equipment?

(8) Is the enemy using heated shelters? What kind?

(9) Can shelters be moved cross-country without vehicles?

(10) Is the enemy using improvised shelters?

(11) What type of winter clothing is used by the enemy? What protection will it afford?

(12) What kind of weapons does the enemy have? Are they effective in extreme cold? What is their effect in deep snow? Can their heavy weapons follow infantry units in cross-country movements?

(13) What kind of aircraft does he use in transport or fire support?

(14) What logistical support capability does the enemy have?

(15) What is the enemy's airmobile capability?

c. For summer operations, units should determine if the enemy has cross-country vehicles capable of negotiating muskeg or swampy terrain: if he has boats is he using them and for what purposes; and if he has bridging equipment and units.

d. Personnel must be aware of intelligence indicators that are present in a cold weather and northern

environment. These indicators can be broken down into two categories--those that indicate the presence of a hostile force in the area, and those that indicate the size of the force. If these indicators are not recognized by the intelligence staff officer, the tactical commander will not be given a complete intelligence estimate on which to base his decisions.

(1) Examples of cold weather indicators that may indicate the presence of or passage of a hostile forces are--

(*a*) Signs of former bivouac areas:

1. Packed snow.

2. Emergency shelters.

3. Remains of fires.

4. Trail networks.

5. Trash left in the area.

6. Freshly cut wood.

(*b*) Tracks in the snow that were made by:

1. Men on skis or snowshoes.

2. Tracked vehicles.

3. Helicopters.

4. Aircraft using skis.

5. Air cushion vehicles.

6. Sleds.

7. Wheeled vehicles.

(*c*) Improvement of winter trails.

(*d*) Presence of winter landing fields.

(*e*) Presence of ice bridges.

(*f*) Ice fog.

(*g*) Smoke.

(*h*) Manmade or mechanical sounds.

(*i*) Hot spots on IR sensors.

(2) Examples of cold weather indication that may indicate the size of a hostile force in an area are--

(*a*) Site and configuration of bivouac areas.

(*b*) Size and number of shelters or tents present in a bivouac area.

(*c*) Number of hot spots present on IR sensors.

(*d*) The number of trails present within a given area.

e. Detailed knowledge of the terrain and climatology of the area of operations is essential. The location and condition of the existing road net and railroads, if any, must be determined. Information regarding soil trafficability, vegetation, water routes and expected ice thickness, snow conditions, wind velocity and direction, and average snow depth should be available to the commander. The general features of the terrain from the viewpoint of cross-county movement should also be known by the commander. For summer operations, it will be necessary to determine water routes suitable for transportation and dry ground routes in barren lands.

f. The increased effect of weather on military operations in northern areas makes it mandatory that continual and accurate weather forecastle rapidly disseminated to the lowest level.

g. Collection agencies are essentially the same as for temperate zone operations although their methods of operation may be different. Increased emphasis must be placed on effective use of air reconnaissance by both Army aircraft and the supporting Air Force units. During seasons when waterways are open, boat patrols are useful in gathering information.

h. It is especially important during the planning phase of northern operations to secure detailed information of the operational areas from strategic intelligence agencies. Every effort should be made to procure basic air photo coverage of the area for each season. Streams, lakes, swamps, and the general conformations of the ground may show clearly on aerial photographs taken during warm months but may

be extremely difficult to distinguish on aerial photography taken when waterways are frozen and the ground is covered with snow. The enemy's need to rely heavily on radio also provides a valuable and often times easily accessible source of intelligence. Support Army Security Agency elements should be tasked to assist in providing input to the EEI in the form of signal intelligence.

i. After operations are initiated, some collection means, such as long range patrols, lend themselves to more than usual exploitation in obtaining information deep in enemy territory. Because of the unusually great operating distances, these patrols can often pass undetected through flank and frontal areas. Indigenous personnel assume increased importance as a source of information. Use of special forces working with the inhabitants in the area of operations prior to full scale operation will enhance the information-gathering capability of the ground forces.

j. Aerial surveillance by the OV-- l Mohawk can be advantageously employed by the use of its various sensors. The infrared (IR) detectors can be used to locate enemy or friendly base camps and isolated groups of men during the long hours of darkness in the winter as well as during daylight hours. The side-looking airborne radar (SLAR) capability provides for detection and location of moving targets on the ground. This information (location and size of element) provides the field commander with vital intelligence for immediate and future operations. Data link of IR and SLAR provides instant readout of information at the command post location. The day and night photo capability can be used to identify friendly and enemy personnel, equipment, and base camps. The panoramic, vertical, and oblique photos can provide aid for advance planning or provide current indigence data in a static situation.

k. Unattended ground sensors can be employed during the summer season in the same manner as they are used in other areas of the world. Their use during the winter may be limited because of battery failure caused by extreme cold.

2-8. Patrolling

a. Patrolling to provide information of the enemy and to provide security increases in importance since combat units will seldom have any close neighboring units.

b. Reconnaissance and combat patrols may operate behind enemy positions for extended periods, depending upon climatic conditions and the capacity to provide support. Subject to equipment issued and weather conditions, such patrols can be self-sustaining for periods of from 3 to 5 days without resupply except for ammunition that may become expended. Ideally, personnel employed on these patrols should be specially trained, including mountain and glacier operation. Whenever possible, qualified skiers should be used in order to increase the cross-country mobility of patrols. Provision should be made for such patrols to carry, in addition to weapons, communications, etc., minimum equipment for survival including tent, stove, and fuel. Prearranged supply drops may be used for replenishment of supplies.

c. The most economical way to move long range patrols into enemy territory is by aircraft. At times, it may be feasible to pick up patrols from enemy rear areas by aircraft. During winter, escort patrols should

be sent with long-range ground patrols to insure that the long range patrols get through enemy lines, to carry additional rations for later use by the long range patrols, and make deceptive tracks on both sides of the route of the long range patrol.

d. Air cavalry units with attack helicopters are ideally suited for security and reconnaissance in northern operations.

e. In long-range patrolling communications are a prime consideration. Normally, radio is the principal means of communication; however, because of extended distances and difficulty in radio transmissions in northern areas, aerial relays or message pick up and drop techniques may have to be employed.

2-9. Counterintelligence

a. Camouflage.

(1) Camouflage during the winter is exceedingly difficult. Reliance should be placed on deception techniques. Commanders must place special emphasis on camouflage and deception techniques.

(2) Summer camouflage techniques do not differ from those applicable in temperate zones.

b. Deception. Deception has an important role in northern warfare. False ski or snowshoes trails are made to mislead the enemy as to the size of the force, direction of movement, and scope of activity. Establish rules for track discipline in snow such as; using single file to conceal troop strength where possible and; restricting the blazing of new trails. Restrict the use of individual warming fires. Open camp fires can be started in dry tree stumps in many locations to deceive the enemy as to size and location of forces. Dummy gun positions can be constructed from materials at hand. Sound and flash simulators should be used in these positions to give them a semblance of reality. If dummy rubber vehicles and weapons are not available, snow and logs can be used as substitute materials. All deceptive measures must be well planned and carefully executed to give them every appearance of reality. Electronic deception is equally important, as the enemy can be expected to gain intelligence by monitoring our nets, in locating our positions by direction finding and employing SLAR and IR devices to detect our location and movement. The use of manipulative electronic deception, in coordination with tactical cover and deception, is essential in concealing the location of major headquarters and operating elements.

c. Concealment.

(1) Excellent concealment for troop movements is afforded by darkness, fog, or falling snow. In forests, clearings are avoided, and troops and vehicles leaving roads should do so only in places where the forest is near the road.

(2) In bivouac areas and supply points maximum use should be made of dispersion and vegetation for concealment.

2-10. Security

Tactical security measures employed in normal operations remain essentially the same in northern operations. Because of the long periods of winter darkness and the tendency for sound to travel great distances in cold air, light and noise discipline deserve special security consideration.

Section IV. OFFENSIVE OPERATIONS

2-11. General

a. Offensive operations are directed toward the destruction of the enemy in the least possible time. Ideally, the objective in cold weather operations is not to pit rifleman against rifleman, but rather to destroy the enemy in place by firepower. Actions will be sudden, violent, and decisive. An operation which is permitted to lag may result in a stalemate or may offer an opportunity for the enemy to seize the offensive. Both forces retain freedom of maneuver limited only by their ability to cope with the climatic and terrain conditions. Due to large operational areas, flanks and rear areas are sometimes lightly defended and present excellent opportunities for the conduct of unconventional warfare, for envelopment, or under favorable conditions, for turning movement.

b. Existing lines of communication must be controlled to assure success in northern operations. Severe winter weather hastens enemy destruction after supply lines are cut. Breaches in enemy lines of communication should be made in the vicinity of dominating terrain if retention of the area is required. During summer, such objectives should be selected where the lines of communication cross a river or pass between two existing natural obstacles.

c. Effective utilization of weather conditions increase opportunities for surprise attacks. This includes the exploitation of falling snow, blizzards, fogs, low cloud cover, and natural night illumination. Imaginative use of what appear to be weather obstacles may turn them into major advantages. However, conducting offensive operations during severe weather conditions will restrict the use of aviation support and increase control and reconnaissance problems.

d. The assault should be conducted at night or during periods of low visibility. Surprise is an important factor, and the opportunities for achieving surpirse are numerous. It may be preferable to deliver the assault without field artillery preparation fires.

e. A period of slow movement may occur between the cessation of field artillery fire on the enemy forward positions and the arrival of the infantry on the objective. This period of slow movement caused by weather or terrain conditions must reconsidered in planning fire support of the assault. However, when weather, terrain, and lack of effective enemy resistance permits, mechanized infantry may remain in their carriers and make a mounted assault to capitalize on shock effect and reduce the time lag associated with a dismounted assault through snow and underbrush.

f. After seizing an objective, immediate attention must be given to consolidation of the objective. The assaulting troops may be fatigued and overheated from the exertion of the attack. Provisions must be made to prevent them from becoming cold casualties.

g. Army aviation can and must be effectively integrated into offensive operations, and airmobile operations should be considered normal rather than special in the northern areas. Vertical envelopment, diversionary attacks, and rapid displacement of supporting weapons and reserves are within the offensive capabilities of an airmobile force. Low troop density throughout the battle area plus flexibility in route selection reduce the hazards of enemy operations and counter action against movement.

h. During summer months riverine operations may be conducted in areas where extensive inland waterways exist, using craft adapted to the northern rivers.

2-12. Main Attack

a. The opportunity for maneuver is usually present in northern operations. Main attacks usually are directed against the flanks or rear areas while supporting attacks are directed against the enemy front to hold him in position. An additional force may be employed to bypass the enemy position and cut enemy routes of reinforcement or withdrawal.

b. The most mobile troops are used to breach the enemy lines of communication.

2-13. Control Measures

Axes of advance normally are used to control forward movement during offensive operations. Boundaries forming a zone of action, maybe used if terrain permits designating discernible boundaries. 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 and seize key terrain.

2-14. Coordination

Coordination is extremely important in northern operations. At times, the distance between two enveloping forces may become so great that messages must be relayed. The radio relay capability of Army aircraft permits significant extension of the range of ground tactical radio equipment.

2-15. Attack of an Organized Position

a. Commanders inform their staff officers as early as possible of all aspects concerning the concept for conducting the attack, so that an attack order can be formulated as far in advance as possible. This applies in particular to the logistical officer whose arrangements for logistical support are most likely to require additional time in northern operations.

b. Reconnaissance is initiated early on a wide front with missions of determining enemy locations and reconnoitering routes and terrain, including terrain in enemy hands.

c. Harassment of the enemy is started simultaneously with reconnaissance and is executed by patrols, limited to objective attacks, and interdiction by aircraft and field artillery.

d. Prepared fires of supporting field artillery and mortars are closely coordinated. Forward observer parties are included in Infantry reconnaissance patrols and in combat patrols. Preparation of firing positions for supporting weapons is begun early as it is likely to be time consuming.

e. Engineer reconnaissance troops should be included in infantry reconnaissance patrols. Bridging equipment and materials are moved well forward to be ready for use when needed.

f. The communication plan is made in detail and must provide measures for overcoming difficulties peculiar to northern operations and the northern environment.

g. Supply reserves are kept mobile when possible. It may be necessary to establish distributing points in forward areas.

h. Aerial photos of enemy positions, terrain and routes thereto should be taken when possible prior to the attack.

2-16. Preparation for the Attack

a. When reconnaissance is completed and other preliminary measures taken for the attack, trails are opened to assembly areas. If the distance is not too great, these trails are not opened until the day before troops plan to move. Wire communications, when used, are laid simultaneously with breaking of trails.

b. Movement to assembly areas is executed the night before the attack unless conditions of low visibility deny enemy daytime observation. Guides must be provided.

2-17. Movement to Line of Departure

A halt is made in the assembly areas only long enough to feed and prepare troops for the attack. Vehicles are dispersed and artillery moved to prepared positions and camouflaged or concealed. Troops remain in the assembly area for the minimum length of time necessary to prepare for the attack. Supporting weapons are moved to selected firing positions.

2-18. Conduct of the Attack

a. The attack may be conducted by the infantry on foot, skis, and snowshoes or transported by tanks or personnel carriers or helicopters. Techniques of conducting the attack are as in normal operations, except when troops are using skis or snowshoes.

b. When the attack is conducted on skis or snowshoes, the attack formation should facilitate use of trails broken by the lead elements of the attacking force. Every attempt is made to get as close as possible to the enemy before delivering assault fire. Whenever possible, the attack on skis or snowshoes should be conducted downslope. Troops do not disperse or halt to fire until reaching the assault position or enemy fire becomes effective. Final coordination lines should generally be closer to the enemy during winter than during summer especially if the assault is made on foot through snow. The decision as to whether the assault is to be conducted on skis, snowshoes, or foot must be made by the commander based upon existing conditions. If skis or snowshoes are removed in the attack they should be brought forward during reorganization.

c. In continuing the attack, special efforts are directed toward rapid displacement of close-support weapons using sleds or vehicles. Supply routes are prepared as far forward as possible to facilitate unit distribution.

d. The relief of committed units is executed as under normal conditions with consideration being given to rapid relief of assault elements to bring them back to warm shelter. Warming tents, if needed, are moved to the closest available concealment by each unit responsible.

2-19. Pursuit

The exploiting force is aided by cross-country vehicles and aircraft. The pursuit force, which must have high mobility, is mounted, on skis, vehicles, or helicopters. Airborne or airmobile troops are positioned near defiles to block the retreat of the enemy. During summer, waterways may be used by the pursuing force as a means of moving patrols behind the enemy to destroy bridges and erect road blocks along the enemy lines of retreat.

2-20. Security in the Offensive

When attacking units have large gaps between them and ffanks are vulnerable, patrol and surveillance requirements increase. Basically, however, security requirements in the offense during northern operations are no different than in more temperate zones.

Section V. DEFENSIVE OPERATIONS

2-21. General

a. The defensive is assumed for the same general reasons as in other areas. It may be necessary in northern operation to assume a defensive posture for short periods during breakup or freezeup seasons,

snow storms, or extremely low temperatures. The defense may also be assumed to encourage the enemy to attack under unfavorable conditions, such as in long, narrow passes or through deep snow and obstacles where movement is difficult.

b. Defensive actions are difficult in extreme cold because of the requirement to keep troops warm and in condition to fight. However, improved opportunities for the success of the defense and counterattack exist since an enemy force may be exposed to the elements especially if warming equipment and other logistical support has not accompanied him. The breakup season is favorable to the defender because trafficability is poor for the attacker.

c. Conduct of the defense under northern conditions is the same as under other conditions. The tendency to remain shelter bound must be resisted. Strong combat patrols are used to harass the enemy flanks and rear.

d. All-round defense is essential since attacks may be launched from any direction. During spring, summer, and fail a mobile defense is extremely difficult because of trafficability.

e. Routes of supply are often attacked by enemy patrols, therefore, supply personnel must be capable of defense at all times. In rear installations, area security and damage control plans are made and a warning system established. Special attention is paid to possible landing areas, such as lakes or rivers. When necessary, combat units will furnish escorts for supply columns.

f. Defense positions located in deep snow suffer less from the effects of enemy fire. Dense forests, thickets, fallen timber, cliffs, and other natural obstructions collect snow and create obstacles to the attacker. Rocks and fallen tree trunks may become tank obstacles. The effectiveness of natural terrain obstacles can easily be increased. The enemy use of frozen waterways can be denied by laying mine fields in the ice as described in FM 31-70.

g. Tents are sunk into deep snow or into the ground and protected by embankments. If the defense is to be of long duration, heated underground shelters are constructed and tents are eliminated. It must be remembered, however, that extensive engineer work is required to build underground shelters during the winter. In some areas, high water tables may preclude construction of underground bunkers and positions. Medical aid stations and command posts are also located in underground shelters for protection from enemy fire. Warm shelters are constructed for reserves. Areas in the defense where there is little snow, or which are easily traversed by the enemy, are reinforced with artificial obstacles such as wire entanglement (especially concertina wire), pitfalls, abatis, antitank mines, and antipersonnel mines and are covered by fire. Deception techniques are practiced extensively. Seasonal changes will affect defense positions. The breakup season usually will destroy positions built during the winter. Positions or obstacles built during the summer may be made useless by heavy snow fall.

h. Special attention must be directed toward maintaining battle preparedness in winter. While resting in forward positions, men must be ready for combat. Constant care must be taken that all weapons are

prepared for immediate use. Firing positions must be kept clear of snow. Guards are rotated and inspected constantly.

i. Proper security of a defensive position requires the location of living and fighting positions for the security force on the outer perimeter. A warning system is established from the security force position to the forward defense force position. All movement on the outer edge of the perimeter and in the vicinity of the living-fighting positions is kept to a minimum to preclude observation or attack by hostile air and ground forces.

2-22. Defense Positions

Strong points should be located on elevated terrain. The value of elevated defense positions is greater during winter than under normal conditions because the enemy must attack up hill in snow.

2-23. Composition and Location of Reserves

An aggressive defense requires the formation of a proportionately large reserve with maximum cross-country mobility. Individual oversnow equipment, oversnow vehicles, personnel carriers, or helicopters are used to obtain this mobility. Airmobile reserves may be stationed farther away. In selecting a location for the reserve, consideration must be given to the importance of rest as well as to the probable area of employment. The major portion of the reserve is placed in covered and concealed positions, protected from enemy light artillery fire, while the remainder may be placed closer to the front lines. Trails and roads to the probable points of action are prepared for the reserve troops and are kept open during snow storms by elements of the reserve. So far as is possible the roads and trails should be camouflaged.

Section VI. RETROGRADE OPERATIONS

2-24. General

Retrograde operations are executed as in normal operations. In the north, suitable conditions are frequently present for leaving strong combat patrols up to a strength of one or two platoons to harass or ambush the advancing enemy. Surprise attacks can be launched against columns of vehicles and troops at natural defiles. In some cases, it may be desirable, prior to the withdrawal, to establish hidden caches of food and ammunition for the use of the troops that have been left behind to ambush the enemy.

2-25. Withdrawals

Withdrawal is best effected at night or under conditions of reduced visibility when enemy reactions are slowest. Trails are broken rearward from positions before withdrawal commences and may be mined as the rear guard withdraws. If a daylight withdrawal becomes necessary, smoke may be used to good effect. Oversnow mobility is exploited to the maximum. During the withdrawal, troops destroy all abandoned shelter that can be used by the enemy. Maximum use is made of mines, traps, and abatis.

Airmobile covering forces or air cavalry may be employed to good advantage to cover withdrawals.

Section VII. AIRMOBILE OPERATIONS

2-26. General

Airmobile operations are particularly adaptable to ground operations in northern regions. Generally, northern areas are devoid of the vast air, rail, and road networks common in temperate areas. The northern areas are sparsely settled and small communities are often separated by great distances and isolated from the outside except by small aircraft, watercraft or other, often slow and primitive, means of transportation. The terrain presents numerous formidable obstacles such as mountains, swift rivers, extensive lake systems, snow, large expanses of swamp, muskeg, and dense stands of timber and brush. Airmobile forces can bypass these obstacles and move rapidly with ground combat and support forces arriving in the objective area ready to fight. Reinforcements can be rapidly deployed to the battle area in minimum time. Support can be accomplished rapidly and effectively under all but the most adverse weather conditions. Conventional doctrine is as applicable to northern operations as it is to the more temperate regions of the world. However, some modifications to operating procedures are required to overcome the limitation imposed by the environmental conditions.

2-27. Special Factors Affecting Northern Airmobile Operations

a. Standard Operating Procedure. The capability of ground combat units and Army aviation units to conduct airmobile operations must be developed through the conduct of frequent airmobile unit training exercises and the development of unit standard operating procedures (SOP) for northern operations.

b. Loading Plans. SOP should contain detailed primary and alternate loading plans for all types of helicopters available in the theater. The aviation mission commander or the aviation unit liaision officer advises and assists the airmobile task force commander in preparing loading plans based on the lift capabilities of the aircraft. Specific considerations must be given to increased weight and to the special equipment required for cold weather, mountain and glacier operations. On most missions fully loaded rucksacks will be carried. So far as is possible, the ahkio, with shelter and supplies and skis or snowshoes must accompany the personnel on the same aircraft. Additional time is required for loading and unloading with winter clothing and equipment. Protection against subzero temperatures and other adverse weather conditions may be required when considering external loads.

c. Missions. Missions for the northern airmobile force are the same as those in other areas with two possible exceptions, these are mountain and glacier, and search and rescue operations.

d. Weather. Weather minimums must be established early in the planning to prescribe the least acceptable weather in which the task force commander will permit the operation to be mounted. Weather factors which must be considered in planning and conducting northern airmobile operations include: temperature, density altitude, wind speed and direction, icing, visibility, turbulence, and snow and ice

conditions. Current aviation weather forecasts are mandatory. Weather forecasts notwithstanding, the best source of weather information is an on the scene report made by a pilot in flight in the area of interest. If possible, a weather reconnaissance flight should be made if weather is marginal or shows signs of deteriorating.

e. Aeromedical Evacuation. Plans must be made for aeromedical evacuation-of the airmobile task force casualties. The evacuation problem is of immediate urgency during periods of subzero temperatures, because in addition to battle casualties, casualties from cold injury are likely to increase.

f. Night or Limited Visibility Operations. The tactical situation may dicate the conduct of airmobile operations during darkness or periods of limited visibility. This is particularly true in the northern latitudes because of the short periods of daylight during the winter months. Flares, helicopter-mounted searchlights, night vision devices, and other suitable techniques may be used to illuminate the area of operations. Airmobile operations may be conducted during bright moonlight nights on snow covered terrain, with little or no artificial light. Areas with deep powdered snow should be avoided or the interval between helicopters greatly increased if more than one aircraft is to land simultaneously.

g. Security Forces. Because of the greatly expanded area of responsibility found in a perimeter-type formation of an airmobile operation, it usually is necessary to economize on the use of security forces. The security force is further reduced because of the requirements to off-load equipment and construct warming shelters during cold weather operations. A single security echelon forward of the objective area defense line may be all that is practicable. When combating highly trained ski troops, it is desirable that all-around perimeter security be maintained because of the secrecy and speed with which ski troops can attack. The forces for the security echelon normally are provided by the forward elements. To enhance early security for the airmobile assault and to avoid the tiresome tasks of breaking trail through deep snow, thick brush or soft muskeg, security forces may land directly on their positions. Air cavalry or other armed aircraft, may be employed to extend the range of security operations.

h. Planning.

(1) The small unit leader must be assured that he has all of the equipment required to accomplish the mission and to sustain his unit under the most adverse climatic conditions. During subzero temperatures individuals must carry their existence load (FM 31-70) at all times. So far as is possible loading plans must provide room for the squad ahkio with shelter and supplies on the same aircraft as the personnel.

(2) During the winter, skis and snowshoes for all personnel must be carried on each helicopter and should be tied together to conserve space and for ease and speed in loading and off-loading. Skis not tied in a bundle must be carried under the arms parallel to the ground to prevent them from striking the rotor blades on the helicopters. The situation permitting, a trail should be broken to the exact landing site, a landing pad should be prepared and the individual's skis or snowshoes removed and lashed together to reduce loading time. Troops must not be on the landing site at

time of touch down.

i. Landing Zone.

(1) During winter operations, frozen lakes should be used as landing zones. Ice thickness should be checked by pathfinders before landings are attempted (table 2). The use of lakes as landing zones offer many desirable characteristics; approaches to and from the LZ will be relatively unobstructed; snow depth will in most cases be less than in sheltered areas; troops can find ready concealment in trees and vegetation around the lake; and the lake offers a ready-made landing strip for ski equipped fixed wing aircraft.

(2) Because of the slowness in unloading troops and equipment from helicopters during winter operations, initial landings should not be made in a defended or "hot" landing zone. The landing zone should therefore be in an undefended or lightly defended area as close as possible to the objective area.

j. Landing Operations in Deep Snow. When landing operations are conducted in deep snow, specific techniques are necessary by the airmobile force.

(1) Because of blowing snow and loss of visibility near the ground (fig 2-2), helicopters may have to be spaced as much as 100 meters (110 yds) apart or may be staggered into the landing zone at 20 to 30 second intervals in powder snow conditions. On wind blown, hardpacked, or crusted snow, the interval between helicopters may be reduced.

Figure 2-2. Blowing snow caused by rotor downwash.

(2) Individuals exit utility helicopters with their own equipment and move perpendicular to the line of flight, breaking trail through the snow. On medium cargo helicopters, personnel should move to the rear following the helicopter ski tracks when debarking. Other personnel follow the trail made by the lead man. Personnel should move approximately 50 meters (55 yds) or one-half the distance to other helicopters to avoid the maximum wind chill effect and blowing snow created by the rotor down-wash of the helicopters. Personnel within the radius of the rotor down-wash must protect their faces by turning away from the main blast and pulling the winter hood over their heads and around the face. After departure of the aircraft, individuals should check each other for frostbite.

(3) Unit equipment, ahkios and bundled skis or snowshoes, are unloaded as soon as the personnel have exited the aircraft. The equipment must be pulled away from the skis of the helicopter. Small

items of equipment must not be thrown into the snow where they may become lost or blown up into the rotors.

(4) When the enemy does not have an aerial surveillance capability, various dyes may be used on the snow to mark the landing zone for easier identification on subsequent lifts.

(5) When unloading in the landing area, troops will frequently be completely disoriented. A crew member of individual aircraft should tell the troop commander, as a minimum, which direction is north in relation to which way the aircraft is facing. Direction can easily be established for the ground commander by landing the helicopter in a predetermined direction. Troop commanders should orient themselves as completely as possible prior to touch down so that squad, platoon, and company assembly can be accomplished with the least practicable delay.

k. General Procedures and Safety.

(1) During extreme cold conditions, troop warming areas must be established in the immediate vicinity of the pickup zone and also in the vicinity of the landing zone, if the tactical situation permits. Delays caused by below weather minimums are frequent in northern areas. Weather decisions should be made as close to the pickup time as possible. Locating troops in warming areas immediately adjacent to the pickup zone simplifies operational requirements. Troops are then readily available and can react to the most recent developments with least delay and are not exposed to the cold during periods of relative inactivity when delays are encountered. Reserve units which must be immediately available for pickup will require warming tents at the pickup zone while waiting to be committed.

(2) Certain procedures and safety requirements are similar for both loading and off-loading helicopters. In cold weather and deep snow conditions, certain precautions take on increased importance and must be continuously emphasized during training and in all operations. The aircraft commander is the responsible person regarding safety procedures. To insure maximum safety, all personnel should be frequently briefed on the dangers of loading and off-loading. The most crucial areas to be concerned with in this briefing are the main and tail rotor blades, and the methods of approach and departure from the aircraft. When operating in deep snow the vertical clearance under the rotor blades is drastically reduced, thus creating a hazard for personnel departing and approaching the aircraft. The UH-1D may sink in the snow approximately 61 cm (2 ft), reducing the normal 236 cm (7 ft 9 in) clearance to approximately 152 cm (5 ft). The helicopter should be approached and departed only when cleared by the crew chief. Do not walk directly forward or aft of utility helicopters. Equipment such as individual weapons, skis and snowshoes must be carried under the arms parallel to the ground to prevent them from striking the rotor blades. Under no conditions should items be carried on the shoulder when loading or off-loading the aircraft.

(3) Door gunners normally will not be used in cold weather operations because of the possibility

of the gunners, flight crew, and passengers getting frostbite because of the open doors. Suppressive fires must then be conducted by attack helicopters. It may also be desirable to eliminate door gunners at other times in order to increase ground combat power when limited lift is available or distances are greatly extended.

(4) During lengthy flights the interior temperature of the helicopter should be kept relatively cool (40ºF.) to avoid overheating troops dressed in cold weather clothing.

(5) Attack helicopters provide aerial escort and fire support to the airmobile force the same as in summer operations; however, over-reliance on aircraft rocket point detonating munitions should be avoided because the fragmentation achieved by thin-skinned ground burst munitions will be minimal in deep snow.

l. Detailed Doctrinal Guidance. For detailed doctrinal guidance on airmobile operations, see FM 57-35.

Section VIII. COMBAT UNDER CONDITIONS OF LOW VISIBILITY

2-28. General

a. In the unforested regions and those areas where natural concealment of any sort is scarce or entirely lacking, it becomes increasingly important that troops be well trained and familiar with operations both at night and under conditions of low visibility arising from blowing snow, mist, or fog.

b. Conditions of low visibility provide the greatest opportunities for surprise. Commanders must insure that weather forecasts and reports are constantly distributed as a matter of standing operating procedures.

2-29. Night Combat

a. Normal night combat techniques apply unchanged. Movement and control are facilitated by the increase in visibility resulting from the reflection from the snow. During a cloudy night, light conditions correspond approximately to those on a clear night, with a full moon without snow cover. On windless nights during periods of extreme cold, sound carries for great distances. Under such conditions, all troops must realize the need for silence. Otherwise, surprise is impossible to achieve and security difficult to maintain.

b. If the snow has thawed during the day, it usually freezes at night making movement noisier but easier than by day. During the spring breakup, daytime thawing usually will restrict the use of roads to night hours.

2-30. Combat During Snowstorms

a. Combat operations are sometimes assisted by high winds and snow storms which cover sound and obscure movement. Close reconnaissance and attack are possible under the cover afforded by such conditions. The associated high windchill and the lack of visibility demand a high degree of training on the part of all troops. Compact formations, simple plans, detailed instructions, limited objectives, and positive means of identification should be employed.

b. Accurate timing is required so that troops do not remain exposed for prolonged periods of time. If the equivalent chill temperature is low, the attack should be carried out downwind, if possible, forcing the enemy to face into it.

c. In the defense, particular precautions against surprise must be taken during blizzard conditions. The number of listening patrols must be increased and continual checking will be necessary to insure that sentries maintain a vigilant watch, particularly to the windward and most dangerous flank.

2-31. Combat Under Whiteout and Fog Conditions

In snow covered terrain, ground irregularities are visible only by the shadow they cast. Under overcast the contrast is diminished, and in whiteout or fog it disappears entirely. Movement under such conditions is extremely difficult, and progress is appreciably reduced. In hilly or mountainous country, it may be dangerous since angles of slope cannot be estimated nor can changes in terrain be recognized.

2-32. Recognition

At night and under other conditions of low visibility, there is marked difficulty in distinguishing friendly from enemy troops when both are wearing white. Distinctive markings and signals are necessary.

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CHAPTER 3

COMBAT AND COMBAT SUPPORT

Section I. INFANTRY

3-1. General

a. The role of infantry in northern operations remains essentially the same as in other climates, although the technique of accomplishing a mission may vary considerably. Units usually are organized into highly mobile, self-sustained tactical groupings with only those weapons and equipment suited to the operation.

b. The value of surprise is greatly increased in forested areas under conditions of cold and snow. Skillful use of weather conditions, such as fog or blowing snow, can be of great advantage. To insure success, plans for infantry operations must be made in detail and be made known to every individual before action is initiated.

3-2. Cover and Concealment

a. In the forested areas, troop movements are concealed by the trees. Cover from hostile fire may be constructed from existing timber, by digging emplacements, and the use of icecrete, snow, and ice. Log and snow covered bunkers may be used for additional protection.

b. In the treeless barren lands, few recognizable terrain features exist. Observation will, at times, be aided by the extreme clarity of the air. In the open tundra and barren lands of the Arctic, the ground is permanently frozen except in some sand and gravel areas, raised beaches, or lakes and river banks. Even here, frost often lies within a few centimeters of the surface. Consequently, the siting, construction, and concealment of defense positions are more difficult than farther south. In winter, snow normally is the only construction material, but fortunately deep hard-packed drifts usually are associated with tactical features. Even during the summer, it will often be difficult to dig in because of permafrost and poor drainage. Advantage must be taken of every natural object and surface depression which will provide any degree of cover and concealment. Breastworks may be built by using peat rocks, surface gravel, clumps of soil, and vegetation. Because of the difficulties of concealment, dispersion and deception must be

practiced. During these periods, units must use caution in their movements, as the advantage will lie with the observer who can remain motionless.

3-3. Effect of Terrain on the Accomplishment of the Infantry Role

Terrain and climate combine to decrease mobility of infantry units. In summer, muskeg swamps and lakes form barriers which must be surmounted or bypassed. When frozen, lakes, swamps, and rivers may often be used as roads.

3-4. Effect of Cold on Infantry Weapons (TM 9-207)

a. In extreme cold, metal becomes brittle. Increased parts breakage occurs in all types of weapons.

b. Many weapons create ice fog which, on a still day, may obscure the gunner's vision; thus requiring movement to alternate positions or the use of a flank observer to direct the fire.

c. Mortars experience an increase in breakage of firing pins and cracking of base plates. When ground mounted mortars are used, the base plates must be cushioned against the frozen ground by using sandbags, small branches or bushes, evergreen boughs, small logs or similar type material which will provide a suitable cushion. Precautions must be taken to prevent the mortar mount from becoming frozen to the ground, and the power supply for aiming past lights should be secured in a warm tent or shelter.

d. Experience firing data should be used for recoilless rifles and rocket launchers, and back blast areas must be increased to compensate for the slower buring propellant. Rocket launcher gunners must wear the, face mask for protection from the flying particles of propellant.

e. Special care should be taken to avoid touching metal parts of weapons with exposed skin. This is especially true when an individual assumes a firing position and the side of the face contacts the weapon.

3-5. Effect of Ice and Snow on Infantry Weapons (TM 9-207)

a. Infantry weapons will function under northern conditions when men have been trained in their proper maintenance, lubrication, and use.

b. The main problem is to keep snow and ice out of the working parts, barrels, and sights. Special breech and muzzle covers should be provided and troops trained in their use. Special light lubricants are necessary because of the effect of cold on normal lubricants.

c. As a result of bringing a weapon into a warm shelter, condensation or the melting of accumulated snow may occur which will cause it to freeze and malfunction when taken back into the outside cold temperatures. This condition can be prevented by leaving the weapons outside, under guard, or thoroughly cleaning them inside the shelter.

3-6. Environmental Effect on Infantry Operations

a. Infantry operations may become restricted because of limited roads and lines of communication. Terrain is less accessible in all seasons than in temperate zones. Troops require more time to devote to problems of living and shelter during winter months. Efforts must be directed toward oversnow mobility. Infantry must not become road bound. The guiding principle in providing equipment for infantry should be to provide only the minimum amount consistent with the health of the troops and the success of the mission. Snowshoes or skis are essential for individual movement; and sleds must be provided for each small group to carry tentage, stoves, fuel, and other equipment necessary for sustained combat. Consideration of mountainous terrain and glaciers is treated in FM 31-72.

b. In attaining individual mobility, the primary consideration is how much a man can leave behind without impairing his capability as a combat soldier. Only ammunition and indispensable items, including lightweight rations and existence loads should be carried. Items not necessary for fighting or survival are transported in unit trains.

c. Because of the dampening effect of deep snow or mud, impact bursts of artillery and mortars are less effective. Mines often fail to explode when stepped on or when driven over by tanks. The use of such weapons, accordingly, is weighed carefully in the light of the specific requirements of each operation. A plentiful supply of ammunition for a few weapons is more desirable than a wide variety of weapons with little ammunition.

3-7. Tactical Considerations

(Detailed operations are covered in chap 2.) The situation will dictate the tactical composition of the forces. The factors of METT (mission, enemy, terrain and weather, troops) and fire support available, govern the tailoring of task forces. The attachment and detachment of units is ideally suited for northern operations. The use of airmobile forces for deep penetrations gives the commander greater flexibility in the formulation of his operational plans, and should be considered normal rather than special operations in northern areas.

Section II. ARMOR UNITS

3-8. The Role of Armor Units

a. The mission of armor units in northern latitudes, as elsewhere is to attack, disrupt, and destroy enemy forces by fire, maneuver, and shock effect. Maneuver is limited to deep snow and extreme cold in winter and by the vast areas of muskeg in the summer. Firepower and the shock effect of tanks against unprotected personnel is as demoralizing in the areas of northern operations as in any other area.

b. Terrain and trafficability studies are paramount to tank employment since trafficability is a problem.

c. Employment of tanks in elements of platoons, companies, and battalions as part of a combined arms task force is desirable, especially in sustained operations.

3-9. Effects of Deep Snow

a. It is impractical to establish definite rules for through-the-snow operations due to the varied conditions encountered. Since experience in each particular area is necessary to accurately predict snow trafficability, reconnaissance must be made for each separate action to determine current snow conditions. Most tracked vehicles are slowed by 60 to 75cm (24" to 29") of wet snow. Heavy tracked vehicles may negotiate fine, dry snow of l to 2 meters (3' to 6') in depth. Normal speeds may be maintained after a packed snow trail has been formed by the passage of several heavy vehicles. The surface of a packed snow trail becomes compacted into a hard mass resembling well-packed wet sand and is easily traversed by all types of vehicles. In the event of thaw, proper driving techniques must be used to prevent vehicles from tracking and eventually becoming mired. Freezeups frequently follow thaws, and produce glare ice which makes roads practically impassable to tracked vehicles, particularly on slopes of 35 percent or greater. Again, proper driving techniques must be emphasized as it is desirable that all vehicles track the lead vehicle on glare ice. Tracklaying vehicles operating in the north should be equipped with all steel chevron tracks for all season cross-country operations.

b. Dry snow causes few operating difficulties as it has little tendency to pack on suspensions systems. Wet clinging snow has a tendency to accumulate on the tracks, suspension idler wheels, and sprockets, and may require occasional halts for removal.

3-10. Ice Crossing

Lakes and streams may be crossed on the ice during the winter months if ice is of sufficient thickness and reasonable precaution is exercised. Crossing sites must be inspected for cracks, pressure ridges, and thin spots prior to placing vehicles on the ice (table 2).

Table 2. Load Bearing Capacity of Fresh-Water Ice

Load	Ice measurements for* temperatures 0° to 10°F				Distance between units	
	Risk**		Normal			
	Cm	In	Cm	In	Meters	Yards
Single soldier on skis	4	1½	5	2	5	5½
File of soldiers—2 meter interval	8	3	10	4		
Vehicles:						
¼ Ton Truck	13	5	20	8	15	16½
¾ Ton Truck	17	6½	25	10	20	22
1¼ Ton Truck	25	10	33	13	25	27
2½ Ton Truck	33	13	40	15½	25	27
2½ Ton Tanker	33	13	40	15½	25	27
5 Ton Truck	45	17½	55	21½	60	65½
5 Ton Tanker	80	31½	90	35½	80	87½
5 Ton Tractor w/loaded Trailer	80	31½	90	35½	80	87½
M561 Cargo Carrier	20	8	25	10	20	22
M8A2 Tractor	45	17½	65	25½	70	76½
M41A1 Tank	45	17½	65	25½	70	76½
M48A2 Tank	67	26½	80	31½	70	76½
M60 Tank	67	26½	80	31½	70	76½
M88 Recovery Vehicle	71	28	85	33½	70	76½
M107 Gun, SP, 175mm	50	20	55	22	50	54½
M108 How, SP, 105mm	45	17½	50	20	40	43½
M109 How, SP, 155mm	45	17½	50	20	40	43½
M110 How, SP, 8"	50	20	55	22	50	54½
M113 APC	33	13	45	17½	25	27
M114 AC (C&R)	26	10	40	15½	20	22
M116 Cargo Carrier	19	7½	35	14	15	16½
M548 Cargo Carrier	33	13	45	17½	25	27
M551 ARAAV	40	15½	48	19	30	33
M577 Carrier CP	33	13	45	17½	25	27
M578 Recovery Vehicle	50	20	65	25½	60	65½
Tractor D7	45	17½	50	20	40	43½
Tractor D8	50	20	60	23½	50	54½
Crane 20 Ton	50	20	60	23½	70	76½
Grader	35	14	40	15½	50	54½
Rolling Liquid Transporter	20	8	25	10	N/A	
Aircraft:						
O-1A, E	13	5	20	8	10	11
OV-1A, B, C	24	9½	45	17½	20	22
U-1A	20	8	25	10	20	22
U-6A	17	6½	25	10	20	22
U-8D, F	17	6½	25	10	20	22
U-21A	21	8½	27	10½	20	22
AH-1G	20	8	25	10	20	22
OH-6A	11	4½	18	7	10	11
OH-13H	11	4½	18	7	10	11
OH-23D	15	6	18	7	10	11
UH-1A, B, D	20	8	25	10	20	22
CH-47A	39	15½	50	20	60	65½
CH-54A	45	17½	50	20	60	65½

*Measurements shown in inches and yards have been rounded off to the nearest one-half.
**Risk ice measurements can be used for individual crossings with safety. The normal ice measurements are for repeated loadings.
Note. Vehicle should maintain speeds of approximately 10 mph. Parking distances between aircraft have been computed based on maximum allowable gross weight and may be adjusted based on loads carried in individual aircraft.

3-11. During Spring Breakup

a. Vehicles mired in deep frozen mud or ice require special recovery techniques. Tanks should be parked on high dry ground, unthawed snow, or on brush or logs to prevent freezing in. During the breakup as the active frost layer begins to melt the ground becomes soft and marshy. Although traction is poor, operation is possible during this period if tanks can penetrate the mud and find footing on the frost layer below. As the season progresses, the active layer thaws and as vehicles sink deeper into the muck they may "belly down" and become immobile. To provide greater mobility under these conditions, vehicles should not follow in the same tracks of preceding vehicles. Movement is possible in areas where permafrost is still near the surface, i.e., on the shaded side of woods, on ground with a good moss cover, and on the shaded slopes of hills. Even when the valleys have become impassable, limited operation may still be possible on crests where drainage is best.

b. Extreme caution is necessary in crossing large streams and lakes early and late in the cold season.

3-12. During Freezeup

Conditions during the early freezeup are much the same as those which occur in the spring. The ground thaws in the daytime and freezes at night. When the frost comes to the surface and the ground is completely frozen, a period of high mobility for the tank is experienced. The frozen ground offers good footing, and the shallow snow does not effectively reduce the speed of the tank. Frozen ruts, especially during early fall, are a hazard. Stream and lake ice cannot be used for crossing; however, many can be forded by breaking through the thin ice. In areas with few streams, the late freezeup season offers the best opportunity for tank employment.

3-13. Summer Movement

a. In summer, much of the northern terrain is a soft mud-based marshland or muskeg, or is a swamp that is covered with a thin layer of moss and lichens. Once the moss layer is ruptured, the mud offers no support above the permafrost level. In some areas during summer, the frost layer recedes to a depth that limits tank operations. Floating bogs may also be encountered. These floating bogs are masses of thickly matted vegetation and rotting vegetable matter that float on pools of water. They are difficult to locate by normal inspection as they usually will support a man; however, they will often not support even the lightest vehicles. If a floating bog is suspected, a long probe pole should be used to determine where the bog lies. Muskeg should be avoided by careful reconnaissance and route selection. In some localities, muskeg is interspersed with large glacier boulders just below the surface. Damage to suspension systems and tracks is highly probable during operations in such terrain.

b. When it becomes necessary to cross open muskeg, vehicles should not follow in the same track. In very soft spots, each vehicle should make its own track. No abrupt turns should be attempted. Recovery in muskeg is exceptionally difficult because tanks "belly down" and tracks do not regain the surface. It is frequently necessary to winch the tank to a spot where the muskeg is solid enough for the tracks to regain the surface before recovery can be completed. Seldom can recovery be accomplished with less than two

additional vehicles.

3-14. Preparation for Winter Operations

The commander is responsible for insuring that tanks and other equipment are completely winterized in accordance with the pertinent lubrication order (LO), with TM 9-207 for added information, to insure use of correct materials prior to the advent of cold weather. Failure to winterize tanks will render them inoperative in cold or extreme cold. Winterization of equipment should be undertaken on a priority basis. Units embarking for the north during the winter months should have all winterization completed prior to departure in order to be operational immediately upon arrival. Tank crews should be provided with snowshoes, tents, and heating equipment.

3-15. Observation of Fire

a. Visibility in the north, as it affects tank gunnery, presents many problems. The formation of ice fog, blowing snow, snowfall in driving winds, and snow blown up by muzzle blast all reduce visibility. Soft snow blown by the muzzle blast will probably exist under any condition where light dry snow is on the ground. The burning propellant will create ice fog. The explosion of a high explosive shell will create a similar condition in the target area. Masses of dry snow are also blown into the air by the burst. First round hits assume even greater importance. When these conditions cause the gunner's vision to be obscured, observation from another tank may be the quickest means of adjusting fire. The tank commander, because of his elevated position and the availability of magnifying sights and field glasses, has much better visibility and depth perception on snow covered terrain than have troops on the ground.

b. Extreme cold decreases muzzle velocity and hence the accuracy of tank ammunition. Corrections for firing table data and for ballistic computer setting must be furnished by ordnance for types of ammunition issued in the northern latitudes. If these corrections are not furnished, then using units must determine them by actual firing.

3-16. Handling of Tank Ammunition

Certain difficulties in handling ammunition are present. The binding tape around the fiber carton is difficult to remove while wearing mittens; ammunition cannot be touched with the bare hands without danger of metal burns. Ammunition tends to freeze in the wooden fuze-protective-ring, making it necessary to cut ammunition from the fiber cases. Cold ammunition placed in the warm interior of a tank will "grow" frost crystals if the tank interior is even slightly warmer than the outer air. These crystals increase the difficulties of ammunition handling. Ammunition racks are difficult to operate while wearing mittens; however, operation is expedited by the use of leather thongs or extensions on rack latches and other handles.

3-17. Operations in Extreme Cold

a. Crew Comfort. Tank compartments are more crowded and entry and exit through hatches is made more difficult by heavy clothing necessary for northern operations. Confined crew positions in tanks cause parts of the body to become cramped, thereby restricting circulation. In these confined positions, clothing is drawn tight or becomes compressed and loses its insulation value. The drivers and commanders are subject to increased windchill as they are frequently required to ride with their heads outside the hatches and are exposed to the wind generated by the movement of the tank. Constant supervision is necessary to insure against frostbite. Halts, regulated to fit the situation, must be made. Personnel must be required to dismount and move around to restore circulation, and warm body parts chilled by loss of insulation and to rotate crew positions. Windbreaks should be used during movement in extreme cold to reduce the windchill factor.

b. Tank Operations. After the tank engine is started and warmed up, the tank should move out slowly. The power train should be broken loose gently to prevent failures due to sudden shock. Sharp turns should be avoided until the transmissions and differentials have had time to warm up. Initial movement should be restricted to low gear operations for some distance until final drives, wheels bearings, and support rollers have become free. At each halt, packed snow should be removed from the suspension and drive sprockets to prevent track throwing.

c. Avoid Exploring. Avoid driving in deep snow, snowdrifts, or on ice unless the route is prescribed and reconnoitered or the mission requires it. Plunging through woods is dangerous as tops of frozen trees may break off and fall straight down on the tank. If necessary, trees should be pushed down slowly and cautiously with the tank hatches closed.

d. Carbon Monoxide. Crews must remain constantly alert for carbon monoxide. Open flame heaters or engine exhaust must not be used to heat closed areas.

e. Vehicle Starting.

(1) Vehicles should be exercised frequently to prevent the power train from becoming cold soaked. Engines not equipped with external engine heaters should be started periodically to keep lubricants and engines warm.

(2) Frozen power trains and engines of extremely cold vehicles are easily damaged by towing in attempts to start these vehicles. In many cases, it is impossible to start track vehicles by towing because the suspension and final drives are so cold that the tracks will not rotate. Extreme care must be used in towing or pushing to insure that no sudden shocks are applied. Metal is very brittle in cold; tow cables, final drives, or push bars may fail under shock loads. However, an engine may be started by towing if *no other means* of starting is possible.

3-18. Maintenance in Extreme Cold

a. Maintenance Difficulties. Maintenance of mechanical equipment in extreme cold is exceptionally difficult in the field. Shop maintenance time is also increased because equipment must be allowed to thaw

out and warm up before repair can be accomplished. Extreme care must be exercised in performing maintenance in extreme cold as bare hands will stick to cold metal. Also, fuel in contact with the hands will result in supercooling due to evaporation, and hands can be painfully frozen in a matter of seconds. For detailed maintenance instructions see TM 9-207.

b. Time Required to Perform Maintenance. At temperatures below -40° F., as much as five times the normal maintenance time may be required. Starting and warmup time is also increased, and may approach 2 hours in temperatures of -50° F. Complete winterization, diligent maintenance, and well-trained tank crews are necessary in winter operations. The degree to which cold affects operation can be stated in three general temperature ranges.

(1) Down to -10° F., operation is not difficult, but resembles operation in the northern portion of the United States during the hardest winters.

(2) From -10° F. to -40° F., operations are more difficult. At the warm end of the range, lack of winterization will result in only a slight loss in efficiency; at the bottom of the range, lack of winterization and training will result in many failures.

(3) Below -40° F., operations become increasingly difficult; at temperatures in the vicinity of -60° F., the maximum efforts of well-trained men are required to perform even a simple task with completely winterized materiel.

c. Maintenance Shelter. Performance of field maintenance at temperatures of below -20 0 F., is extremely difficult unless some type of heated shelter is provided. Maintenance shelter tents, portable shelters, or large tarps and air duct heaters are necessary whenever tanks are operated in the northern latitudes.

Section III. ARTILLERY

3-19. Field Artillery, General

a. Artillery fire support will be provided in northern operations as in other areas. However, artillery units will find that problems of maintenance, mobility, resupply, observation, survey, and communications are intensified.

b. (1) The rugged and inaccessible nature of the terrain may require the use of self-propelled and air mobile artillery. Normally, a light towed artillery battalion (some terrain may dictate SP artillery) will be attached to an infantry brigade employed as a task force. Medium or heavy artillery, airmobile artillery or rockets may be employed for additional fire power and a nuclear capability.

(2) Glacier and mountain operations may require the employment of air mobile artillery. Units assigned such a support mission may be equipped with supplementary weapons in order to accomplish the task. Personnel must be thoroughly trained in the techniques of loading, lashing,

rigging, palletizing, and airmobile tactics.

c. The artillery of a task force employed in northern operations must be prepared to assume functions, such as counterbattery, normally performed by a higher headquarters.

d. MTOE must be augmented with cold weather operational equipment as necessary. If it is to be used in winter operations, all equipment should be winterized prior to its arrival in the theater.

e. Training and fire control at battery level should be emphasized. Training for northern operations should be accomplished prior to commitment of units whenever possible. Special emphasis must be placed on the problem areas inherent during cold weather operations. Personnel must also be thoroughly indoctrinated in the use of field expedients for both summer and winter use.

3-20. Field Artillery Movement

a. Successful movement is accomplished as a result of careful, detailed, and comprehensive route reconnaissance. Extensive reconnaissance, both air and ground, should be carefully considered in great detail prior to any operation.

b. (1) Winter is the best time of the year for cross-country movement in the area of northern operations. However, problems are often encountered in crossing certain rivers and muskeg areas which do not freeze even at temperatures of -50° F. Ice thickness and load bearing capacity must always be determined prior to crossing frozen lakes and rivers. Bulldozers or vehicles with blades will be required to break trail for cross-country movement during winter months. For load-bearing capabilities of ice, see table 2.

(2) During the summer months, movement across the extensive muskeg is severely restricted. Engineer support must be relied upon.

c. The problem of determination of location and orientation while moving is increased due to the limited map coverage and difficult terrain. In many cases, vehicle column movements can only be oriented by the column commander dismounting and determining direction with a compass. Artillery weapons used in airmobile operations require tracked prime movers for linkup operations and further commitment.

d. In order to obtain a cross-country capability in this area of practically nonexistent road networks, it may become necessary to replace some of the wheeled vehicles with tracked vehicles in the maintenance, survey, reconnaissance, and communication elements.

e. The artillery must have the same mobility as the supported unit. This includes appropriate traced vehicle transportation and proficiency in the use of snowshoes and skis, particularly for the forward observers and liaison personnel. Army aircraft can assist in maintaining direction, determining location, reconnaissance, communications, and observation of fire.

f. During winter movement, protection must be given to personnel traveling in vehicles and for those remaining with disabled vehicles. Face masks and protective clothing for all drivers and assistant drivers not in heated cabs are mandatory. Vehicular heaters, both engine and personnel must be carefully maintained and a sufficient quantity of heater repair parts should be on hand at the unit level. Loading plans should reflect the presence of equipment such as tents, stoves, etc., on each vehicle.

g. Since artillery is faced with large bulk and weight resupply problems, maximum use of aerial resupply should be planned. Continuous exploitation of the tracked vehicle capability for resupply purposes is necessary to insure the accomplishment of the mission. All batteries should carry an emergency POL supply with them for use when and if they are separated from their parent battalion.

h. Constant and energetic emphasis on motor and vehicle maintenance is required. The abnormal effects of low temperature upon vehicle motors and equipment becomes a matter of prime concern. During extreme cold, it may be necessary to run engines and exercise all vehicles at frequent intervals to prevent cold soaking. Aggressive leadership and command supervision is essential to insure operation and movement.

3-21. Field Artillery Position Areas

a. Positions should be chosen primarily for tactical employment. However, consideration should be given to locations affording protection from the elements. Areas should be prepared prior to occupation whenever possible. Parapets and gun positions often must be built up with snow and available brush and wood rather then being dug in. Effective and continuous operation requires the establishment of warming tents or shelters within the position area.

b. Camouflage is difficult but not impossible. Maximum use should be made of camouflage paint, lime, and available terrain features. Units should be dispersed and camouflage discipline constantly enforced. The operation of vehicles, personnel heaters, stoves and the firing of weapons can cause ice fog which discloses unit locations. Periodic displacement to alternate positions should be accomplished whenever possible.

3-22. Field Artillery Observation

a. During winter months, good observation is limited to a few hours each day because of the short periods of daylight. Observation will also be limited during periods of fog, ice fog, snowstorms, and blowing snow. Snow cover reduces depth perception and obscures ground features and landmarks. Amber filters for observation instruments are required to improve visibility and reduce eye strain. Personnel operating these instruments should be relieved frequently.

b. Ground bursts are difficult to observe on snow covered terrain and in muskeg due to the dampening effect. Preliminary adjustment by airbursts or use of colored smoke may be required.

c. Difficulty in determination of location will require use of special techniques to bring initial fire into the target area. Observers will often be required to navigate by dead reckoning for orientation and for locating

targets. The use of polar coordinates to locate the target is common. Resection from orienting rounds is one method that can be used to assist the observer in determining his location. Safety of friendly troops must be carefully considered at these times.

d. The use of aircraft for observation should be exploited to the maximum. Light aircraft or helicopters should be assigned or attached to the artillery for observation purposes. Such aircraft can also assist in establishing communication relays, reconnaissance for routes and positions, identification of objectives, and for orienting ground troops in addition to adjusting artillery fires.

e. Observers must be equipped to move with the supported elements. Special consideration should be given to the radio equipment to be used by the observers. The weight of radios, batteries, and other equipment becomes critical if the observers are required to use skis or snowshoes as a means of transportation while attached to the infantry elements.

3-23. Target Acquisition

a. Traverse type survey is impractical over extended distances. Instrument fog-up and other mechanical failures are experienced. Recording and computing under winter weather conditions are extremely difficult. Survey control and adequate maps are seldom available. Grid azimuths may be determined by astronomic observation or by using a gyroscopic direction determining instrument. Starting coordinates will often have to be assumed. Triangulation usually is more feasible than traverse.

b. Use of helicopters to transport survey parties to inaccessible locations and to mark stations for triangulation may be necessary.

c. Electronic distance measuring devices are the most practical means of carrying survey over extended distances.

d. As meteorological data is a requirement, metro sections may have to be equipped with tracked vehicles in order to accompany the forward elements during task force operations. Metro section operations pertaining to the collection of data differ very slightly from those experienced in other areas.

3-24. Field Artillery Delivery of Fire

a. Normal fire direction procedures and techniques are valid during northern operations. Certain procedures must be emphasized because they are encountered more frequently in the north than in temperate zones. Due to increased communications difficulties, extended areas, and separate task force operations, individual firing batteries will be required to control their own fires more frequently than in other areas.

b. In most areas, survey control will be scarce or unavailable, therefore, it is often necessary to fire from an observed firing chart.

c. Due to poor visibility, shortened daylight hours in the winter, ice fog, dense brush, and wooded areas, high burst registrations are common. In the situation where survey control is not available, units may be required to register by establishing a base and firing high burst registrations from the howitzer positions.

d. During the long periods of darkness during the winter, aiming post lights are continually required. To insure their operation during cold periods, the power supplies for the lights should be located in warm tents or shelters and remoted to the lights.

e. Extreme cold weather will affect the ballistic characteristics of the weapons and ammunition, the most significant of which is a reduction in range. K factors of 100 meters per 1000 meters (100 yds per 1000 yds) of range are not uncommon. Great care must be taken when firing the initial round to assure clearance of friendly positions. Whenever possible, metro plus velocity error (VE) techniques should be used. When a metro message is not available, known or estimated experience factors regarding range K should be utilized. If any doubt exists as to what range K can be expected, high burst techniques may be utilized to determine the point of impact of the initial round.

f. Special care should be taken when selecting fuzes. This will vary with the type of target area terrain. Keep snow and unfrozen muskeg will reduce the effect of impact bursts by as much as 80 percent. Fuze time and variable time (VT) are particularly effective against personnel in the open. Some types of VT fuzes will malfunction when temperatures are below 0° F. When possible, these fuzes should be warmed by placing them inside the gun carriages (self-propelled), prime movers, special warming tents, or shelters constructed from gun tarpaulins. Low temperatures will also cause malfunctioning of illuminating rounds by the freezing of the parachute and its components. Warming of these rounds will greatly reduce this probability.

g. Chemical munitions are adversely affected by deep snow. The canisters from base ejection shells may be smothered in the snow. Phosphorous shells, although producing the desired smoke, contaminate the area of impact with phosphorous particles which remain buried in the snow.

h. The field artillery digital automatic computer (FADAC) is capable of operating in extremes of cold ranging to -25° F. with the addition of the back over this temperature can be lowered to -40° F. Extreme care should be taken by allowing a gradual warmup period to decrease the condensation that occurs when a cold soaked machine is brought into a warm humid room or tent. If temperatures are not exceedingly cold, the machine can be turned on immediately upon entering a room or tent thus decreasing the possibility of condensation by allowing rapid heating of internal circuitry. The back cover should be left on the machine during this warming period. All switches and buttons on the front panel of FADAC are concave in design to facilitate them being operated by pressing with a pencil rather than removing the Arctic mittens and increasing the possibility of frostbitten fingers.

3-25. Field Artillery Communications

a. Wire and radio nets used in temperate zones are valid in the north and require no expansion. Due to

difficulty of laying and maintaining extensive wire lines, radio normally is used as the primary means of communications. However, this does not imply that there should be any relaxation in the attempt to establish wire nets in the shortest time possible in order to back up the existing means of communication. If available, an internal radiowire integration system should be established. The utilization of track-mounted VHF equipment will reduce the serious communication problems faced by the artillery.

b. Since cold weather reduces the battery life and the operating range of the small man-carried forward observer portable radios, a requirement often exists for a relay between the firing elements and the forward observers (FO). Use of Army aircraft may be exploited for this purpose. However, this method is less desirable than ground stations during extended operations.

c. Communication problems encountered in northern operations and their solutions are discussed in detail in chapter 5.

3-26. Air Defense Artillery

a. Air defense artillery missions in northern areas are the same as those in other areas, subject to modification of techniques caused by climate, terrain, and nature of the operations. Lack of roads may reduce mobility and make resupply operations more difficult. Cold weather causes longer warmup times for electronic equipment, use of special heating devices for ready missiles, and, in air defense missile units, may require launchers to be exercised at frequent intervals. Helicopter lift capabilities should be considered for resupply. In northern latitudes the intense cold, with its attendant unpleasantness and complicated living conditions, affects military operations but does not stop them.

b. The type of air defense artillery units employed in northern operations are dictated by mission, terrain, and available transportation. MTOE often must be augmented to accomplish the assigned mission. Winterization and modification of equipment where necessary should be accomplished prior to entrance into a northern area. Special clothing is required due to two types of cold encountered: Wet-cold and dry-cold.

c. Air defense artillery positions should be selected for their tactical utility and consideration of the logistical factors involved. Air defense missile units should, if possible, occupy previously prepared positions. Light air defense artillery weapons mounted on full track vehicles may occupy hastily prepared positions and effectively accomplish their mission. In adverse terrain, or under winter conditions, it may be difficult to dig in positions. Explosives may be used to expedite protection of the position, or parapets may be built up from logs or ice and snow. Alternate positions should be chosen early and prepared as time permits. Siting of air defense artillery such as Nike Hercules system in arctic terrain is the same as anywhere else. Movement during winter months is not impossible but is impractical. For most efficient operation, previously prepared positions must be used. Level and orientation is affected by earth tremors that occur frequently in the northern part of the North American Continent. During spring thawing, leveling would have to be done several times daily due to permafrost on other than solid rock foundations.

d. Both friendly and enemy forces may use aviation to overcome scarce road network, strengthen signal

communications, improve target acquisition, and to move and support small units. As forward area weapons units become available, they may be used to provide protection against aircraft. For use of nonair defense weapons against aircraft see paragraphs 6-35 through 6-38.

e. Surface-to-air missile units using nuclear warheads provide protection from any high altitude threat. Due to the electronic equipment for air defense artillery fire control systems, personnel must attain a high state of training to perform efficiently in the north. Heated shelters will be required for maintenance personnel to perform their duties. Generators, fire control equipment, and launching equipment must be operated at frequent intervals during periods of extreme cold. The effects of extreme cold on cables require that they be heated before coiling and uncoiling. Cable heads, plugs and connectors must be kept dry and free of snow. Metal becomes brittle when cold and even a slight jerk or blow may cause a pin to shear or a hook to break.

f. Commanders whose force includes Nike Hercules missiles should not neglect the secondary ground support capability of these weapons.

(1) Muskeg and tundra areas afford suitable landing sites to ski equipped aircraft during the winter, with some engineer effort. A good reconnaissance must be conducted to detect the presence of clumps of vegetation, rocks, and other hazards to landing. Movement of aircraft and ground handling of equipment is extremely difficult in these areas.

(2) Snow covered glaciers make suitable landing fields for ski equipped aircraft. Ground reconnaissance should be made prior to landing. Crevasses, often hidden by snow, constitute a threat to any movement on glaciers.

(3) When ice floes are solid enough in winter, they can be used for landing ski-equipped aircraft. Solidity of an ice flow can be judged from the air by the color of the ice. Dark patches indicate near-surface water showing through. These patches make the ice floe too thin and unsuitable as a landing area. This color factor can also be used to judge the safety of frozen lake or river surfaces. The thickness of the ice above the water is another indication of the solidity of a floe. However, this thickness can vary from 8 to 25 cm (3" to 10") depending on the type of ice composing the floe.

(4) In a fixed wing landing on either a floe or frozen lake surface, the pilot should lay a set of tracks on the intended landing surface by making a touch and go landing. A visual reconnaissance is then made of the tracks; any discoloration indicates that the landing surface is too thin for the airplane.

Section IV. ARMY AVIATION

3-27. General

Army aviation missions do not change when operating in northern areas. The increased difficulties in surface transportation as opposed to the flexibility of air transportation will create increased demands for

Army aviation support. Factors considered in support of tactical operations are the same as for normal operations, however, the effects of terrain and weather require the use of special equipment and modification of training programs. A summary of weather and terrain is covered in other portions of this manual. This section deals only with Army aviation operations as they differ from normal operations and in the application of special equipment and training.

3-28. Selection of Landing Sites

a. Airfields.

(1) During winter months the terrain offers many landing fields for aircraft equipped with skis. Preparation of forward landing areas requires little effort; however, construction of permanent or deliberate areas is often impracticable. Frozen lakes make excellent landing sites for both fixed and rotary wing aircraft. Except for use as a hasty airfield, packing or removal of snow may be necessary before lake surfaces are usable. Parking ramps should be cleared of snow and paths provided for movement of heaters and auxiliary power units if extended usage is anticipated. A ground reconnaissance should be performed to insure uniform ice thickness and absence of obstructions. Many lakes are subject to overflow from nearby streams, creating a mushy layer which can only be detected by means of ground reconnaissance. Aircraft equipped with floats can use lakes and streams for landing areas during summer months. Preparation of even temporary forward landing areas during summer months may require extensive engineer effort.

(2) In a helicopter landing on either a floe or frozen lake surface, the helicopter pilot should start shutdown procedures only after he is sure that his landing surface is solid.

(3) Determining the slope of potential landing sites in mountainous terrain is particularly difficult due to illusions projected by adjacent contours. In addition, depth perception is impaired in snow covered mountain areas. Circling or flying alongside the site will aid in overcoming these problems. Small trees, branches, bushes, or other material dropped from aircraft can provide visual references.

b. Helipads.

(1) Selection factors such as size, approaches and exits, takeoff and landing direction, and security are the same as for normal operations.

(2) Helicopter landing sites can be hastily prepared in winter by packing the snow with troops on skis or snowshoes or with tracked vehicles if available. Helipads should be marked by an object that contrasts with the snow to provide a reference for depth perception. The panel marker should not be used for this purpose, since it cannot be adequately secured to the snow covered surface.

(3) In mountainous terrain, it is often necessary to prepare landing sites by pioneer methods.

(4) Helicopter operations in muskeg and deep snow are hazardous because the basic design of landing gear offers no flotation.

(5) Wheel-through-skis or skid pads should be made available for northern operations during all seasons. Utility helicopters equipped with skis or skid mounted pads do not provide sufficient flotation in deep powder snow and the helicopter can settle deep enough to cause the tail rotor to strike the snow.

3-29. Weather Hazards

a. General.

(1) Flying conditions in northern areas normally are good, when an entire year is considered. The cold temperatures greatly affect ground maintenance, but rarely interfere with an aircraft at flight altitude.

(2) Over the Arctic Ocean and along the flying weather usually prevails throughout the year. Considering ceiling and visibility, the summer months provide the best flying weather. This is true, although the number of cloudy days during the summer will exceed the number of cloudy days during the winter. Frontal activity during the summer is weak and will very seldom cause severe turbulence, icing, or strong winds. Thunderstorms that develop during the summer months can usually be circumnavigated and do not greatly interfere with operations. High winds frequently limit flight operations in some areas.

b. Visibility.

(1) Northern weather conditions which frequently render flight impossible are--snow, clouds, fog, heavy rain, and whiteout.

(2) Over the Arctic Ocean and along the coastal areas, the main hazards to aircraft operations are: blowing snow and strong surface winds during the autumn and winter, and fog during the summer. Blowing snow is a hazard in all operations, but especially hazardous in hovering operations. For this reason, hovering should be kept to a minimum. This restriction to visibility may be deceptive to the inexperienced pilot because the shallowness of the layer of blowing snow usually permits good vertical visibility at the same time that the horizontal visibility is very poor within the layer. It can be minimized by disturbing the surface and allowing it to refreeze or consolidate. After consolidation the snow will crust and form a hard surface.

(3) The major restriction to aircraft operation and in the winter, besides the cold temperatures regular water-droplet fog, is ice fog. Although it is not more hazardous to aircraft operations than ordinary fog, it constitutes a serious problem because of its frequency of occurrence and its tendency to persist for extended periods. Ice fog normally will be found in the vicinity of populated

areas at temperatures of -35° F. or lower, but may occur at temperatures as warm as -20° F. Visibility in ice fog may be reduced to almost zero at ground level; however, ice fog usually does not rise above 30 meters (100 feet). It can be self-induced by rotor systems and engine exhausts. Ice fog frequently takes from 15 to 30 minutes to dissipate after aircraft takeoff. Ice fog does not cause icing of aircraft because no water droplets are present.

(4) Along the Arctic coast during June, July, and August, fog occurs on an average of about 20 days each month. When the temperature is below freezing the fog becomes a potential source of icing. Caution is required when operating an aircraft in fog when the temperature is between 32° F. and -20° F.

c. Turbulence. Some degree of turbulence is frequently present in mountain passes and when this condition is severe, flights are prohibitive.

d. Icing.

(1) Only those aircraft equipped with deicing and/or anti-icing equipment are capable of safe instrument flight into clouds or visible moisture when the temperature is freezing or below.

(2) Takeoffs should not be attempted when frost, ice, or snow is on the airfoil surfaces. Even a thin layer of snow may not blow off; and only a thin layer is necessary to cause loss of lift, hence influencing flight characteristics. Hoarfrost may form on the surfaces of aircraft left outside during extreme cold. This should always be removed before aircraft are operated.

3-30. Planning Factors

a. The payload capability of aircraft is reduced in northern areas due to the added aircraft weight caused by ski or float installation and required survival equipment. This reduction may be offset inmost instances by the increase in aircraft performance due to a favorable density altitude condition.

b. All available charts should be carefully studied to insure that the manufacturer's recommended maximum power settings are not exceeded in extremely low temperatures.

c. During winter months, aircraft doors should not be removed for aerial resupply purposes unless canvas doors, or suitable substitutes, are fabricated for use in flight.

d. Equivalent chill temperatures should be studied and appropriate measures taken to insure proper protection of personnel exposed to propeller and rotor wash.

e. Particular caution must be exercised during external load operations in snow or dry cold air since static electricity is generated more quickly and in much higher voltages than in normal operations. A grounding probe must be used to dissipate static electricity.

f. When operating in mountainous terrain, wind directions, and velocity may be indicated by observing drifting snow. Swirling action indicates turbulence.

g. Higher fuel consumption caused by lengthened warm-up times and fuel burning heaters must be considered when planning use of aircraft. On extended flights refueling becomes a major problem in the north, because of long distances and inability of surface transportation to move fuel to isolated points.

h. The climatological history of the operational area should be studied to determine the probable frequency and duration of weather conditions which will limit or preclude flight operations.

3-31. Night Operations

a. Navigation during the hours of darkness is extremely difficult due to the sparsely populated country, although reflection from snow covered terrain serves as an aid to visibility under some circumstances. Navigation through mountain passes after dark, under overcast conditions, is not recommended except for emergency flights.

b. Personnel should receive intensive training in night external loading operations. Lack of visual horizon, blowing snow, and the fact that use of the aircraft lights frequently cause loss of visual reference makes this work extremely dangerous.

3-32. Navigation

Low level navigation is most difficult due to the monotony of the terrain and lack of detail on many maps. Lakes, which abound in many northern areas, may be used in conjunction with pilotage; however, during spring thaws the number of lakes in some regions is multiplied, making accurate identification extremely difficult. Pilots must exercise caution to insure proper orientation at all times.

3-33. Maintenance

a. The problems of increased maintenance stem directly from the low temperatures. Special precautions and equipment are necessary to insure efficient operation of the aircraft. Operation of aircraft at temperatures below -50° F should not be attempted except in emergencies, unless the aircraft, with appropriate winterization kit, and auxiliary systems have proven reliable at lower temperatures.

b. Reciprocating engines should not be started at temperatures of 10° F, and below, without the use of an electrical power unit for assistance in starting. A source of external heat for application against engine accessory case, carburetor induction system, oil pump, and battery will insure easier starting. The standard portable combustion type heater, incorporating a blower and flexible hoses for application of heat to localized areas, may be used for preheating aircraft components and systems before starting. In addition to preheating engines for starting, these units may also be employed to heat specific portions of the aircraft so that maintenance personnel can work without gloves. When temperatures remain below freezing, aircraft

batteries not in use should be removed and stored in a warm place.

c. Thickening of oils at low temperatures presents problems in operation and starting. An aid in extreme cold is the installation of standard winterization equipment which includes baffles on oil coolers and engine cowl baffles to maintain proper temperatures. Oil dilution units may also be installed, although it is normally satisfactory to drain the oil from engines at the end of the day's operations and to heat it prior to replacing it in the engine.

d. So far as is possible, wheels should be kept on dry surfaces to prevent them from freezing to the ground.

e. Mooring of aircraft is made relatively simple in regions of extreme cold by the expedient of placing one end of a rope on the ground, covering it with snow, melting the snow and allowing it to freeze, then mooring the aircraft.

f. Maintenance time factors may be multiplied by five in areas of extreme cold. Aircraft mechanics are greatly hampered by the heavy winter clothing and gloves. Installation of auxiliary equipment such as winter cowls, oil dilution systems, personnel heaters, and covers also adds a time factor to normal maintenance operations. Maintenance units usually require additional personnel in the airframe sections.

g. Shelter must be provided for personnel performing maintenance. In the absence of maintenance tents, personnel parachutes placed over the equipment is a satisfactory improvised method.

h. Operation of aircraft, particularly helicopters with their inherent vibrations, in temperatures below -35° F. results in a marked increase in metal fatigue. All metals become increasingly brittle as the temperature decreases. This will be evidenced by an increase in the number of skin cracks and popped rivets in stress areas. Careful attention must be devoted to these areas in all stages of maintenance operations.

3-34. Armament and Ammunition Handling

The special care that is required to handle infantry (para 3-4 and 3-5); armor (para 3-16); and artillery (para 3-24), ammunition and equipment also applies to attack helicopter systems and ammunition.

3-35. Survival

a. Training. A respect for the northern environment should be engendered in all personnel. Personnel should attend a survival course in living in the field. This course covers construction of shelters, signals, wearing of clothing, and living off the land.

b. Equipment. Proper clothing is necessary for all personnel. Aircraft survival kits must be carried on all flights and passengers should be briefed on the contents of the kits before taking off. These kits are authorized in CTA 50-901.

Section V. CHEMICAL OPERATIONS AND BIOLOGICAL DEFENSE

3-36. General

The principles for employment of chemical agents, and CBR defense in northern latitudes are the same as for temperate climates. The application of these principles to operations in northern latitudes or at low temperatures (below 32° F.) must be based upon a thorough understanding of the peculiar characteristics of the area of operations, structure and tactics of the operating forces, and the technical limitations of chemical agents. Force structures and characteristics of northern areas are discussed elsewhere in this manual.

3-37. Toxic Chemical Agents

a. Production of Casualties.

(1) Low temperatures have a varying effect upon the casualty producing characteristics of most toxic chemical agents. A toxic chemical gent, to produce a casualty, must gain entrance to the body through inhalation, ingestion, or penetration of clothing and the skin. Nerve agents usually are most effective in producing casualties when entry to the body is through the respiratory system. Nerve agents are also effective when absorbed through the skin. Blister agents usually are employed to produce blisters upon contact with the skin, but may also produce casualties upon inhalation of vapors. Because of their high freezing point, blister agents are generally noneffective in low temperature operations. The nerve blood and blister agents will also produce casualties if taken into the body in contaminated food or water.

(2) For a toxic chemical agent to produce a casualty through the respiratory system, the agent must be capable of being vaporized or converted to aerosol. While the freezing point of toxic chemical agent is not an exact indicator of its volatility, generally, the lower the temperature, the more difficult it becomes to vaporize or aerosolize a given toxic chemical agent.

(3) Chemical operations in extremely low temperatures suffer some degradation compared to operations at ordinary or higher temperatures. The increased difficulty of establishing casualty producing concentrations of vapor or aerosol seriously reduces the effectiveness of agents through the pulmonary route. Agents presenting skin absorption hazards, are reduced ineffectiveness due to the heavy clothing normally worn in extreme cold. These agents are also somewhat slower in penetrating dry skin. These disadvantages are partially off-set by the increased difficulty in accomplishing necessary protective measures. Since the individual may be exposed to the lower agent concentration for a longer period of time, he may still receive a casualty producing dose of the agent. The exact effect of these conflicting factors; i.e., increase or decrease in casualties from a given ammunition expenditure will vary with temperature and agent employed.

b. Tactical Employment.

(1) Since weather, terrain, and logistical considerations limit the size of forces which can operate effectively in northern latitudes, the size of the available targets for chemical attack usually will be small.

(2) The offensive capabilities (excluding aerial delivery) of units in terms of ability to deliver toxic chemicals will delimited. This limited delivery capability dictates that the usual method for conducting toxic chemical attacks will be to place the available concentration of fires directly upon those small well located target elements which are most vulnerable to chemical attack. "Time on Target" fire techniques will be utilized by artillery to place a maximum number of rounds on the target in minimum time. Fuze settings should be varied depending upon the nature of the soil, depth of snow, and type of target being attacked.

(3) Minefield, placed to restrict the enemy the use of key terrain, should be composite mine fields. The chamical mines should be placed to force the enemy off the road net and to utilize undesirable terrain. Approaches to bridges and bridge abutments can be contaminated at the time of destruction of the bridge, to delay and reconstruction.

c. Defensive Measures. The current doctrine for chemical defense is a flexible system of protection for operations in a toxic chemical environment which requires troops to wear individual protective clothing and equipment consistent with the toxic chemical threat, work rate imposed by their mission and the temperature and humidity, without unacceptable degradation of their efficiency from the effects of heat stress, psychological stress and other factors affecting the senses. The limiting factor of this chemical defense posture is that personnel garbed in full protective clothing for extended periods of time are subject to the buildup of body heat making them susceptible to both heat and cold injuries. However, under extremely cold temperatures, this problem may not exist.

(1) Protective masks should be equipped with the appropriate winterization kit to prevent frost crystals from clogging the intake valve. In extreme cold the winterization kit will be installed on the protective mask and the mask will be carried under the parka or field jacket to keep it warm. When the mask is removed after prolonged wearing, the inside of the mask, particularly the area around the outlet valve must be wiped dry to prevent the outlet valve from freezing. Ice and frost must be kept clear of the inlet valves. As soon as possible after removing the mask, it should be dried out in a warming shelter to insure that it will be functional if required again in the near future. Frostbite of the face may occur if head harnesses are adjusted too tightly.

(2) Freezing and thawing does not affect the therapeutic value of atropine; however, atropine injectors must be protected from freezing to prevent damage from freezing rupture and to insure proper functioning.

(3) Reagents in the chemical agent detector kits must be protected from freezing. This can be accomplished by carrying the kits underneath outer clothing. Although the validity of tests are not

affected by extremes of temperature, some test may require longer periods of time for approximate color changes under cold temperature conditions. In extreme cold, the vapor concentrations above chemical contamination may be low enough to escape detection. The detection of these agents may be facilitated by warming a small sample of the contaminated material or by concentrating the vapor beneath an inverted box or other suitable substitute and sampling from a small hole in the container.

(4) Water, the most common ingredient in decontamination operations, is useless if temperatures are much below 32° F. Certain organic sol vents may be used for limited decontamination of essential equipment such as weapons, vehicle doors, and loading ramps, etc. The M13 decontaminating and reimpregnating kit, individual, will most probably not be affected by cold.

(5) The multilayer clothing normally worn in freezing weather offers fairly good protection against skin absorption of chemical agents and almost complete protection against these agents when frozen. However, there is a great danger to personnel wearing contaminated clothing in a heated shelter. The heat will volatilize the chemical agents and can thus produce casualties. Additional clothing should be available for changing prior to entering heated shelters and separate tents or storm entrances should be provided for personnel to change clothing after they have been exposed to contamination.

3-38. Defense Against Enemy Biological Operations

The principles for defense against biological agent attack in cold climates are identical to those for temperate climates; however, it will be more difficult to assure the requirement for food, water, rest, and cleanliness in cold weather. Troops suffering from dehydration, or from lack of nourishment or rest, will be particularly vulnerable to biological attack.

Section VI. FLAME AND SMOKE OPERATIONS

3-39. Flame Operations

a. Flame operations can be utilized to advantage in both offensive and defensive operations in the northern latitudes. The standard portable and mechanized flame throwers have the same limitations as other mechanical type weapons containing moving parts and rubber components when operated at low temperatures. Both weapons must be winterized as prescribed in TM 3-1040-204-14, TM 3-1040-206-10, TM 3-1040-209-12, and TM 3-1040-211-12, before they will perform satisfactorily. In addition to winterizing the weapons, special procedures must be followed in preparing thickened fuels used by these weapons to insure that the fuels will gel. These procedures involve either heating the fuel ingredients or, if this is impractical, using a chemical additive called a peptizer. Thickened fuels should not be stored for extended periods of time, since they tend to deteriorate after 48 hours and may not work satisfactorily. For details pertaining to flame weapons, munitions and equipment see FM 20-33.

b. At low temperatures, the ignition of flame thrower fuels may not occur readily. To insure ignition, two or more charges from the ignition cylinder should be ignited before firing a burst, SOP for the employment of flame weapons should provide that sample batches of thickened fuels be prepared and the weapons be test-fired under conditions approximating those expected to be encountered at the time of employment (TM 3-366, TM 3-1040-204-14, TM 3-1040-206-10, TM 3-1040-209-12 and TM 3-1040-211-12).

c. Flame expedients (FM 20-33) involving the use of thickened and unthickened fuels do not suffer from the same limitations as do mechanical flame throwers. These weapons, if properly fabricated and emplaced, will perform satisfactorily under all conditions of temperature. Since ignition at low temperatures is more difficult, additional ignition charges in the form of incendiaries should be incorporated in flame expedients.

d. Low temperatures have little or no effect on the functioning of air-delivered flame munitions. In preparing thickened fuels, the same procedures should be followed as for other flame throwers and, if possible, test firing of the munitions should be accomplished under conditions approximating those expected to prevail at the time the weapon is to be employed. In northern latitudes air-delivered flame weapons are particularly suited for attacking troops in field shelters and fortifications.

e. The fire starter is a flame type munition designed to assist in starting fires under adverse weather conditions. This munition will function satisfactorily with no special handling procedures required for use in extreme low temperatures. Unit SOP should provide that individuals or small detachments operating along or away from the main body in northern latitudes carry fire starters in their personal equipment. SOP should also provide that fire starters be included as part of the survival equipment carried by all Army aircraft, tanks, and vehicles.

3-40. Smoke Operations

Ideal meteorological conditions exist during the greater portion of the year for the employment of smoke. Standard artillery munitions, smoke pots, grenades filled with smoke-producing chemicals, and smoke generating helicopters may be used with the following limitations.

a. Base ejection artillery smoke shells containing canisters filled with HC smoke mixture are not considered effective for use on terrain covered by loose snow because the canisters bury themselves in the snow and the effectiveness is reduced because of the cooling effect of the melting snow. However, if these munitions are used on terrain covered by hard packed snow and ice, they lose little of their smoke producing capability. Artillery shells filled with WP (white phosphorus) will likewise become buried in the snow and will lose much of their effectiveness in producing casualties or a smoke screen under these conditions. However, WP is the most effective smoke shell for use in northern areas.

b. Burning type smoke munitions such as smoke pots and grenades function satisfactorily at low temperatures. However, these munitions generate heat and will, if used on snow covered terrain, burrow into the snow and lose their effectiveness. By clearing the snow so that these munitions rest on the solid earth, it is possible to use burning type munitions to produce good smoke screens.

c. Bursting type munitions, such as the WP grenade, function satisfactorily at low temperatures and require no special handling procedures. However, the grenade, if used on snow covered terrain, will also lose its effectiveness as a result of dropping through the snow. Under these conditions, the explosive force of the grenade is smothered and the number of grenades required to produce a smoke screen or a casualty effect increases to such an extent that their use is not recommended.

d. Mechanical smoke generators present no operating problems if properly winterized. Before a decision is made to employ mechanical smoke generators the commander should assure himself that the logistical problem of supplying large quantities of fog oil to the generator sites can be solved.

Section VII. NUCLEAR WEAPONS

3-41. General

Conditions in northern areas may significantly modify the blast, thermal and radiation effect of a nuclear detonation. See FM 101-31-1 for specific information on the effect of ice, snow, high winds, and low temperatures.

34-2. Nuclear Radiation

a. General. Because of the limited road net generally found in northern areas, nuclear radiation may severely disrupt all operations. The source of this radiation and modifying effect, are contained in paragraph 2-25, FM 101-31-1.

b. Monitoring and Survey. Since monitoring for nuclear radiation requires the use of battery powered radiac instruments, it is imperative that these instruments be kept warm to maintain maximum efficiency in extreme cold. Radiological surveys for radiation normally are limited to those areas or routes occupied or used. Aerial survey is the most practical for large area surveys. Surveys and monitoring procedures are covered in FM 3-12.

3-43. Protection Against Nuclear Attack

a. At low temperatures, troops operating in the field are particularly vulnerable to all of the effects produced by a nuclear detonation because of their inability to dig foxholes and underground fortifications. Shelters and fortifications constructed from snow and ice provide some protection and, wherever possible, should be constructed to take maximum advantage of the additional protection provided by natural terrain features. During the winter months, the trunks and limbs of trees will be frozen and become very brittle and will reconverted into many projectiles moving at high speed. Unprotected personnel in blast areas will suffer many punctures and lacerations from these projectiles. In mountainous terrain with heavy snow covering, units should be aware of the possibility of avalanches resulting from the blast effects of a nuclear weapon. The snow covered terrain and the atmosphere of some regions increase the reflectivity and

improve the transmission qualities of thermal radiation; however, heavy, larger, lightly colored type clothing furnishes virtually complete protection against thermal radiation, outside the radius at which other effects will govern.

b. Tents which provide necessary warmth for living will not provide protection from radioactive fallout. Maximum use, consistent with the tactical mission, must be made of natural terrain features to provide protection against nuclear radiation. Snow and ice, although not as effective as earth in reducing radiation hazards, are readily available and can be used to provide shielding against radiation effects. Loose snow falling on a contaminated area has a half-thickness of about 60 cm (24"); that is, 60 cm (24") of loose snow covering the contamination will reduce the dose rate to about half the original value. Thirty centimeters (12") of hard packed snow will reduce the dose rate by about 1/2 and may be of value for constructing radiation shields over contaminated areas or around shelters.

c. Low temperatures will also make the decontamination of personnel who have been in radioactive areas more difficult. The requirement that contaminated personnel be provided with bathing facilities and a change of clothing must often be modified and field expedient methods utilized. Field methods consist of removal and vigorous shaking of all outer clothing, or the use of brushes improvised from shrubbery for brushing the clothing. When in a contaminated area, personnel should keep clothing completely buttoned in order to minimize contact of radioactive materials with the skin. Tracking of contaminated snow into shelters and populated areas can be minimized if trails and roads are scraped after fallout ceases. If practicable, the removal of the top layer of contaminated snow within an occupied area will materially reduce the radiation dose rate.

Section VIII. ENGINEERS

3-44. General

Engineers in northern operations carry out their normal combat, combat support, and combat service support missions. Special aspects of combat service support tasks are covered in TM 5-349 and FM 31-70. Environmental factors increase the volume and scope of engineer operations and the difficulties attendant to execution of these operations. The scarcity of trails, roads, and airfields increases the need for construction effort. At the same time, the effect of the extremes of climate increases the manpower and equipment effort required for both construction and maintenance. The numerous streams, swamps, and lakes necessitate increased quantities of stream crossing equipment and correspondingly increased effort for its installation and maintenance. Cross-country movement of large forces requires augmented engineer effort. The problems confronted in construction of conventional engineer field works are magnified, as are the problems of installation of field fortifications. While water potential is normally adequate, the difficulties of supplying potable water by conventional methods are increased.

3-45. Field Fortifications

a. Troops must be capable of constructing field fortifications on snow and frozen ground using materials

available. This may include constructing obstacles with wire, mines, and timber under the special conditions of winter and by the icing of banks and the preparation of traps in the ice of rivers and lakes.

b. Excavation is difficult in frozen ground, therefore, hand tools are of little use. Explosives are effective but large quantities are required. Charge calculations cannot be made directly from data in FM 5-25, because of variations in moisture content, soil types, and vegetation as well as property changes resulting from low temperatures. Consequently, demolitions must be computed on an experience factor basis and test shots will be necessary in most instances. An expedient method, although slow, is to build a fire on the ground and dig out the soil as it thaws. Too much thawing of large areas, however, makes digging difficult unless there is adequate drainage. Gravel is easier to excavate because it does not freeze as solidly as silt or clay and usually has better drainage. Natural soil deposits that have been excavated should be mixed with water and placed around the excavation for use as additional fortification. Use of available materials should be encouraged to the maximum extent to decrease logistical requirements.

c. Hastily made firing positions and trenches are built in the snow and reinforced with readily procurable material such as ice, wood, or branches. A minimum of 200 cm (6½') of solidly packed snow is required for adequate protection from small arms fire. If possible, positions are dug into the ground. Shelter is built simultaneously with the construction of positions.

d. Weak spots in the defense, where there is little snow or which are easily traversed by the enemy, are reinforced with artificial barriers such as wire entanglements (especially concertina wire), pitfalls, abatis, mine fields, and iced slopes.

e. In forested areas, measures should be taken in summer to protect defensive positions against deliberately set forest fires. Consequently, fire breaks should be prepared in areas where this is likely to occur. Low ground in front of the defense position can sometimes be flooded by construction of a dam.

f. Dummy positions, which are especially effective in winter, are used extensively to mislead both ground and air observation. Road and trail networks are coordinated with the plan of defense. This will include roads and trails for movement of reserves, artillery, and supplies. Care must be taken to provide maximum concealment of all routes, especially those to positions in forward areas. Seasonal changes will affect defense positions. The breakup seasons usually will destroy positions built during the winter and will fill low spots with water. During the breakup season, special attention is pad to drainage of trenches and shelters. Positions or obstacles built during the summer may be made useless by heavy snow in the winter.

g. Breastworks of snow can be erected if time is short. Sandbags filled with sand or snow are effective in the silent and speedy construction of defensive positions in frozen ground. Water poured on the bags freezes and improves their protective qualities for the duration of the cold weather.

h. If the snow is deep enough, tunnels can be constructed. They do not provide effective protection against artillery fire, but do afford complete concealment. Snow tunnels must be revented, and long tunnels should be ventilated. Snow walls must be used for cover when the ground is too frozen for trenches. The minimum thicknesses for protection from small arms fire are given in table 1.

Table 1. Breastwork Construction

Snow wall material	Minimum thickness Feet	Centimeters
Newly Fallen Snow	13	400
Firmly Frozen Snow	8 to 10	250 to 310
Packed Snow	6½	200
Ice	3¼	100
Icecrete	1	31
Frozen Snow Water Mixture	4 to 5	125 to 155

Note. These materials will disintegrate under sustained fire.

i. Antitank devices of usual shapes can be made from ice and frozen into place. In forested regions, they can be made from logs. Tank traps can be made in the water in early winter by cutting out a section of ice approximately 4 meters (4 yds) wide and floating it under the ice sheet on the down stream side. It leaves a clear water gap. Prevent refreezing of the gap by laying a mat across it and insulating with a snow cover. The snow also provides concealment. This trap is effective but tends to freeze within a short period of time if not properly insulated. If the ice on the gap is less than 4 cm (1½') thick, the trap also serves as an antipersonnel obstacle.

j. A body of water may become an effective barrier by using explosives to break the ice. In blasting, the explosive is placed under the ice to take advantage of the excellent tamping effect of water. Holes are cut or blown in the ice by explosives and the charges are held in position under the ice by bridging these holes with poles. (See FM 31-70.)

k. Roadblocks can be created by icing roads and snowdrifts or by using icecrete, timber, and wire cable in conjunction with mines and barbed wire. A cable block consists of a piece of l-inch wire cable painted white stretched diagonally across the road about 60 cm (24") above the surface of the ground. It is most effective if placed so that it is approached by vehicles coming downhill or from behind a blind curve. Antitank mines should be placed in the ditch toward which the vehicle is deflected by the diagnonal block. Icing the road near the cable increases the effectiveness. This type of block has the advantage of being easy to construct, difficult to detect, and simple to remove for the passage of friendly troops or vehicles. In forested areas, abatis can reconstructed by using fallen trees and barbed wire.

l. Wire barriers are practical, but tend to lose their effectiveness as depth of snow increases and, therefore, require continuous surveillance (FM 5-15). When constructing wire barriers iron pickets are more practicable than wooden pickets in frozen ground. Explosives, power drills, steam jets, or heated iron rods can be used to sinkholes. Wire can easily beset at the necessary height in woods and forests by attaching it to trees. The wire should be placed close to the ground to prevent the enemy from tunneling underneath the barrier. If time is lacking or there is uncertainty as to the amount of snowfall, long pickets are used and the upper strands of wire can be added later as the snow accumulates. Constant maintenance of wire

installations is necessary, especially during heavy snowfall. Concertinas are the best wire obstacles for use in deep snow, however, they must be moved or replaced when hard packed snow covers them. Prefabricated wire devices of triangular cross sections (Lapland fence), with six wires on the enemy side and four wires on the friendly side and on the base, may be placed on snow for temporary use. In case of snow accumulation, the tripods can be lifted out of the snow with poles or other means and reset on top of newly fallen snow. On the soft ground, the base strutting of tripods and the base wires give enough bearing surface to prevent the obstacle from sinking. The small reflective surfaces of the wire are invisible from the air at relatively short lateral and oblique distances. Screwpickets, however, should be painted white.

3-46. Roads and Trails

a. Since routes of communication in most northern areas are generally limited to an extremely primitive road and trail network, a major construction effort to assure movement and resupply is necessary. Full utilization of all intelligence available through map, ground, and aerial reconnaissance is mandatory to assure proper route selection and avoid needless dissipation of construction effort. Route selection criteria vary by season; summer routes being selected for ground bearing (in most instances areas with deciduous trees offer best trafficability), whereas grades generally dictate winter routes because of the difficulties encountered in earthmoving during subzero weather. Tracked vehicles do not eliminate the need for roads, regardless of the season.

b. Roads made by combat troops under winter conditions will be improved only to the extent of the capabilities of organic equipment. Roads must be made wide enough to accommodate vehicles which will be using them but, because of the necessity for concealment from enemy air, unnecessary clearing is avoided. On roads with a width of less than 7 meters (23'), frequent turnouts must be provided to permit two-way traffic.

c. Tractor trains operating on properly constructed trails can move large tonnages. They can be used to advantage on lines of communication and in rear areas, but because of their slow speed and vulnerability to attack they normally are not used forward of the brigade supply point.

d. The vast roadless areas of the north become, under summer conditions, even more difficult for overland vehicular movement than during the winter months when the ground and waterways are frozen. Combat troops are frequently required to construct temporary summer roads and bridges along the routes of communication without engineer support. In contrast, winter roads generally are constructed on the ice of waterways or along the frozen swamps and muskeg areas, the summer routes are selected to follow the high ground, flood plains of the braided streams, shallow rivers, and the shore lines of gravel bottomed lakes--all characteristic terrain features of the northern regions. If a swamp must be crossed, it is done at the narrowest point requiring the least ground reinforcement. In heavily forested areas, existing game trails, clearings, and lanes through the trees may be widened and used for roads. Techniques of road construction under summer conditions are contained in TM 5-330.

e. The construction of snow roads for wheeled and tracked vehicles and snow removal or compaction on all types of roads and trails is important. Normally, snow is removed by snow plows, graders, angledozers,

and drags. Early winter snow clearance accelerates the penetration of frost into any unstable subgrade, consolidating the subgrade. The snow removed from the road is scattered away from road ditches. Piling of snow or forming of snow banks along the road creates a condition favorable to the deposit of snowdrifts. Deep-rutted snow which is hardened by traffic or freezing can be leveled with harrows, drags, graders, dozers, or by packing loose snow into ruts. Road surfaces, culverts, bridge channels, and ditches are maintained and kept clear to provide melted snow drainage. Maintenance of roads made by combat troops for tracked vehicles normally consist of such tasks as straightening sharp curves, filling holes, building turnouts, and draining surface water. Frequently, winter traffic effects on snow roads will result in a loose snow-soil mixture which cannot be compacted. If temperatures are sufficiently low, this condition can be corrected by adding water and restoring stability by freezing. In the more common case, traction can only be restored by removing the unstable material.

3-47. Ice Routes

a. General. In some areas, the best sites for winter road routes will be found along frozen waterways. They have an advantage in that they are relatively easy to prepare, requiring only snow removal and possible strengthening of the ice in places, and the only slopes found on such routes are at the entrance and exit to the waterway. However, disadvantages are many: A sudden temperature rise can make the route unusable, many men and much equipment must be stationed along the route to effect continuous maintenance and repair, convoy speed is limited, and recovery operations of vehicles which break through the ice may force traffic to seek alternate routes.

b. Planning. Tactical plans should not be based on ice routes and bridges unless there are no other alternative solutions. The many variables connected with ice routes and bridges make tactical plans based on ice bridges and routes risky at best. If ice bridges are used, fixed bridging should be installed as soon as possible to insure continuous use during warming and high traffic density periods.

c. Reconnaissance. Road routes over and across lakes and streams are selected only after intensive and detailed reconnaissance of ice conditions. This reconnaissance is concerned mainly with determining the ability of the ice to support the heaviest load which it must bear. The reconnaissance for a route over ice must be conducted by personnel qualified to interpret ice characteristics to prevent men and equipment from being needlessly endangered. The entire route over ice must be checked as the ice can differ in many ways in a relatively short distance.

d. Strength of Ice. The strength of ice varies with its structure and temperature. A snow cover or a warm current will affect the ice temperature and generally will produce a thinner and weaker ice cover. Table 2 provides working capacity figures for planning purposes.

e. Expedient Crossing. An expedient for a tactical crossing of skiers, snowshoes, and oversnow vehicles may be used when a detailed prior reconnaissance is impossible. Leading men of the trailbreaking party are roped together. The lead trail breaker in a prone position drives an axe into the ice at arm's length; if the ice sounds solid he moves forward 5 meters (5 yds) and tests again.

f. Ice Bridges. If the conditions are favorable, an ice bridge may be easily constructed. Construction of an ice bridge requires pumps or some other means of flooding the ice, and freezing temperatures. Temperatures below 10° F. are desirable. If the ice is exposed to direct sunlight or the temperature is above 25° F., flooding should be done in the evening to take advantage of the colder night temperatures. Time spent selecting a good site will be well repaid in reduced construction and maintenance effort. It takes less effort to conduct an adequate reconnaissance of a crossing site than to extract a vehicle which has broken through the ice. A site should be located which, within the tactical limitations, provides the best combination of shortest distance, gradual sloping embankments, and low turbulence. The natural ice should be at least 10 cm (4") thick at the site selected in order to support men and equipment required to construct the ice bridge. A check should be made to insure that there is water flowing under the ice, and that there are no hot springs present; otherwise, construction of the bridge would be impossible. For details of ice bridge construction, see TM 5-349.

3-48. Airfields

a. The preparation of airfields for fixed wing aircraft depends upon the conditions encountered. In deep snow, the surface must be smoothed and packed by the use of a drag or by driving vehicles over it. With a small amount of pioneer work, hard wind-packed areas can be made usable for aircraft equipped with skis (TM 5-330 and TM 5-349).

b. Deep soft snow presents difficulties in the landing and takeoff of airplanes, even when they are equipped with skis. The deeper a ski sinks into the snow, the longer will be the ground run required for takeoff. Repeated pulverizations each followed by light compaction and backfill will densify the supporting snow structure for aircraft traffic.

c. Preparation of Landing Sites for Helicopters.

(1) The amount of effort exerted toward improving landing sites will depend on their intended use. The procedures discussed here are primarily for sites in forward areas that are to be used frequently. Even though no elaborate preparations are necessary for this type operation, the unit commander should realize that the state of development of sites adjacent to his unit will greatly influence the reliability of support he receives from helicopter units. Inasmuch as site locations seldom will be found that satisfy all requirements, some preparation usually will be required.

(2) If trees must be cut to clear a landing site or approaches thereto, stumps in the immediate vicinity of the landing spot should be cut flush with the ground or removed, if possible. Otherwise, they should not exceed 30 cm (12") in height because of the possibility of puncturing the bottom side of the helicopter fuselage. Also, it is seldom desirable to prepare a wooded area by burning because of the dust problems which will be created.

(3) Landing sites may be prepared on the sides of hills by blasting a ledge. However, the slope gradient and clearances must be considered when preparing such sites.

(4) Even though the terrain surrounding the troop unit's position is hilly and wooded, a suitable landing site still may be prepared. First, enough trees are felled in the vinicity to provide a clearing for the site. These are wedged among the stumps on the lower side of the slope to provide a foundation for the site. Earth above the proposed site is then dug out and filled in around the tree trunks on the site. Care must be taken to insure that the filled-in portion is solid enough to support the weight of a cargo helicopter. For security reasons, the site should not be cleared or filled more than necessary so that its position will not be easily detectable by the enemy. Unnecessary digging should be avoided as this creates a dust hazard.

(5) Sites in cleared areas, fields, and roadways are easily prepared for landing. When extremely dusty conditions prevail, it may be desirable to prepare the ground with oil or other form of soil stabilizer. Small trees are felled, holes filled in or marked, and all loose rubble must be cleared from the area. Loose objects, such as inadequately secured panels, may be drawn into the rotor system and cause damage, or loose rubble or debris may be blown against personnel on the ground resulting in injury.

(6) It is especially important that all communication wires strung between trees or across valleys in the vicinity of landing sites be removed or lowered to the ground. If the wires are in use and cannot be strung along the ground, they must be marked. This can be done with strips of cloth of highly contrasting colors hung across them at intervals to make them clearly visible to the pilot during takeoff and landing.

(7) It may be advantageous at times to use portable airfield surfacing materials such as prefabricated steel or aluminum mats or membrane surfaces. However, this material normally will not be available and its use may create handling problems during extreme low temperatures.

3-49. Camouflage

a. Camouflage techniques include the correct use of camouflage clothing; the camouflage of shelters, weapons, defensive positions, camps, and bivouacs; and the selection of site making the best use of natural camouflage. Camouflage will often require the use of nets and natural materials, the enforcement of track discipline, control of lights, smoke, noise, and practice in deception using available natural materials and specially constructed dummies.

b. Snow exaggerates contrasts and makes camouflage essential. If possible, tracks that reveal positions should be covered. Deceptive track plans are essential. Snow and other natural materials should be used to conceal trenches and foxholes by placing loose snow on the side of the enemy. The slope of the snow should be gentle with all sharp angles hidden. Locations of emplacements and vehicles are chosen to take advantage of existing dark patterns. Dummy installations should be erected profusely (FM 5-20 and FM 31-70).

c. Issue camouflage nets, wire mesh, and garnishing materials used for camouflage on snow covered

terrain should be whitewashed or painted with white paint to improve their effectiveness. Vehicles, aircraft, artillery pieces, and tanks should be painted white to blend with their surroundings. Camouflage painting is generally best accomplished by painting the entire vehicle with an extremely light coat of white so that a trace of basic color shows through to form varying shades of gray. Pattern painting is then applied to this. Special care must be given to tracks and wheels since, as a general rule, painting will not prove satisfactory because of wear. Vehicle crews must be trained, upon halting, to pile snow around tracks and wheels. Deceptive track plans in snow are essential. Tent camouflage can be accomplished by scattering snow and branches on the tent after it is erected.

3-50. Mines and Mine Fields

a. For use in snow, mines should be white and the tracing tapes colored. As much work as possible should be done in warm shelters to increase the efficiency of both the men and the mines. Arming of mines in quantity is a difficult task in low temperatures. When mines are laid in the snow, track discipline is important. With no snowfall imminent, a well-tracked terrain is best for mine fields. To insure activation, pressure type antipersonnel mines should be placed on a firm bearing surface such as boards or large rocks. Antipersonnel mines activated by pull or pressure type fuzes are effective on ski trails.

b. Antitank mines are not always effective under heavy snow cover. When they are buried too deeply, the snow causes them to become bridged over. The mines may be placed on the ground where the snow has been removed or near the surface of the snow on other support. A thaw or concentrated traffic often renews the effectiveness of a snow-covered mine. The mine may fail to detonate if water has entered it and become frozen. In deep snow, antipersonnel mines need bearing devices to keep them near the surface. Minefields should be inspected periodically and necessary maintenance performed. White painted trip wires are effective. Mines should not be lifted, when they are equipped with antilift devices, or when frozen to the ground. Under such conditions they should be destroyed in place.

c. To emplace mines under ice, holes are drilled, and mines are suspended by cords about 60 cm (24") below the ice. The field is laid out so that the mines are staggered about 3 meters (3 yds) apart. The field is sympathetically detonated by electrically exploding one or more of the mines in the field. Gaps 10 to 15 meters (10 to 15 yds) in width may be blown depending on the thickness of the ice and the number of mines used. Defensively, they can be used to restrict the enemy from using ice on lakes or rivers as avenues of approach or as routes of withdrawal. In an approach march or an attack over ice, they can be used to protect open flanks.

d. Antipersonnel mines are used for mining ski and other trails in snow. When a pressure type firing device is used, the mine must be placed about 2 cm (1") under the snow surface because the weight of an individual is distributed over the length of the ski. When a pull type firing device is used, the trip wire is placed at various heights above the snow surface by tying it to the trees and saplings off of the trail. All extra tracks must be swept away.

3-51. Employment of ADM

Principles governing tactical employment of atomic demolition munitions are covered in FM 5-26, FM 101-31-1, and are applicable to northern operations. Technical aspects of systems are contained in the TM 39-series.

3-52. Problems for Engineers and Commanders

a. Commanders must be capable of employing ADM in northern operations. Conditions of weather and terrain must be considered and plans must include--

(1) Protection of personnel and equipment.

(2) Loading and unloading equipment.

(3) Tactical transporting equipment.

(4) Communications.

b. Existing engineer organizations can be adapted without difficulty to northern conditions, however, modifications will usually be required in the type and nature of their equipment. In general, the amount of engineer heavy construction equipment must be increased with crawler replacing wheeled tractors; tracked personnel and cargo carriers must be added to permit equal mobility of supported and supporting units; and special purposes equipment (ice augers, portable duct heaters, and extra maintenance shelters) added to compensate for the environmental conditions. This in turn will necessitate some revision of specialist requirements. Such modifications and the overall requirement for engineer units, however, vary much more widely in the north than in other regions with the season, the operational theater, and the mission of the force. During the planning stages, all these factors must receive detailed study to determine the proportion of engineers in the task force, the type of equipment needed, and the organization they require.

c. Environmental characteristics of northern areas which complicate engineer tasks are--

(1) Permafrost.

(2) Extreme and rapid temperature changes.

(3) Wind, snow, and ice storms.

(4) Flooding.

(5) Alternate thawing and freezing.

(6) Terrain such as mountainous, muskeg, or tundra regions.

(7) Hot springs.

d. Specific engineer tasks complicated by northern conditions are--

(1) Water supply.

(2) Fire protection systems.

(3) Road construction and maintenance.

(4) Bridge construction and shore work.

(5) Construction of appropriate defensive systems.

(6) Mine and antimine warfare and reduction of other obstacles.

(7) Construction of airfields, airstrips, and helicopter landing sites.

(8) Installation and maintenance of camouflage and decoys.

(9) Construction of storage and supply distribution areas.

(10) Construction of troop shelters and administrative facilities.

e. In the north, as in any undeveloped area, much is required of the engineers to facilitate the movement of the command. Extreme cold adds to the importance of efficient organization for engineer work. Parties forced to stand about idle in the open rapidly become chilled and lose much of their efficiency. Tasks must be laid out, and equipment and materials should accompany work parties. Firefighting equipment and techniques differ in extreme cold because of the problem of procuring and transporting water. Fire prevention measures and inspection are of the utmost importance and must receive constant attention. Water that is stored for firefighting purposes should have calcium chloride added to keep it from freezing. The chief reliance is upon nonfreezing firefighting chemicals. It is unsafe to rely on the use of snow to extinguish fires because the snow is usually tramped clown around structures within a camp and is therefore unavailable in sufficient quantities.

(1) In the provision of shelters, it should be borne in mind that less fuel is required to provide adequate heat for one large space than if the same space is divided between two or more structures. This is because of the reduced area of outer walls, in the former case, through which heat escapes.

(2) Gasoline burning, portable tent heaters of the airduct type which rely on a small gasoline motor to operate the blowers can be modified, if electric power is available, by replacing the gasoline engine with an electric motor to make them more reliable in operation and to be less of a fire

hazard.

(3) In semipermanent camps, where gasoline or fuel oil stoves are employed, the usual 5-gallon gasoline can should be replaced with tanks made from one or more 56-gallon drums set up on stands outside the tent or building, with fuel piped inside to the stove. Frequent inspections for fuel leakage must be made and corrective action taken to eliminate all fire hazards.

3-53. Water Supply

a. The problem of supplying water in the north to units up to battalion size or reinforced brigades is much greater than that of individual supply. For instance, melting snow and ice on stoves, burners, or open fires in sufficient quantities to provide water for all needs of large units is impractical because a large amount of fuel is needed to obtain a small amount of water. Seventeen cubic inches of loose snow, when melted, yields only 1 cubic inch of water. Melting of snow is not recommended for supplying water in quantity except in an emergency. The chief sources of water supply for large units in the order of their efficiency and economy are: drawing water from under river or lake ice, melting ice, melting snow, and well drilling (semipermanent and permanent camps).

b. When possible, water points on lakes and rivers are located on the leeward side where there is generally clearer water, less snowdrifting, and more shelter from the wind. Sites on a lake are located as far from the shore as possible, within effective camouflage limitations. To cut holes in ice at water points, ice augers, air tools, steam jets, or other such equipment prove most effective, holes can also be drilled through ice by the use of hand augers, however, shaped charges are far superior to hand tools in preparing water holes in thick ice since hand tools are generally inefficient if ice is over 60 cm (24") thick. A point to note in this connection is that the ice usually will be thinnest where it is covered by the most snow. The methods used, however, vary with the condition of the ice and with the equipment, personnel, and time available. At low temperatures, ice rapidly forming over the water in the hole can be kept clear by placing the suction strainer about a foot below the surface when pumping. Continual pumping or insulating the surface keeps the hole clear.

c. If snow is used as a water source for large units, it may be shoveled into any available tank or container and heated by any method available. When powdered or loosely packed snow is used for water, pack it tight in the container and tamp down or stir it frequently while melting to increase the moisture content and so increase its heat conductivity. Granular snow, usually obtainable near the ground, has a higher water content than the lighter snow of the surface layers.

d. In extreme cold, heated shelters are necessary in which to operate water purification units. For highly mobile situations, an inclosed, heated truck-mounted unit can be used to advantage as a mobile water supply unit. Water supply tents should be situated on the ice, directly over the hole through which water is pumped or as close thereto as possible, to reduce the possibility of water freezing in the intake hose.

e. Because of the normal low turbidity, it is probable that safe water can be provided by chlorination without pretreatment, if filtration is accomplished by means of an improved diatomite or ceramic filter.

Some of the treatment problems encountered in the North are--

(1) Water in certain areas requires heavy chlorination to obtain a standard residual test of 0.4 parts per million after a 30-minute contact period in active parts of distribution systems at fixed installations, and of 1 part per million after a 10-minute contact period under field conditions.

(2) Water softeners and controlled acidity are required in most cases to prevent scaling in heating systems and power plant cooling systems.

f. For units in the field, water may be stored in insulated 5-gallon cans. Immersion-type heaters may be used to prevent freezing of a water supply tank or trailer.

g. Field distribution of water to men and small units is handled in several ways. For immediate use, men or units may fill their containers directly from the source. If they do this, they sterilize the water by boiling it for at least 5 minutes or treating it with individual water purification tablets if it is not already sterilized. As the water is pumped from beneath the ice, unit mobile storage tanks are filled and the water then dispensed to men. Individuals may furnish their own cooking and drinking water by melting snow or ice. All field water distribution units are insulated or equipped with some form of heating device to keep the water in liquid state.

h. (1) Transportation of water by truck is practicable only when there is a road net established. The best way to transport water in the north is by the use of tracked vehicles which are not dependent on a road for maneuverability. If 5-gallon cans are used to carry water, they are filled only three-quarters full to allow agitation of the water during transit. Cans are stored off the floor in heated shelters as soon as delivered. Sled-mounted 250 to 300 gallon water tanks in which immersion-type heaters have been installed have proved satisfactory.

(2) For small units of two to four men, the 5-gallon insulated food container is satisfactory. These can be filled each night with water from melted snow or ice or from unit water dispensers. They hold enough water for the minimum daily needs of about four men. The insulation is sufficient to keep water from freezing for as long as 40 hours at an ambient temperature of -20° F., if the temperature of the water was at the boiling point when the container was filled.

(3) Disposition of waste water is a constant problem in extreme cold and, even in the summer, in the presence of underlying permafrost. For periods of up to 6 months, satisfactory drains can be constructed by digging or blasting deep pits filling these with large rocks and then recovering with about 50 cm (1½') of earth.

(4) The steam generator-type snow and ice melting device has many potential uses, including jetting in ice and frozen soil; thawing frozen equipment and water and fuel lines; freeing equipment, tanks. and vehicles frozen into mud or ice; and assisting in the placing of obstacles and mines in frozen materials.

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CHAPTER 4

COMBAT SERVICE SUPPORT

Section I. GENERAL

4-1. Purpose

This chapter contains information relative to combat service support in northern combat operations. Procedures for support of task forces in cross-country operations are emphasized.

4-2. Factors Affecting Northern Logistic Operations

Logistic support in northern areas is critically affected by--

a. The long and difficult terrain distances over which support must be rendered.

b. The lack of ground communications systems, even in the approaches to population centers

c. The general lack of civil and industrial facilities that can be adapted for military purposes.

d. Environmental factors, including winter cold, permafrost phenomena, low bearing capacity soils in summer, vegetation cover, and terrain barriers.

4-3. Logistic Mobility

a. Tactical mobility is limited by logistic mobility. Logistic mobility requires rapid, convenient, and economic supply storage and handling methods; responsive resupply systems; effective maintenance and service support systems; and effective ground and air transport, all integrated into competent support organizations.

b. Logistical organizations are limited in mobility and organic transportation, particularly air transport.

Dedicated air transport will be essential for the conduct of urgent logistical missions and functions in northern operations. In the absence of air transport organic to the logistical units, the tactical unit (customer) must provide transportation on a case by case basis, which may detract from the tactical unit's mission. Priority air transportation provided by the Air Force may be responsive in terms of days on highest priorities when response in terms of hours is required.

Section II. PLANNING

4-4. General

Success in combat operations in undeveloped northern areas is dependent on adequate support plans. Every command decision must include full consideration to resources and their accessibility.

a. A task force commander is directly responsible for administrative as well as tactical control of certain logistic elements which in conventional situations operate under higher echelon control. The integration of these elements into his force increases command and control requirements. Normally it is desirable for the commander to delegate control of all support operations within the task force to a senior subordinate.

b. A force should not move out in northern operations until adequate support plans have been developed. With realistic support plans, the commander can fight in response to the tactical situation as it may develop. If the support, as planned, breaks down in the course of the operation the tactical operation may not succeed.

c. Development of an adequate support plan requires the commander's close personal attention, as well as the participation of the operations and logistics staffs. In a cross-country movement, the operations officer and the logistics officer must formulate concepts and prepare detailed plans jointly and concurrently. The operations officer must understand and accept the limitations of logistic capabilities.

d. Troops committed to northern operations on short notice will frequently be faced with the problem of familiarizing themselves with special items of equipment. Training in the methods of exploiting such specialized equipment to secure the maximum combat capability from its use is essential.

4-5. Requirements Planning

a. Requirements planning begins with the first stage of operational planning; the lead time required to obtain and issue special equipment establishes a minimum time within which an operation can be mounted. Nonmilitary local supply sources can be exploited, in some easels, to acquire certain specialized items and thereby reduce requirements lead time.

b. Special equipment is required to afford the combat force adquate mobility and environmental protection. General equipment requirements for northern operations are stated in common tables of allowances (CTA). In addition to CTA authorizations, all equipment requirements must be determined

for each operation according to the terrain, weather, nature of the operations, and planned duration of the operation. In most northern areas, consideration must be given particularly to requirements for cross-country transport for all elements of the combat force and direct support activities.

c. Equipment requirements vary seasonally. Therefore, requirements planning is a continuing activity for planning staffs. Long advance projection of requirements is necessary to insure ordering and delivery of special equipment, since northern areas are usually poorly served by strategic water transport and large volume deliveries depend upon seasonal shipping.

d. The logistics staff should prepare and keep current a control record of all equipment and support resources under its control and responsive to its requirements. This is particularly necessary when a force is new to northern operations, for, in the absence of such a formal record, important capabilities may be overlooked.

e. Special items of supplies and personal equipment will be limited to those required by the terrain and environmental conditions.

f. A variety of special organizational equipment will be necessary. Certain of these items, depending on the area of operations and weather conditions to be encountered, will be indispensable.

(1) During summer, mosquito netting or screens and aerosol-type insecticides will be necessary to provide mosquito and fly-proof enclosures for sleeping, eating, and administrative duties. Boats, outboard motors, and low ground pressure floatable vehicles for negotiating rivers, lakes, and marsh areas can be utilized to good advantage to provide transportation for personnel and critical supplies.

(2) In the winter season, the extreme cold weather makes it imperative that the organization have on hand a variety of special equipment.

(*a*) The special equipment required for small unit living during the winter season will depend on the depth and characteristics of the snow, extent of vegetation, and other terrain and climatic conditions. It can be expected that most of the following items will be needed; tents, tent stoves, 200 pound capacity sleds (ahkios), machetes, saws, axes, shovels, repair parts, and bindings.

(*b*) At company, battalion, and bridge level, there is a need for additional items such as ski-wax, pine tar, or lacquer (for sealing ski running surfaces), pickmattocks, shovels, tent stoves with repair parts, ice augers, iron wire for lashing, nails, insulated food containers, power saws, ice saws, extra skis, ski poles, and climbers, extra gloves and mittens, tent repair kits, casualty evacuation bags, sleeping bags, rope, spare snowshoes, auxiliary cold-starting aids (slave kits), air duct heaters, battery chargers, antifreeze compounds, special cold weather hydraulic fluids, cold weather lubricants, cold weather batteries, cargo sleds,

and low ground pressure vehicles. Special equipment required for operations in mountainous areas is described in FM 31-72.

(*c*) The extra equipment required for heat and shelter including the clothing each man wears, must be kept within limits, but the soldier must never be separated from his existence load. Special means should be provided for transporting the group equipment, to allow each man maximum freedom of action during combat and on the march. This might take the form of tracked cargo carriers or tractors drawing sleds. This transport must operate closely enough to the forward elements to deliver tents, stoves, fuel, and food each night or whenever a long halt is made.

(*d*) In general, it can be expected that increased stocks of repair parts and cold weather lubricants will be needed for all equipment exposed to extreme cold, with the greatest increase occurring with those parts dependent on lubrication for long life. Extreme cold weather reduces the efficiency of lubricants, puts a heavy drain on batteries, results in many materials becoming brittle, and restricts the amount of maintenance that can be accomplished in the open.

(*e*) For operations in extreme cold, maintenance and other combat service support activities require heated shelters, and the continued efficiency of all personnel depends on being able to get into a warm shelter frequently. Accordingly, some type of heated shelter must be planned for all echelons. Mobility will be restricted by the necessity of transporting shelters, stoves, and fuel; however, the proper types and amount of such equipment will sufficiently increase the efficiency of the command to justify its transportation.

(*f*) Maintenance operations during cold weather requires that increased time be allowed for operator and organizational maintenance. Experience indicates that a multiple of five times the normal time is required.

4-6. Mobility Planning

a. For relatively small forces, construction of an MSR is uneconomical and, by tending to tie support elements to a fixed route, increases vulnerability to enemy behind-the-lines activity. Accordingly, where cross-country transport is available in sufficient quantity, the support plan provides for cross-country movement of the entire force, with exploitation of air resupply to augment the ground cross-country line of communication. Wheeled transport represents a valuable and familiar resource with which the average force is reluctant to dispense. However, since employment of wheeled vehicles in a cross-country movement normally requires roadbuilding, the diversion of effort to road building ordinarily offsets the gain from the use of wheeled transport.

b. Cross-country transport vehicles and aircraft are employed to transport supplies and essential

maintenance services to give the task force the maximum possible self-sustaining capability in the cross-country operation. Nonessential items are left behind and all elements of the force are stripped of equipment that reduces mobility.

c. Plans provide generally for use of the most efficient and economical support capabilities before premium methods are used.

d. Army aviation is employed to supplement ground transport and is used freely when such use results in net economy in effort. For example, the use of helicopters to deliver daily ration issue to forward rifle companies frequently effects a major saving in effort for the battalion. The use of helicopters to return empty fuel containers for refilling materially reduces turnaround time and increases the availability of the fuel.

e. Natural waterways may be used during summer seasons for logistic movements.

(1) Powered boats with shallow draft are employed for both troop transport and supply movements in upstream areas. Near the mouths of large rivers, conventional ship-to-shore lighterage may be used effectively for support of task forces. Long distance bulk river transportation equipment of conventional commercial design may be employed effectively.

(2) Most northern rivers are not improved. Use of natural waterways for logistic support movements requires relatively extensive effort for the location of channels and installation of navigation aids. Successful stream navigation requires a detailed knowledge of local conditions by the lead pilot.

(3) When a river line of communication is established, cross-country supply handling and ground transport equipment must be provided, to move supplies from the river bank to the supported force. Effective movement control procedures must be established to insure coordination between waterborne and ground transport equipment. To avoid development of position-betraying logistic complexes at riverside, installations are located some distance from the river bank and unloading points for river transport equipment are moved frequently.

f. During the winter, frozen river surfaces are not always dependable routes of movement. Surface ice thickness varies according to local conditions, including river depth and velocity, the existence of hot springs, range and previous duration of low temperatures, and other factors. In addition, ice movement makes the surface extremely rough and broken in many places. With careful reconnaissance, frozen river surfaces may be used for local vehicle movements and for river crossings. However, during the cold season, it is generally preferable to establish ground routes following the most favorable terrain in river valleys.

g. Successful distribution in northern operations depends upon effective and comprehensive coordination of transport means and supply planning. It is essential that logistic and operational planners be informed

at all times of the location and load of all supply transport, of supplies available and planned for lift, and of projected operational support needs. The general support activity maintains a central record of all air and ground transport committed between general support supply points and the supported force. Within the task force, all transport, regardless of organizational assignment, is centrally coordinated.

h. Logistical mobility can be improved effectively under special conditions by propositioning supplies by air or inland waterways to be picked up by ground elements arriving overland. Airdrop and air landing techniques can be used as appropriate.

4-7. Rear Area Security Planning (See FM 31-85)

a. The independent task force is responsible for its own rear area. The independent force in cross-country operations does not have a continuous rear zone through which support can move under friendly control and protection. Elements left behind the main body are vulnerable to the guerrilla forces which are characteristic of undeveloped area operations. As the independent force moves, it moves with all associated activities, including the direct support element, keeping the support tail well tucked in at all times. The task force tactical plan provides for all-around protection of the task force perimeter.

b. Specific provisions are made for local defense of each logistic complex, including field trains and the direct support element. All personnel in rear areas are armed and integrated into the local defense plan. Defense plans include provisions for blocking airstrips and other cleared and open areas against helicopter and airborne landings. Support elements not prepared psychologically and by training to defend themselves are highly vulnerable to enemy attack. Support units prepared to defend themselves can withstand helicopter-borne and airborne attack effectively. Air mobile and/or air cavalry units can be used as rear area security reaction forces.

c. Logistical units normally are staffed for operation on a 12-hour day basis with each man being assigned to a logistical mission task as a primary duty. These personnel are capable of fighting as infantry when required. Experience has shown however, that when such units are required to man perimeter defenses on a continual basis during calm periods and/or for extended periods of high intensity harassment productive mission output of the unit is severely reduced or halted. Manpower requirements for defense such as l-man during daylight hours and 3-men at night per perimeter defense position generally exceeds acceptable mission manpower losses. During periods of high intensity conflict involving logistical units, all mission accomplishment is halted. The use of combat troops in perimeter defense may be more economical than utilization of logistical troops. Primary defenses of a logistical area should be manned by combat troops with secondary backup by logistical units.

d. When high intensity conditions are anticipated in a task force rear area, logistical units may become a liability rather than an asset to the separate task force. Under such conditions, logistical functions are better accomplished by direct user resupply from secure rear areas.

4-8. Low Visibility Operations

Logistic forces must be trained to perform mission tasks at night, in fog, snowstorms, and similar conditions.

Section III. ORGANIZATION FOR LOGISTIC SUPPORT

4-9. General

a. Organization.

(1) When major units are employed, the normal logistic support organization is employed. Logistic operations in northern areas differ from temperate zone operations only in the techniques of adaptation to the environment.

(2) When brigade or smaller task forces are employed independently, general support is provided on an area basis and direct support is provided by an independent support battalion or mobile direct support elements tailored to fit the size of the force.

b. Direct Support. For the purposes of northern operations, direct support is that support, over and above organic capabilities of a combat unit, which must be rendered in the immediate vicinity of the unit, to provide extended combat endurance in independent operations.

c. General Support. For the purposes of northern operations, general support includes all support other than direct support.

4-10. The Northern Theater

a. In a northern theater, under combat conditions, the same requirement for force economy that limits combat force strength limits administrative resources. Organic combat service support forces usually are not sufficient to provide conventional support organization. The effort to follow conventional patterns or fixed depot complex and line of communication structures would lead in a small theater, to a serious disproportion between combat and support strengths. A small theater can be described as small in area, units, operations, or a combination of all three. To avoid such disproportion, economy in organization is promoted by functionalization. The most economical and responsive transport means are employed to reduce the requirement for storage at multiple locations. Maintenance is performed in place so far as is practicable and cannibalization and washout procedures are exploited to reduce uneconomical long distance evacuation of equipment for maintenance.

b. The theater is organized with the fewest possible echelons of control. In the simplest configuration, which is typical for a small theater, a distinct communications zone is not organized. The combat service support organization consists of the mobile direct support elements supporting task forces and a general support organization which provides--

(1) Combat service support to task forces and other units located within their areas of responsibility.

(2) General transportation services including transportation movements management, and when available, line-haul motor, rail, and inland waterway transport, cross-country bulk carriers, logistic air transport, including Army air transport, mode transfer points, and surface and air terminals.

(3) A combat service support headquarters directly under the theater Army commander.

c. The theater support organization includes functionalized supply, maintenance, and service headquarters:

(1) The theater support headquarters--

(*a*) Exercises tactical and technical control over assigned and attached combat service and combat units.

(*b*) Provides the theater Army logistic organization which, in addition to other functions, plans for and participates in joint and combined logistic operations at the joint and combined command levels.

(*c*) Maintains central theater logistic records by mobile ADPS systems and maintains logistic communications with CONUS or supporting major oversea command by electronic data links.

(*d*) Performs civil affairs functions within the theater Army area, except those functions performed by tactical unit commanders within their areas of combat operations.

(2) The theater support organization establishes supply handling areas in the vicinity of ports and establishes the minimum necessary number of area general support complexes, each complex consisting of supply storage and issue, maintenance, medical, and other essential services. Storage is planned so that the loss of any one area to nuclear attack will not result in loss of total stocks of any critical commodity.

(3) Storage and transportation of Class V, except special ammunition, are integrated into the established general supply system. Responsive transport is exploited to assure effective supply support without the conventional echeloned supply system.

(4) The theater support organization establishes and provides general transportation services for movement of supplies and personnel and for medical evacuation.

(5) Since the combat and support forces are widely separated within the theater, the theater Army controls only those areas which are actually occupied by friendly forces. Intervening spaces are uncontrolled and must be regarded as accessible to enemy elements. The combat service support organization is responsible for security of its own elements, including line of communication elements, moving through uncontrolled ground space and in addition may be assigned responsibility for stability operations. To assist combat service support elements in providing local and area security, separate combat or MP battalions may be assigned to the theater support organizations.

(6) Due consideration for protection of logistic elements from enemy air attack must be reflected in air defense planning. Local air defense capabilities are included in handling areas in the vicinity of ports and establishes the organizations.

d. The small northern theater normally involves air and naval elements as well as ground components. The ground force combat service support headquarters participates in joint planning and support of joint operations and usually is responsible for provision of certain common service and cross-service support to the other components.

e. The requirements for performance of the full range of theater combat service support functions and joint staff and support functions with a small staff and limited resources place on the combat service support headquarters unusually severe demands for ingenuity, effectiveness, and economy of effort. Combat service support of the small separate theater is one of the most difficult of Army support problems.

4-11. Direct Support

a. Direct support to the brigade normally is provided by division support command elements in the brigade trains area. These elements are selected supply, medical, and maintenance elements of the division support command charged with providing logistical support to the brigades and to other divisional units. These units are provided for support to each committed brigade and for area support and division units operating in the brigade area.

b. The division support command elements in the brigade trains area normally consists of the following:

(1) A forward support company of the maintenance battalion with teams from the aircraft maintenance company.

(2) A medical company from the division medical battalion. This company normally establishes and operates a clearing station and also provides medical evacuation from the combat battalion aid stations and provides for the medical supply requirements of the brigade.

(3) A forward supply section of the supply and service company. This section operates one distribution point for Class III supplies and one for Class I, II, IV and VII.

c. The division support command elements normally operate under the control of the support command commander. However, when the brigade is organized for independent or semi-independent operations the direct support elements normally are attached to the brigade.

d. For additional information on the organization and operation of the division support command, see FM 54-2.

e. Direct support to separate independent bridges normally is provided by an attached or assigned support battalion. This battalion contains the direct support elements necessary to support the brigade in independent operations, and closely parallels the elements provided by the division support command to divisional brigades.

4-12. General Support

a. General support functions in support of brigade forces are performed by general support units in the Army service area.

b. General support activities in support of cross-country operations are established at points accessible to line haul transportation. Line haul transportation may be provided by rail, highway, inland waterways, airlift, and cross-country trains.

c. General support activities are organized under general support organizations. These organizations include supply, maintenance, and service elements to include medical evacuation and hospitalization capabilities; hold sufficient stockages to support the projected operations, with due consideration to local replenishment cycles, time and distance factors, and seasonal resupply considerations; have the capability to operate lines of communication to direct support elements cross country by land and Army air.

4-13. Selection and Layout of Support Organization Sites

a. The site selected for location of the support organization should be one that facilitates logistical support by road, air, water, and rail, where available. If not available, cross-country means of transportation should be used. The site should also be conveniently near the units which will be supported. Cities and villages in the northern region may be so located or afford such housing facilities as to warrant their selection. Consideration should be given to the use of such existing structures to decrease tonnage and construction time. The following additional factors are considered in the location of a support organization:

(1) Proximity to a stream or lake. Some streams and deep lakes remain open even in extremely low temperatures and, when frozen, their ice yields more water than snow per unit volume. Avoid

locating sites on flat ground in the immediate vicinity of northern streams as their courses frequently change and seasonal floods are common.

(2) Proximity to local source of fuel for heating purposes.

(3) Downwind side of hills and part way up the slope. Cold air flows to the bottom of valleys in calm weather. The area selected must be free of danger from avalanches.

(4) Terrain which lends itself to defense.

(5) Good soil conditions (rock, sand, or gravel) to minimize unfavorable effects of permafrost.

(6) Timbered areas. Timber affords concealment and wind break and may be used as a source of fuel, material for construction, and bedding.

(7) Proximity to fixed communications facilities for entrance to long distance communications service.

(8) Area of sufficient size to allow proper dispersion.

(9) Proximity to terrain suitable for establishment of an all season airstrip.

b. The loop system is used for the layout of the site to provide turn arounds and prevent congestion along the MSR. An advance party equipped with a bulldozer is essential to prepare an area for displacement of support elements, especially during the winter months. When preparing the area, consideration should be given to the location of installations. The most active installations should be located near the entrance of the site to reduce the amount of through traffic.

c. All semipermanent installations must have the essentials for survival--sleeping bags, emergency rations, fuel, medical supplies, and communication dispersed in two or more locations so that a single catastrophic fire or explosion will not destroy all available resources.

d. The installation of a headquarters can present more than normal problems. Limited or non-existing roadnets, lack of built up areas, and the extreme difficulty in concealing major installations far removed from civilized areas are major factors. A more detailed reconnaissance is necessary and engineer support is required to enable physical occupation. A good deception plan, well executed, offers a greater measure of security than attempts to completely camouflage a major installation in undeveloped areas. The effects of terrain and limited roadnets, combined with the requirement for passive security measures may dictate a greater dispersal of activities within the installation.

Section IV. MATERIEL AND SERVICES

4-14. Levels

a. At general support activities, supporting independent task forces on an area basis, stocks are maintained at levels sufficient to assure continued support in the event of interruption of line haul transportation. Generally 7 to 10 days stocks are maintained at general support organizations. These need not be kept at one place but should be dispersed in consonance with security and projected deployment of supported forces.

b. Direct support element stockage includes from one to two days supply of Class I for the supported force, in addition to the basic load for direct support elements; not less than one day of Class III; and one or more days of Class V for the supported force.

(1) Up to approximately 3 days of supply of selected fast-moving Class II items are held by the direct support element.

(2) Class IX repair parts are held by maintenance elements on the basis of the authorized stockage list (ASL) and the prescribed load list (PLL), with due consideration for the nature of the operations supported, weather conditions, the degree of mobility of supported and supporting elements, and order and shipping time from general support elements. Minimum stocks of major assemblies are held by direct support maintenance elements. To avoid increasing the maintenance unit load so far as to reduce mobility, primary reliance for supply of major assemblies is placed on rapid release and movement of these items from the general support organization.

(3) In general, for communications-electronics materiel, organizational, direct support, and general support levels when operating with or in support of independent task forces in locations remote from line haul must rely on larger stocks of minor components, subassemblies, and maintenance float of smaller end items. The black box exchange approach and replacement by resupply should be used as far as possible in the forward areas. Stocks of repair parts and attempts at detailed repair in forward areas should be minimized. Unserviceable components, subassemblies, and maintenance floats should be exchanged directly at general support in secure rear areas. In most instances all of these transactions must be accomplished by direct air transport from general support to direct support or user. Major items such as surveillance and counter mortar radars and other sophisticated C-E items must be available in rear areas for immediate onsite replacement in the forward area. Due to the urgency of requirements and the sensitivity of C-E items to damage during overland transportation, dedicated helicopter transportation on a full time basis is essential to the logistical organization.

(4) In establishing the Class III day of supply, consideration is given to the greatly increased POL consumption in northern winter operations which results from the requirement for space heating, warmup of equipment, topping-off fuel tanks prior to an operation, and the greater distance traveled by all elements in dispersed operations.

(5) Maintenance float items of major equipment are held at the direct support element.

(6) Class IV construction materials and bridging are held at the direct support element only if there is the prospect of an early requirement. Such materials are brought forward from the general support organization when the need for them is apparent. Care is exercised to avoid bringing up construction materials without firm plans for employment and thereby wasting transport and exposing valuable assets to loss.

4-15. Storage

a. During summer seasons, well-drained ground is selected for storage sites.

b. Winter storage.

(1) All supplies stored in the open should be stacked on pallets or dunnage to prevent freezing to the ground. Stacks should be located to minimize the effects of drifting snow. Supplies stored in open areas which may be subjected to drifting snow must be marked with poles and small flags, since a single storm may bury all visible marks in the snow. Any extensive dumps should be accurately surveyed from nonobliterable landmarks, so that snowplows or blades removing snow do not run over and damage materials buried by the snow. Waste and salvage dumps must likewise be well identified by marking, survey, and recording.

(2) CONEX containers may be used for rations requiring protection from weather but not requiring heated storage.

(3) Nonperishable rations may be stored without heat during the winter but at interseasonable periods may be damaged by repeated freezing and thawing.

(4) Liquids not subject to damage by freezing are packaged in metal containers.

(5) Medical supplies, special fuzes, batteries, and other items subject to damage by freezing are stocked in heated shelter, for this purpose tentage warmed by high BTU blower-type heaters may be employed.

(6) Gasoline and diesel fuel may be stored in flexible containers at low temperatures, although the containers cannot be moved easily and are subject to damage from handling at temperatures below -30ºF. At extremely low temperatures flexible containers and hoses become brittle and break easily. If the container or hose breaks allowing spillage on an individual, instant frostbite could result.

c. Mobile direct support stocks, including Class V, are held on mobile storage vehicles. Stocks, including

spare parts, may be transported in CONEX containers, which afford good environmental protection. Class I and Class V stocks are utilized on pallets and the mobile direct support element is provided with tough terrain forklifts to facilitate handling of utilized and containerized supplies. Mobile direct support Class III stocks are held in flexible tankage so far as is possible. POL also may be stored and distributed in 600-gallon skid-mounted tanks equipped with powered or hand pumps. Drums are used only when more efficient methods are not available. Resupply movements of heavy tonnage commodities are managed between the general support and direct support activities so as to take maximum advantage of intransit loads for backup stocks instead of tying up transport and supplies in static on-vehicle loads at the direct support element.

4-16. Distribution

a. When the battle area consists of several areas controlled by independent combat elements, operating with little or no mutual support, the zones between these controlled areas are uncontrolled and must be regarded as equally accessible to friendly and enemy elements. Accordingly, the normal echeloning of supply points is infeasible for support of independent task forces in northern operations. Stocks must be held at a general support supply point or in mobile storage by the general support organization.

b. Unit distribution is the preferred method for all deliveries from general support to direct support elements and, so far as is practicable from direct support elements to trains of supported battalions. Air delivery direct from general support organization to using unit, bypassing direct support elements and battalion trains, is often practicable and in such cases is economical of time and effort.

c. The distribution system utilizes all available means of transport for essential movements. Loads are consolidated for forward movement. Loaded vehicles are routed through to the farthest forward breakdown point. As far as impractical, loaded vehicles and containers are exchanged for empties at the point of use and empties are moved to the rear by the earliest available transport. Prompt return of empty containers, with particular emphasis on POL containers, is essential to prevent interruption of the distribution operation; a continuing forward flow of containers, without effective return of empties, will soon exhaust resupply capabilities. When part of the MSR utilizes roads on which wheeled vehicles are employed, rendezvous points are established for transfer of loads from wheeled to tracked transport. To reduce labor at the transfer point and throughout the distribution system, supplies are palletized or containerized and held in unitized packages as far forward as possible. Cross-country materials handling equipment (MHE) capable of handling utilized loads is provided to the task force. Emergency resupply deliveries to the task force and medical evacuation from direct support element clearing stations is accomplished by Army aircraft controlled by the general support organization. All transport capabilities are centrally coordinated within the general support organization and the independent task force.

4-17. General Maintenance

a. Maintenance in northern areas consumes a high proportion of the total attention of any force. Factors tending to increase maintenance requirements include the long distances over which operations are

conducted; the heavy strain of cross-country movement on all equipment; the lack of railroads which throws a major part of the line of communication task on vehicular transport; the need for increased quantities and additional types of equipment to provide environmental protection and cross-country mobility; and the general effect of environmental factors in making all activities slower and more difficult.

b. (1) The difficulty in carrying out physical activities in cold weather demands continuing emphasis on the performance of organizational maintenance. Failure to accomplish organizational maintenance throws an additional burden on field maintenance capabilities, which jeopardizes accomplishment of the field maintenance mission and with it the mission of the supported force. It is impossible to provide enough field maintenance support to make up for uncorrected and cumulative deficiencies in the organization maintenance area.

(2) To insure proper performance of organizational maintenance, competent training and constant command supervision are essential. Training literature is adequate but must be used.

(3) Vigorous supervision of organizational maintenance is the most effective means available to the combat commander to insure sustained operational effectiveness of his unit.

(4) The operator is the first line of defense against deteriorating equipment. Operators can assist the maintenance program by detecting and reporting the majority of equipment failures. By utilizing the operators manual and performing the required checks and services, the equipment will be maintained in the best possible condition.

c. Maintenance emphasizes onsite repair by maintenance contact teams. Maintenance contact teams must be equipped with light cross-country vehicles and portable heaters. Controlled cannibalization may be authorized to reduce the number of items evacuated from the task force and to keep the maximum possible number of items operational. Generally it is infeasible to carry much maintenance float equipment at the direct support level, although a small number of communications items may be an exception to the rule. Primary emphasis is placed on keeping authorized equipment operational, and using maintenance float items only in case of complete loss of an operational item.

d. Direct support maintenance relies upon the effective utilization of skilled maintenance personnel and the timely supply of critical repair parts.

e. Aviation maintenance is performed at each echelon. The general support organization provides contact teams for spot repairs in forward areas as necessary.

f. TM 9-207 lists detailed information on lubrication, operation, and maintenance techniques.

g. Adequately heated buildings or shelters must be provided for cold weather maintenance. Proper and satisfactory servicing is difficult unless personnel are working in temperatures that are reasonably

comfortable. Maintenance of many components requires careful and precise servicing. The hands of the mechanic cannot be encumbered with bulky gloves when he is working. Unless sufficient heat is provided, maintenance will suffer. Heat is furnished by various means, chiefly the portable duct heaters. Without the use of heaters and external heating equipment, the increase in maintenance man-hours will be from 25 percent to 200 percent above normal requirements.

h. When buildings are not available a large tent is a temporary expedient. Wooden flooring should be laid inside the tents, and, if possible, in all maintenance shelters where men are working. A portable canvas shelter that can be used for a windbreak or protection from snow will facilitate maintenance under adverse conditions. The shelter should be heated by an oil or gasoline stove and illuminated by an extension cord or "trouble-light." Even if the shelter cannot be put over the equipment being worked on, it can provide a warmup place for maintenance personnel. Tarpaulins of various sizes can be utilized as a windbreak. Tarpaulins can be supported on a framework of poles erected around a vehicle and used as a backup for heat provided by a space heater.

4-18. Vehicle Operation and Maintenance

a. General. The use, maintenance, and repair of equipment in winter operations in the north establish the need for skill and forceful leadership. The commander who can maintain mobility in extremely low temperatures will often have a decisive advantage. Part of this mobility is gained by the use of low ground pressure vehicles for the movement of combat troops and accompanying supplies. This will generate a requirement for sufficient logistical backup to support operations over a dispersed area.

b. Vehicle Operations.

(1) In extremely low temperatures, vehicles must be operated periodically to prevent cold soaking of engines and power trains. This requirement makes surprise and concealment extremely difficult.

(2) In offensive operations, direct support units will be located in rear areas and will be engaged primarily in rehabilitation of damaged equipment. Normally, recovery and on site repair by forward contact teams will be exploited to the maximum extent. Recovery capability of direct support units must be increased due to the effects of heavy snow, extensive muskeg areas, unpredictable weather, and a limited road net.

(3) In defensive operations, ordnance support is forward with supported units on maintenance assistance and resupply missions.

(4) Technical intelligence of enemy ordnance takes on added importance in northern winter operations for comparing movement capability of opposing forces.

c. Vehicle Maintenance.

(1) The installation, maintenance, and repair of engine preheater and personnel heaters installed on vehicles for cold weather operations, as well as the changeover to arctic lubricants, requires many man-hours. Low temperatures, with resulting lowering of the lubricants, efficiency and increased brittleness of some materials, add greatly to repair requirements throughout the winter.

(2) Every element of equipment used in northern winter operations is affected by the cold and must be maintained in the best possible mechanical condition. All equipment must be completely winterized in accordance with the equipment lubrication order (LO) and TM 9-207. Adequate maintenance shelters are necessary and a larger number of experienced maintenance personnel must be available than are normally provided by staffing guide. Efficiency of the individual and equipment varies directly with the temperature. It may become extremely difficult, due to lack of facilities, for units to perform organizational maintenance when egaged in combat operations. Under these conditions, the maintenance officer must recommend to the commander ways and means of solving the preventive maintenance problems.

(3) Some of the maintenance problems can be solved by--

(*a*) Advising using units on the use of proper lubricants for each piece of equipment. It is important to instruct units to lubricate vehicles immediately after operations. At that time, working parts are warm and maximum penetration of lubricants will result.

(*b*) So far as is possible, keeping optical instruments from sudden and extreme changes in temperatures.

(*c*) Keeping chains, shovels, and saws with all vehicles.

(*d*) Keeping batteries warm and fully charged.

(*e*) Adding ½-pint of denatured alcohol to each 10-gallons off fuel at time of filling.

(*f*) Keeping stored lubricants warm.

(*g*) Machine surfaces corrode rapidly in cold weather, therefore they must be kept clean at all times.

(*h*) Keeping condensation down. Fuel tanks, fuel lines, crankcases, and even engines are subject to icing up.

(*i*) Training personnel to recognize the differences between temperate and cold weather operation. Operators should learn that:

1. Linkages are stiff and should not be forced.

2. Windshields crack easily when subjected to sudden blasts of warm air or water.

3. Vital spots or portions of equipment affected by cold should be kept undercover.

4. Operators should be completely familiar with the cold weather portion of their operators technical manual.

5. Lubrication should be applied according to the temperature range of the equipment lubrication order.

(4) Using units must perform required maintenance if the capability of supporting ordnance is not to be exceeded. In extreme cold, the consideration of performing on site field maintenance on disabled equipment is balanced against available shelter or the possibility of erecting shelter at the site.

(5) Condensation of moisture inside of fuel tanks can be minimized by refilling fuel tanks immediately after stopping for the night.

(6) To prevent brakes from freezing, the wheels should be chocked instead of setting the hand brake.

(7) Check daily for water or antifreeze solution in crankcase oil. If fuel or water contamination is found, change the oil; if antifreeze contamination is found, do not operate the vehicle until cause is determined.

(8) Park on timber, brush, or any material that will keep tires off the ice, puddles, or snow, otherwise the tires may freeze to the surface. Always keep tire stems capped.

(9) Never operate equipment in a closed area because of the possibility of carbon monoxide buildup.

4-19. Service

a. Differences in service techniques required by northern latitudes include the following:

(1) Precautions are required to keep snow out of gasoline and fuel oil during decanting and other handling operations.

(2) Recovery of damaged or abandoned items of equipment must be accomplished immediately to

prevent covering by snow or becoming inaccessible in muskeg areas after the spring thaw.

b. Materiel handling equipment must be operated with the same cold weather precautions as are other gasoline powered items of equipment. Bath and laundry units should be established immediately adjacent to rivers or lakes to reduce the problem of the water freezing between the source of supply and the water heater and to facilitate disposal of the waste water. Since these facilities are not always within reasonable distances of major units, their equipment authorization should provide them with organic capability for displacement, organization of area, and resupply.

c. Recovery and evacuation of remains must be accomplished expeditiously to prevent them from being lost by snow cover.

4-20. Supply

a. Clothing and Equipment. Requirements exist for many different items of clothing in northern areas. These include waterproof and water-and-wind repellent outer garments, insulated footwear, and hand, body, and headgear designed on the layer principle for protection during extremes in temperatures. CTA 60-915 will serve as a guide in determining the types and amounts of clothing best suited for particular areas and seasons. Five-man and 10-man tents, Yukon stoves, and arctic sleeping bags are provided for use by troops in the field. The stoves are designed to burn petroleum products, wood, or coal. Air duct heaters--250,000 BTU or 400,000 BTU are provided to heat large areas such as maintenance shelters or field hospital facilities. These heaters are either gasoline or electrically operated; both types are standard.

b. Subsistence.

(1) Subfreezing temperatures will involve changes in the amounts, types, storage, preparation, and distribution of foods. Rations must be of a type not susceptible to damage by freezing, or else heated transportation and storage space must be provided.

(2) Given free choice of unlimited amount of foods of all types, the normal individual operating in extreme cold continues to consume proteins, carbohydrates, and fats in approximately the same ratio as in temperate climates. Fats and carbohydrates are quick energy-producing foods. An ounce of beef fat contains more calories than the same weight in sugar, but a greatly increased intake of fat cannot be tolerated by the normal individual unless accompanied by a corresponding increase in lean meat. Operations on a sustained basis in a mountainous terrain will require greater amounts of food due to the increased physical demands being made on the body (AR 40-25).

(3) Outdoor activity in extreme cold results in body dehydration. Abnormal amounts of thirst-provoking foods should be avoided, both for comfort and logistical reasons. Hot drinks serve not only to quench thirst and correct fluid deficiency but also to transfer heat physically to the body.

(4) Individuals should avoid eating frozen food because of the fact that more energy is used up by

trying to digest frozen food than heated food.

c. POL Supplies.

(1) The increased amount of cross-country movement and extensive use of tracked vehicles with high fuel consumption characteristics must be considered when planning POL requirements for northern operations (FM 101-10-1). The normal type of military issue gasoline used in the temperate zones is not satisfactory for use in extreme cold. MIL-G-3056 Type II, Combat Gasoline, should be used. Diesel engines should use DF-1 or DF-A of Spec. VVF- 800-A. Alcohol for addition to fuel used in motors is absolutely required. Wherever possible, vehicle fuel tanks should be kept filled to decrease condensation. When gasoline is used for space heating, the requirements will increase as temperatures go down.

(2) The use of standby engine heaters, vehicle cab heaters, and the added percentage of time vehicles are operated in the lower gear ratios when operating cross country in wet ground or deep snow add to the consumption rate of gasoline. Fuel oil used for space heating must be of the lightest grade obtainable (Diesel Fuel, DF-1 or DF-A of Spec. WF-800a) to insure that it remains fluid at temperatures below -40ºF.

(3) Special cold weather type oils and greases which remain fluid in extreme cold are required for northern winter operations. These special oils and greases range from extremely light oil for lubrication of instruments to wheel bearing grease. Instructions given in the lubrication order (LO) for each vehicle should be followed. TM 9-207 authorizes and prescribes products for use in wheeled and track-laying vehicles which operate in northern climates where temperatures are anticipated to be consistently below 0ºF. Nomenclature and specification number are given for each product. TM 9-207 also prescribes general instructions that apply to the processing of wheeled and track-laying vehicles for northern winter operations.

(4) The necessity for a complete change of all lubricants in vehicles and the changing of lubricants, hydraulic, and recoil fluids in artillery and other equipment at the approach of cold weather will require unusual amounts of this type of supplies. The low viscosity of motor oils used during cold weather results in higher consumption rates because of oil escaping past piston rings and oil seals. Lubrication and oil changes must be made more frequently.

(5) Permanent, Arctic Grade (-90) antifreeze compound will be used as prescribed in TM 9-207.

Section V. MEDICAL SUPPORT

4-21. General

a. The operation of medical field units in northern operations is basically no different than operation in

more temperate zones with the following exceptions:

(1) Medical units which are intended to be highly mobile should use the Tent, GP, Small, in preference to the larger and heavier general purpose tents.

(2) A means of providing heat in the tents by a nonexposed flame type heater is necessary in patient areas where oxygen or anesthetics are being administered, i. e., ducted, forced air heaters.

(3) The surgeon cannot depend on using existing school houses, office buildings, and similar structures to house hospitals in northern latitudes. Generally housing is inadequate or nonexistent.

(4) In the forward areas under winter conditions, plans for medical evacuation must provide means for keeping patients warm during the process of evacuation. Special evacuation bags and heating devices or heated tracked vehicles to be used as ambulances area necessity.

(5) Increased numbers of personnel to pull sleds for patient evacuation are required for forward elements when operating in deep snow and extreme cold.

(6) Medical supplies susceptible to damage from freezing must be stored in heated shelter. Under conditions of extreme cold, liquid, whole blood, or blood expanders can be administered only in heated shelters.

b. Medical officers and aidmen with good physical stamina are essential to successful medical operations. Extensive first aid and self aid training for all personnel in combat units is necessary.

4-22. Medical Units

a. Division level health services should be available in the brigade combat trains to provide backup medical support to the aid station. This element must be equipped with appropriate radios in order to communicate with air ambulances. Also, this element should be provided vehicles that have an equivalent mobility to the units supported. The medical element should be provided with an X-ray unit and film processing equipment to eliminate the necessity of evacuating all sprains as possible fractures.

b. The size of the task force and the type of combat operation will influence the bed requirements and the type hospital units best suited to support the force. The hospital should be housed in tents, frame type, sectional unless better housing is available. Tents, GP, Medium, with liner, may be used when necessary. Flooring is considered mandatory. Water trailers should be kept in heated areas or provided with heater units to prevent freezing.

4-23. Evacuation

a. Small units operating as independent task force elements in northern operations should establish a

relatively short holding period for patients because the adverse environmental conditions make it exceedingly difficult to provide extensive definitive care over an extended period. The patient holding period at unit level may vary from 1 to 3 days, subject to change by the unit surgeon as the tactical situation dictates. Unit medical support must maintain mobility equal to units being supported.

b. The general nature of the northern area terrain makes surface evacuation of patients difficult in winter and virtually impossible in summer. The lack of adequate roadnets and the military necessity of moving supplies over the same route greatly restrict patient evacuation.

c. The most practical means of patient movement is by helicopter. The task force surgeon normally will be provided with adequate air ambulance support for evacuation within the task force area of operations. Air medical evacuation is the primary means of evacuation outside of the task force area. Aircraft, resupplying the task force can be used to carry patients on the return trip.

d. Evacuation of walking wounded becomes a problem in northern environments where there are no prominent terrain features for personnel to follow to the battalion aid station. Snowstorms, fog, and clouds further hamper the movement of wounded personnel by limiting the visibility to that area within a few feet of the individual. If, however, walking wounded must be evacuated by foot, groups of no less than two individuals should be sent to the battalion aid station.

4-24. Hospitalization

Method of determining bed requirements for the task force is basically as appears in FM 8-55. The dispersion allowance for hospitals operational in northern areas may be greater than for others located in more moderate climates. Several climatic conditions can delay rearward evacuation for extended periods, and thus increase patient holding time in the task force area. Only that definitive medical treatment capable of being performed within the established patient evacuation policy should be rendered. Such treatment normally is limited to that treatment supportive to the immediate emergency and to successful evacuation. The hospital unit should never sacrifice available beds by engaging in a program of definitive care that could as well be done farther to the rear.

Section VI. TRANSPORTATION AND TRAFFIC CONTROL

4-25. General

Transportation units can operate in subzero temperatures in much the same manner as in more temperate zones. However, individuals will require additional training in cold weather operations and in the increased maintenance requirements in northern areas. Provisions should be made for additional troop strength and equipment requirements. When operations are conducted over frozen terrain, vehicles of the track-laying type are the best means for cross-country movement in northern areas. When operations are conducted during summer weather, use of inland waterways are sometimes the best means for cross-country movements.

4-26. Ports

The ability to discharge cargo at northern ports is reduced by the limited facilities that are available. Rail and highway networks tend to limit the amount of cargo handled through any port. Where multiple port facilities are operated, personnel and equipment require augmentation. Environmental conditions limit the number of efficient working hours performed by terminal service personnel.

4-27. Rail

If available, rail transportation gives the capability of moving large tonnages of cargo and large numbers of personnel over long distances. Use of rail transportation in northern regions is greatly hampered by a limited network, heavy snowfall, snow slides, and extreme temperature changes. Additional equipment and operating personnel are required due to the need for separate snow removal crews. Train weights may be limited due to lightweight rail and low capacity trestles and bridges. Maintenance and wear on rail equipment increases, requiring more shop repair personnel. Rail track crews must be supplemented and track-age more frequently inspected since slides, glaciation, roadbed disturbances, and rail deficiencies often render the right-of-way impassable. During periods of heavy snowfalls, rail movement may be augmented by tractor trains or cross-country tracked vehicles.

4-28. Highway

a. The absence of multiple railroads in the northern areas increases the utilization of highway networks and justifies a requirement for more transportation highway units. Consideration must be given to maintenance and recovery points, roadside rest stops, and messing facilities for driver personnel on long haul routes. Drivers should be thoroughly trained in accordance with pertinent TM and FM. Wheeled vehicles are generally restricted to road movement and have little use in cross-country operations. Mandatory characteristics of any vehicle to be used in support of small units and individuals in northern operations during all seasons are mobility over muskeg and tundra and through brush and light timber and the ability to break trail in deep snow.

b. The regulation and control of highway traffic in northern operations necessitates a well formulated and coordinated plan for implementing the maximum use of the highway network. Highway regulation is essential because of the factors of movement of oversized and overweight equipment, convoy clearances, short daylight hours, winding, icy, narrow roadways, longer turnaround times, safety conditions, snowslides, and avalanches.

4-29. Air Transportation

Logistical and tactical transportation support requirements utilizing Air Force and Army air equipment for air-landed or airdrop operations, in northern regions follows the same general procedures as employed elsewhere. These northern areas generally devoid of adequate road and rail networks

necessitates increased employment of aircraft for troop movements and logistical support missions. Use of aircraft (rotary and fixed wing) for deployment of troops, resupply, and evacuation during northern operations under both winter and summer conditions provides a flexible mode of transportation. Priorities must be established and prior planning accomplished far in advance of the actual employment of aircraft, due to useful load limitations and meteorological effects on flying.

4-30. General Traffic Control

a. Conditions. Road nets are limited, existing roads frequently provide for only one way traffic, and road conditions are normally hazardous during winter months due to ice and snow cover. Visibility is seriously affected by snowfall, snow drifts, frequent ice fog, and long hours of darkness which extend the operation of vehicles under blackout conditions.

b. Traffic Control Operations.

(1) Extensive use of wheeled vehicles by military police on improvised roads and tracked vehicle trails is impractical. Military police operating in such areas require a tracked vehicle capability. When military police vehicles are operating on improved roads during periods of heavy snowfall, severe drifting or icing, they must be operated in the four-wheel position and be equipped with chains on the rear wheels.

(2) All hazardous road contours, such as curves and road junctions, should be marked with reflectorized delineator stakes positioned along the outside limits of the road shoulders. Delineator stakes are useful for ice bridges and to indicate edges of contour-bound mountainous roads.

(3) Rotary and fixed wing aircraft, if available, will provide essential mobility for control of traffic in expediting movement of units over the limited roads and trails. Rapid reconnaissance over routes in use can be achieved by use of aircraft. The frequency of route reconnaissance depends upon traffic density, weather, and type of vehicles on the road. The requirement for investigative and control personnel at serious accidents, incidents, and other emergencies demand minimum response time. This can be accomplished by rotary wing aircraft.

(4) Traffic control posts and check points requiring continuous operation in winter months will require the doubling of personnel. A "buddy" system must be established and shelter provided for traffic control personnel. These personnel should be equipped with reflectorized vests or jackets, or as a minimum, a reflectorized crossbelt and cufflets.

c. Enroute Survival Shelters. Main land routes and regularly traveled air routes should have survival shelters located at intervals which provide emergency sources of food, heat, and shelter from storms. Vehicle operators and pilots must also carry the essentials for survival in their vehicles and aircraft in case of mechanical breakdown away from shelter. Traffic control personnel must insure that improperly equipped vehicles do not depart base areas.

Section VII. PERSONNEL

4-31. General

Personnel functions and procedures are basically no different in northern operations.

4-32. Selection of Personnel

a. Physical and mental prerequisites are prime factors in selecting the individual for field operations.

b. In addition to the basic physical and mental prerequisites for the combat soldier, individuals should be free from the following physical defects or limitations:

(1) Circulatory diseases affecting the extremities.

(2) Skin grafts on the face.

(3) Inner ear difficulties.

(4) Previous history of severe cold injury.

Medical records should be screened and personnel affected by any of the above conditions should be rejected for assignment to northern latitudes. Individuals trained for, and to be assigned to, specific duties not involving frequent or prolonged exposure to the elements may be treated as exceptions to the above.

c. Personnel who have displayed a degree of mental instability or lack of adaptability which is insufficient to be considered as special cases elsewhere, frequently create much greater problems in northern areas. While limitations in this area are most difficult to delineate, the factors exist and cause sufficient problems to warrant consideration and possible rejection.

d. Personnel efficiency is greatly reduced by extreme cold. Protective clothing that must be worn further reduces their efficiency. It is impossible to handle extremely cold metal with bare hands. Gloves or mittens must be worn at all times, causing the loss of sense of touch and adding to the length of time to perform simple tasks. Thin nylon gloves to be worn underneath conventional gloves will enable maintenance personnel to have some sense of feel and should be made available thorugh normal supply channels. Personnel also have to be rotated frequently to avoid over-exposure to the cold.

4-33. Replacements

During winter months, environmental conditions demand that replacements be properly equipped and

receive cold weather indoctrination upon arrival in an area of northern operations and prior to joining units in the field. It is highly desirable that specialized training of replacements be conducted in an area that closely parallels northern conditions. Replacements should be given a period in which to become acclimatized prior to utilization under combat conditions.

4-34. Morale

a. Extremes in temperature, light, darkness, and long periods of isolation are factors which have a marked effect on morale in northern operations. Aggressive leadership at all levels is essential to surmount the obstacles which impede the provision of basic necessities required to maintain good morale.

b. The health of each soldier and confidence in his ability to meet the rigors of northern operations is related directly to his physical condition. The effect of physical fitness on morale cannot be overemphasized.

4-35. Discipline

Well-disciplined troops, properly trained, with an understanding of the mission can operate effectively throughout the year. Increased and unceasing supervision of individuals throughout the chain of command is mandatory during the winter months. First indications of malingering must evoke immediate corrective action from commanders or supervisory personnel at all levels. Weather and terrain encountered in northern operations may prevent the personal contact desired by a commander. Subordinate commanders are relied upon and the value of well-disciplined soldiers becomes increasingly significant.

4-36. Prisoners of War

a. During winter months, a major problem in the evacuation of prisoners of war is their protection from extreme cold, particularly those captured without sufficient clothing and equipment for survival. Evacuation plans should be made accordingly.

b. In order to allow for timely interrogation of prisoners of war, there is a necessity for prompt evacuation, to include utilization of aircraft, in order that this source of intelligence information can be fully exploited. If air evacuation is utilized, security of prisoners of war must be extremely strict while in flight.

c. It can be anticipated that relatively large numbers of prisoners will be taken at onetime. In addition, many troops will surrender because of deteriorating morale caused by a combination of factors such as ration shortage, sustained exposure to cold, and other elements.

4-37. Refugees

a. Due to sparse population of most northern areas, it can be anticipated that relatively small numbers of refugees will be congregated in one given area. Operations around built-up areas, railheads, major road junctions, and certain coastal areas will result in larger numbers of refugees.

b. When large numbers of civilians are moving about within an area of tactical importance, they must be regulated and controlled to preclude their interfering with the conduct of military operations. To prevent this interference, plans must be made for prompt evacuation to include utilization of aircraft. During winter months, a major problem in the evacuation of refugees is their protection from the cold, particularly those refugees without sufficient clothing and equipment for survival. Plans should be made accordingly.

Section VIII. CHAPLAIN

4-38. General

a. The chaplain in northern operations can perform his duties in subzero temperatures in much the same manner as he can in any other climate; however, these duties will be affected by the extremes of the environment.

b. The wheeled vehicle normally assigned to the chaplain lacks the necessary cross-country mobility, therefore he must be provided alternate means of transportation, i.e., a tracked vehicle, helicopter, etc. The chaplain must further make every effort to keep the command informed of his movements. He must insure that travel routes times of departure, points of destination, and estimated times of arrival are filed. If possible, the chaplain should move from place to place in company with ether elements of the command. This policy precludes isolation and potential cold weather injury or tactical disaster in the event of vehicular failure or enemy ambush. Thus, close coordination with the organizational primary staff elements insures maximum effective use of organizational transportation resources.

c. Because of the possibility of frostbite, caution must be exercised when conducting services in the open during periods of extreme cold. Unprotected flesh should not be exposed for even a few minutes. Services should be scheduled, whenever possible, for small groups in heated shelters.

d. The chaplain will sometimes lack adequate space for counseling and may find communication difficult with other elements when supported units are operating during adverse weather and at extreme distances. Normally it is possible for the chaplain to relocated near the unit medical facility. In this way, he is readily available when needed for medical contingencies and for counseling sessions. Frequently, the two functions are mutually supporting.

4-39. Religious Services

a. During periods of extreme cold and because of the lack of heated shelter, chaplains may not be able to

conduct certain types of services.

b. High winds and cold may eliminate the possibility of setting up an altar with ecclesiastical appointments thereby making it necessary to streamline the worship service wherever possible.

c. Chaplains whose congregations are under obligation to attend religious services on the Sabbath or Sunday may find it necessary to utilize privileges excusing troops from mandatory attendance.

d. It may be necessary for the chaplain to adjust vestments to be worn over his field uniform and the troops permitted to continue to wear headgear and other protective clothing throughout the service.

e. Care must be taken in handling metal objects used in the worship service. Chalices and cups may freeze to the mouth or hands. Water and sacramental wine may freeze in these objects if they are not already frozen before pouring. If it is an integral part of the service, it will be necessary to take proper action to keep wine warm enough to be poured.

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CHAPTER 5

COMMUNICATIONS

Section I. GENERAL

5-1. Role

Military operations in northern latitudes may be characterized by the employment of independent task forces, usually beyond mutual supporting distance of each other. The lack of major land lines of communication, the necessity of relying upon air lines of communication, and the great dispersion between forces means that primary reliance must be placed on radio as a means of communication. Operations over extended areas will require augmentation of radio equipment and personnel. When these factors are considered in conjunction with the extreme cold and deep snow, it can be seen that, under some circumstances, operations of isolated task forces will be practically impossible unless these forces are able to communicate with higher and adjacent units to arrange for support and supply.

5-2. General Effect of the Environment on Communications

a. High frequency transmission and reception, while capable of spanning the extended distances dictated by tactical requirements, are subject to interference by magnetic storms, aurora borealis, and ionospheric disturbances, which may completely black out reception for hours, or even days. Transmission and reception under most conditions is possible providing proper installation and operation procedures are followed.

b. The combined effects of terrain, cold, ice, dampness, and dust on communications equipment increase maintenance and supply problems to the extent that the full effort of operators and repair personnel is required to provide satisfactory communications.

5-3. Support of Signal Communications Activities by Army Aviation

Army aviation should be used whenever possible to assist in overcoming the communication difficulties caused by terrain and extreme climatic conditions.

Section II. COMMUNICATION

5-4. Propagation Methods

a. Radio communications in the northern latitudes suffer from propagation difficulties and exceptional planning steps are essential for radio operations in northern areas. Emphasis must be placed on the selection and use of proper frequencies and if the radio propagation graphs, charts, and prediction data presently available are fully utilized.

b. In order to appreciate the effect that atmospheric disturbances such as the aurora borealis can have on radio communication, it is necessary to understand the methods by which radio energy from a transmitter can reach the distant radio receiver.

c. The transmission of a radio signal from a transmitter to a receiver can occur essentially in one of two ways; that is, by a direct path between the antennas of the transmitter and the receiver or by a reflection from a layer in the upper atmosphere called the ionosphere. The radiated signal from the transmitter is divided into two main components, the ground wave and the sky wave. The ground wave travels along the surface of the earth and has a relatively short range. The sky wave travels upward into space at all angles up to the ionosphere. The ionosphere is an electrically charged region which exists at altitudes of 40 to 250 miles above the earth and which has the property of reflecting radio signals back to earth just as a mirror reflects light. In this way long distance communication is possible; however, the ionosphere is variable and its action depends on the time of day or night, the season of the year, and the effect that radiation from the sun has on the reflective powers of the ionosphere. Also, it is selective in regard to frequency and the angle at which the radio waves arrive. Above a certain frequency (40 to 60 megahertz (MHz)), the greater amount of the energy in radio waves passes through and is not reflected.

d. Tactical radio equipment operating in the so-called line-of-sight frequency band (30 MHz and upwards--the frequency modulated series of tactical radio sets are included in this band) is not affected adversely by auroral activity. In fact, the greater ionization of the upper atmosphere which takes place during aurorals will, on occasion, increase the range of the tactical FM radios. The use of VHF and microwave radio relay equipment will provide the greatest degree of reliability for multichannel means of communications in northern areas. Tactical tropospheric scatter radio equipment, when available is another reliable means of providing multichannel communications for distances up to approximately 300 kilometers (186 miles).

5-5. The Auroral Effect

The reflecting properties of the ionosphere are directly related to the position and radiation activity of the sun. The sun's bombardment of the earth's atmosphere coupled with strong magnetic activity concentrated near the poles causes a visual effect that is called the aurora borealis in northern latitudes. Ionization of atmospheric particles is increased, and radio waves reaching distant receiving points by means of sky wave propagation are reduced in intensity by increased absorportion. This absorption becomes more

pronounced during violent eruptions of the sun's surface which is visible in the form of sunspots. During such a period, a radio "blackout" may occur on nets crossing or passing through the auroral zone. The greatest auroral activity occurs between 60° and 70° North latitude and occurs at intervals of 27 to 28 days. Signals from distant stations are usually much stronger prior to such periods. Monthly predictions of expected conditions are published by the National Bureau of Standards and are available to communications-electronics staff officers at all levels of command. It must be emphasized that "blackouts" occur throughout the high frequency spectrum and down to 26 KHz and may last several days. In addition, high frequency sky wave transmissions are subject to sporadic blackouts which are, at present, unpredictable and erratic as to duration and coverage.

5-6. Atmospheric Static

a. In the medium frequency band (300 to 3,000 KHz) very little continuous high level static is experienced in northern latitudes, but steady rushes of high level noise are common and signify an auroral blackout on the frequency being monitored.

b. Flakes or pellets of highly charged snow are occasionally experienced in the North just as rain and sand static are encountered in many tropical and desert regions during periods of high winds. This phenomenon is commonly called precipitation static. Charged particles of snow driven against metal vehicles, antennas, and other objects usually discharge with a high pitched static roar that can blanket all frequencies for several hours at a time. While these phenomena are uncommon except in aircraft, they can take place just when communications are vital to some operations.

c. Antiprecipitation, static-proof antennas can be constructed by covering exposed portions of the antennas with layers of polystyrene tape and shellac to withstand breakdown voltages on the order of 30,000 to 40,000 volts. The value of such a system depends entirely on the station's isolation, since discharging particles on metal masts and other equipment near antiprecipitation receiving antennas can produce heavy static by radiation from the tiny sparks.

d. Very heavy shocks can be experienced from the unground lead-in of antennas subject to high winds or blowing snow even when the degree of audible static is not great.

5-7. Antennas and Grounds

a. Difficulties will be experienced in erecting antennas in the north. The frozen ground makes it difficult to drive the antenna ground, guy, and ground plate rods. Mountain pitons are considered excellent anchors for antenna guys in frozen earth, ice, or rocky soil. In addition, in extreme cold, ropes can be frozen to the ground and guys tied to these anchor ropes. Additional time must be allowed for these operations, and care must be exercised in handling lead-ins and metal masts since they become brittle in extreme cold. Vertical antennas are preferred for ground wave propagation in the high frequency band; but the use of fractional wave length whip antennas is not recommended, except for short distances.

b. All large horizontal antennas should be equipped with counterweights arranged so as to give before the wire or poles break from the pressure of ice or wind. Wet snow and sleet freezing to the antenna may be removed by jarring the supports.

c. Suitable grounds are difficult to obtain under conditions of extreme cold inasmuch as the frozen ground offers high electrical resistance. The permafrost which underlies much of the Far North offers as much obstruction to ground rods as solid reinforced concrete. Where it is possible to install a ground rod, the rod should be driven as deeply as possible into the frozen earth or preferably through the ice of one of the lakes or rivers that abound in the North. In many instances it will be impracticable to secure a ground and it will be necessary to install a counterpoise. In no instance should more than one transmitter be connected to the same ground or counterpoise, nor should electrical noise-producing items such as direct current, battery-charging generators, or metal-walled huts be connected to receiver ground systems.

5-8. Effect of Extreme Cold on Battery Power Supplies

a. Although extreme cold impairs the operation of the electrical components which make up radio sets, it has its most serious effect on the dry type primary batteries which are used to power the small man-carried portable radios and many of the test instruments used to repair signal equipment. To minimize the effects of cold on dry type batteries, only those batteries designed for cold weather operations should be used for northern operations.

b. Batteries of all types show decreased power capacity at low temperatures; specially designed cold weather batteries are more efficient. Batteries should be stored at supply points between temperature ranges of 10° to 36° F. Upon removal from storage, and prior to use, the batteries should be heated slowly to a temperature of 70° F. Warm batteries will give good results if used promptly upon exposure to cold. The conventional dry cell type battery loses efficiency rapidly at low temperatures and decreases in capacity as the temperature drops below 70° F. (The terminal voltage of the battery is not affected by cold, but its capacity, life, or effectiveness to supply operating voltage over a period of time is affected.) At 0° F. it is 40 percent effective; at -10° F., 20 percent; and at -30° F., only 8 percent effective.

c. Dry batteries, if kept warm, at low ambient temperatures, will deliver satisfactory service life. Carrying of batteries inside clothing, or the use of insulated containers or heating devices, to provide a warm temperature for the battery are satisfactory as long as the battery temperature is not permitted to exceed 100º F. Battery vests designed for wear under outer clothing, consisting of temperate type batteries of flat cell construction should be used with man-packed radio sets during extreme cold. The useful life of the battery can also be extended if it is warmed up prior to the time it is placed in operation in the low ambient temperatures. Batteries which become inactive because of the cold may be reactivated by a thorough warming at temperatures below 100º F. A battery no longer serviceable in cold weather may be used indoors where the temperatures are warmer.

5-9. Electronic Warfare

The low temperatures, low visibilities, and the lack of ground lines of communication in the northern regions impose greater reliance upon radio type devices for command and control of ground combat forces. Radio navigation aids, so necessary because of the scarcity of landmarks, prevailing low visibility, and the long hours of darkness, are particularly sensitive to electronic warfare measures; this is especially true where alternate base stations are few and far between. On the other hand, the enemy must also rely upon electronic aids and a small electronic warfare unit properly employed can play a decisive role in northern operations.

5-10. Techniques and Expedients for Increasing Range and Reliability of Radios

a. For effective application operators require special training initially and refresher training prior to commitment to northern operations. Training of tactical FM radio operators in special techniques is particularly important because these personnel normally have no formal training. Consideration should also be given to the additional training requirements for Radio Telegraph, SSB-voice and other HF radio sets recommended for Northern operations.

b. Where radio communication is the primary means of signal communication, it is essential that the following techniques be followed at all times:

(1) Operators must be completely familiar with their set. They should read and understand the technical manual which is part of each radio.

(2) Operators should keep the radio set clean, dry, and as warm as possible.

(3) They should handle the set carefully. Radios that are exposed to extreme cold are particularly sensitive to jars, shocks, and rough handling.

(4) Preventive maintenance procedures take on added importance. Operators should detrained to setup a routine inspection and check procedure covering the following points:

(*a*) Plugs and jacks should be clean.

(*b*) Antenna connections should be tight. Insulators must be dry and clean; snow and ice removed.

(*c*) Power connections must be tight.

(*d*) Motors and fans should run freely.

(*e*) Knobs and controls should operate easily.

(*f*) Lubrication must be checked more frequently.

(*g*) Dry batteries must be fresh and kept warm.

(*h*) Operating spares must be on hand.

(*i*) Breath shields should be used on all microphones.

(*j*) Additional guying for antenna masts is required to prevent mast failure cause by severe cold and extremely high winds.

(*k*) Insure that the proper antenna length is used relative to operating frequency.

(*l*) Check to assure that the antenna has been erected and oriented properly.

(*m*) Operators should insure that radios are turned off whenever vehicles are started. This is necessary to avoid a sudden surge of power. Before the radio is turned on the vehicle should be allowed to warm up inside.

c. With equipment in good shape, lack of communication can be caused by the following:

(1) Excessive distance between sets.

(2) Bad intervening terrain, such as hills and mountains.

(3) Poor choice of location of one or both ends of the radio net.

(4) Poor choice of operating frequency for sky wave.

(5) Poor choice of antenna; improper antenna orientation.

(6) Not enough transmitter power.

(7) Excessive noise and interference.

d. The following techniques and expedients can be used to increase the range and reliability of radio nets.

(1) Use the radiotelegraph (RATG) method of operation rather than the radiotelephone (RATEL).

(2) For tactical FM radios, elevate the antennas as high as possible either by siting the set on hills and mountains, using an elevated ground plane antenna, an improvised elevated half-wave antenna, or an improvised vertical half-rhombic antenna.

(3) Use remote control devices in order that stations may be sited in advantageous positions.

(4) Use intermediate voice or automatic retransmission stations for both FM or HF nets. Radio sets using a retransmission device can be used as intermediate relay stations.

(5) Use Army aircraft for radio retransmitsion or relay when out of normal range, or other means or retransmission as practicable. Either intermediate voice or automatic retransmission from the aircraft can be employed in many situations. This will often prove to be the only means of successful communication to isolated teams and units, and for long range patrols.

5-11. Radio Communications

a. Command radio nets must be established first and priority given to maintenance throughout the tactical operation. When an element moves out of ground wave range from its base of operations, retransmission points must be established or sky wave propagation will have to be depended upon when it is not possible to establish intermediate retransmission points. When it can be anticipated that distances are so long as to preclude communications with equipment normally available, higher headquarters should be requested to furnish communications support. Situations may arise where radio communications will not meet full expectation. Alternate means, such as messenger service, must always be included in the signal communication plan.

b. The establishment of air-ground circuits is of major importance in all tactical operations in northern latitudes because of the dependence on aircraft for airmobile operations, logistical support, observation, and messenger missions.

c. The use of low or medium channel-capacity VHF-UHF radio relay equipment mounted on small tracked vehicles will provide the most reliable means of communications to mobile task forces as low as battalion size organizations. Such equipment configurations should retain the same mobility and concealment requirements as the supported unit while providing reliable telephone communications not subject to northern propagation difficulties.

d. The use of the radio wire integration technique to extend both radio and wire circuits will be an important factor in successful communications.

5-12. Factors Affecting Wire Communications

Tactical wire communication has the same capabilities and limitations in northern latitudes as in temperate zones. Due to the distances involved and the difficulty of overland movement, wire communications may be limited to telephones serving local installations. If long distance wire communication trunk (telephone, teletype, facsimile, and data transmission) are required, radio relay systems which can be integrated into the wire system must be considered because of relative ease of installation, economy of transport, and other logistic factors. The installation of radio relay systems on

mountain tops normally will be necessary for extension of long distance wire circuits. Extensive planning for installation, maintenance, and support of equipment and support and survival of personnel operating these mountain-top relay sites is mandatory. Consideration must be given to the fact that more time is required to install and maintain field wire lines during periods of extreme cold and deep snow. Batteries which are used to operate field telephones and switchboards are subject to the same temperature limitations as those used to power the small portable tactical radio sets.

5-13. Special Considerations Applicable to Northern Latitudes

a. Aside from the logistical considerations, the most difficult task in providing wire communication is that of constructing and maintaining the necessary circuits. Field wire may be laid on the snow, but must be suitably marked to facilitate maintenance. Below the tree line, trees, if high enough, may be used to support the lines. Initial circuit layout should include consideration of wire and cable routes with respect to expected vehicular and oversnow traffic, so as to minimize the damage from tracklaying vehicles and ski troops. Field wire lines should not be laid on ski trails which are used for troop movement; a separate communication trail should be broken and used. If the wire circuit is to remain in place during the warm season, particular care must be given to its placement through areas, such as lakes and muskeg, which may be impassable in summer and make maintenance impossible. Similar care should be taken to avoid locating wire lines in areas subject to snow and earth avalanches. Consideration must also be given to the effects of frost thrust and the shifting of ice masses.

b. Telephones, teletypewriters, facsimile equipment, wire carrier terminals, and telephone switchboards, must be operated in heated shelters. Batteries and battery operated equipment should be kept warm even when low temperature batteries are used. Microphones, telephones, and operators' sets must be provided with breathshields to prevent frost formation from disabling them. Further difficulties can be expected from switch malfunctioning and stiffening or breaking of associated cord and plug assemblies.

c. Grounds are extremely difficult to obtain in frozen soil. Grounding of wire equipment is necessary; however, special cold weather ground stakes should be used and should penetrate the frozen surf ace of the earth 1 meter (3') below the surface. It may be necessary to use special blasting devices to obtain a suitable ground. When a grounding rod cannot be driven 1 meter into the soil, it should be driven in at least 30 cm (12") and water poured around the base to increase conductivity. Because of the difficulty of obtaining grounds and the high resistance of the soil, simplex telephone and teletypewriter circuits, which utilize a ground return to complete the circuit, should not be used.

d. Due to the difficulties of resupply and the necessity of limiting basic loads to the bare essentials, the communications-electronics staff officer must make every effort to recover all available wire for subsequent reuse. He must plan his circuits, so far as possible, to facilitate recovery, taking into account that wire or cable laid in or on the snow is extremely difficult to recover because of the melting, refreezing, and drifting action that takes place around the wire. The initial supply of wire, supplemented by limited resupply, may constitute the only source of field wire.

5-14. Techniques of Wire Construction in the North

a. Field wire is most conveniently laid from the dispenser MX-306/G. When these dispensers are used, communication can be maintained constantly to check the continuity of the circuits and to furnish a means of communication to the wire team. The dispenser can be attached to a standard packboard and the wire laid by a lineman on skis or snowshoes. When the distance is such as to preclude the use of lineman on foot and the terrain prevents the use of oversnow vehicles, wire can be laid from dispenser by Army aircraft.

b. Oversnow vehicles equipped with reel units can be used to lay field wire or cable. If recovered field wire is available and has been properly serviced, it should be used in preference to wire from the dispensers, thus conserving the dispenser wire for critical situations. Field cable can be most effectively laid from drums mounted on reel units installed on the vehicle itself. However, the undertaking of a major cable construction project in temperatures below 0º F. presents a formidable obstacle. The cable sheath and insulation, unless warmed, is no longer pliable. The act of unwinding it, by force, without preheating it for several hours could damage it to the point of uselessness. A heated shelter should be provided for wire-laying crews. An arctic personnel shelter mounted on a truck or tracked vehicle provides a good facility for tactical wire or cable laying. The wire or cable can be kept reasonably warm and pliable as it is played out of the shelter. The wire or cable should be dressed immediately before it has a chance to become stiff from the cold. All cable for tactical use should be stored in heated storage areas before being transferred to the portable shelters used for laying the cable.

c. Army aircraft can be used very effectively to install field wire circuits between points difficult to reach by ground transport means. The wire is laid from the dispenser, MX-306/G. Individual dispensers are connected prior to payout to provide the required length. The course over which the wire is to be laid must be suitably described to the pilot and the terminal points of the circuit marked by smoke, panels, or lights. In making plans for construction using this method, allow for a 50 percent slack factor, and consider the wire beyond recovery and extremely difficult to maintain.

d. Often the communications officer will find it necessary to use a combination of the previously mentioned techniques to install a single circuit. Lines to isolated relatively inaccessible detachments, such as weather stations, radar sites, and observation posts, may require the use of vehicle-towed cargo sleds or man-pulled 200-pound sleds to transport the additional amount of wire necessary to complete the circuit. Rockets and rifle grenades in conjunction with the dispenser can be used to carry field wire several hundred meters across ravines and crevasses.

e. It is extremely important, both from the viewpoint of conserving labor and considerably reducing required quantities of wire, to keep field wire and cables from being drifted over by the snow. Cables and wire that interconnect two or more units in a command can be covered with snow so deeply in a single day that the loss of many man-days in recovering or maintaining the circuits may result. This can be avoided by pulling the cable from under the snow after each snowfall and allowing it to rest on top of the snow, or better still, by using trees or cut poles to support the wire for overhead type construction. Make allowance for drifting snow in deciding on the height above ground at which to support the lines.

5-15. Tactical Employment of Field Wire

Distances involved and the difficulty of supply will govern the extent to which field wire is employed. Every effort must be made to integrate the wire system with the radio system so that a complete electrical communication system is available for command and control.

Section III. VISUAL COMMUNICATION

5-16. Factors Affecting Visual Communication

Visual means of communication are particularly effective in air-ground operation, when atmospheric conditions or security requirements preclude the use of radio, and in mountainous country where the extreme ruggedness of terrain prevents the laying of wire but affords line-of-sight for siting of visual stations. Signal lamps may be used when the situation permits. Blowing snow, haze, ice, fog, and other atmospheric conditions may affect the range and reliability of visual signaling in the northern latitudes. Security requirements for visual means of communication are the same in the North as in temperate zones.

5-17. Panel Communications

The standard panels are satisfactory for air-ground signaling when displayed against a background of snow. It must be recognized that blowing snow can obliterate panels in a matter of seconds.

5-18. Pyrotechnics

a. Colored smokes most easily seen against snow covered backgrounds are, in order, red, violet, green, and yellow.

b. Smoke grenades, mortar and artillery marking rounds of the base ejection type will tend to be smothered by deep snow. Use of a time fuze to obtain air bursts will facilitate location of marking rounds. In using white phosphorus projectiles, the white phosphorus will tend to be smothered, and in addition, particles of phosphorus will remain to contaminate the area.

Section IV. MESSENGER

5-19. Special Factors to be Considered

Communication by messenger is frequently the only means available to units. In the uncharted areas of the northern latitudes of the world, the ability of messengers to find their way takes on added importance. Messengers should be good skiers, resourceful, familiar with northern peculiarities, and carry their own existence load. Messengers should always be dispatched in pairs.

5-20. Aircraft Messenger Service

Messenger service should be scheduled between units and should, if possible, be integrated with the aerial resupply missions. The use of helicopters for messenger service must be considered, as units will seldom be located near landing areas suitable for fixed wing aircraft.

5-21. Vehicular Messenger Service

a. Vehicles may be employed to maintain messenger communications between units when the conditions of time, terrain, and distance permit. At best, surface transportation is slow, subject to interception by ground ambush parties, and uneconomical with respect to fuel and equipment.

b. It is essential that all vehicles utilized for messenger service over infrequently used routes possess the capability of oversnow operations, and be equipped with radio, emergency equipment snowshoes, heating apparatus, and simple navigational equipment. It is likewise essential that messengers be trained in radio operation and ground navigation. When security permits, the vehicle should be kept in continuous communication with its headquarters. The unit to which the vehicle is destined should be informed by enciphered radio message as to the time of departure and expected time of arrival.

Section V. PHOTOGRAPHY

5-22. General

Photographic equipment is generally designed to operate in temperate climates, under cold weather conditions camera equipment will operate in a sluggish manner and film emulsions acquire different sensitivity. The information below was provided through the courtesy of the Eastman Kodak Company. This information is designed to minimize the cold weather effects on cameras and associated equipment.

a. Effects of Cold on Photographic Equipment.

(1) Leather, rubber, and photographic film become stiff and brittle at low temperatures. The lubricating oils used in cameras congeal so that moving parts will not operate. Film speed is lowered by the cold and at -50° F, will be approximately one lens opening slower than at 60º F.

(2) Film will become progressively more brittle as the temperature drops. Care should be taken to retain film in its original container until it is ready for use. It has been determined that film that retains its moisture content will remain more flexible at low temperatures than film that has been allowed to dry out. Film can be bent with the emulsion side in with less chance of breaking them if bent with the emulsion side out. Whether the film breaks at low temperatures will depend on the care taken in handling it and the type and condition of the camera using it.

b. Camera Equipment.

(1) Whether or not photography will be successful during cold weather operations depends on the selection of the proper camera. Some cameras wind the film with the emulsion side out, this places undue strain on the film and will sometimes cause film breakage. Cameras that wind the film with the emulsion side in will generally perform satisfactorily.

(2) Cameras that use the film to cock the shutter should be avoided because they will almost always break the cold film.

(3) Cameras using film packs should be avoided because of the sharp bend the film has to make when the tab is pulled.

(4) Generally it is better to use a motion picture camera that uses a film magazine because of the difficulty encountered in threading roll film during cold weather conditions. A lightweight portable camera is desirable. Electric power, if available, from a reliable source is more dependable than spring-driven motors. Under field conditions, however, the spring-driven motor may be more reliable than an electric motor drive that depends on batteries for its power.

(5) Cameras should be winterized prior to use in cold temperature areas. This is accomplished by dismantling the camera and removing all old oil or grease. Relubrication should be accomplished with special low temperature lubricants. Cameras that have been winterized should not be used in a temperate climate unless they are relubricated.

(6) Motion picture cameras that have been winterized should be thoroughly broken in prior to actual use. This can be accomplished by splicing a piece of film 3 to 4 feet long end-to-end threading it in the camera and allowing the camera to run 3 or 4 hours. In magazine type cameras the loop should be formed in a dummy magazine. After the breaking in period, the camera should be checked for speed and general behavior. Still cameras should be given break-in conditioning by operating all moving parts enough to insure that they operate smoothly.

(7) All cameras should be protected from cold winds as much as possible during use. When battery driven motors are used on cameras they should be kept as warm as possible. Miniature cameras and small motion picture cameras should be carried underneath the parka or field jacket to obtain body heat.

(8) The lens should be inspected each time before use. Static electricity generated during periods of cold-dry conditions will attract pieces of lint to the lens. This lint should be removed prior to taking a picture.

c. Batteries. All types of batteries lose efficiency when cold. After a few hours of exposure to cold, the batteries used in flash holders and electronic flash power packs become so weak that they will not operate

the flash equipment. Photographers should keep their batteries underneath outer clothing to obtain body heat. For extended shooting several sets of batteries should be used so that one set can be warming while the other is operating. Since fresh batteries will operate at colder temperatures than partially used ones, every cold weather shooting session should start with the freshest batteries available.

d. Picture Taking Techniques.

(1) Certain cold weather precautions should be observed with any type of camera. Breathing on the lens will cause condensation that freezes instantly and is difficult to remove. Unpainted metal surfaces should not be touched with the bare skin because of the possibility of the skin freezing to the surface. A painful loss of skin is the end result. Cameras, and other equipment with optical lenses should not be brought into heated rooms without careful, slow warming. This is necessary to prevent cracking of optics and to prevent condensation. Conversely, a warm camera cannot be taken out into a snowstorm because the snow hitting the camera will melt and turn into ice.

(2) Camera shutters, especially focal-plane shutters, operate more slowly as the temperature falls. In general, faster shutter speeds are more affected than the slower speeds, although no two shutters behave the same. When taking pictures during cold weather the shutter should be snapped several times at 1/10-second to insure that the shutter is operating. It is also a good practice to leave the shutter uncocked until just prior to taking the picture. This will prevent the shutter from freezing in a cocked position. Because of the slow-down in shutter speed, exposure determination becomes problematical. It is therefore advisable to make several exposures broadly bracketing the correct exposure.

(3) Since shutter controls, focusing mechanisms, and diaphragms may freeze, it is well to preset the camera indoors. Set the shutter and diaphragm for the nominal value of exposure to be expected under prevailing conditions. Then set the focus for the hyperfocal distance for the selected aperture. Focusing the lens on the hyperfocal distance gives the greatest depth of field for any particular aperture. With the camera preset in this fashion, even if all of the controls freeze, as long as the shutter continues to operate, pictures can be made.

(4) Film in any camera can be changed during a driving snow storm if a dark plastic bag big enough to fit over the head and shoulders is used. A deep lens hood should be used for filming in the snow because it will help keep the lens dry even during a fairly severe storm.

(5) Flash bulbs have a greater tendency to shatter at low temperatures, so caution must be exercised in their use. Light reflected from snow close to the camera can cause lens flare, even though standard lens hoods are used. To insure better synchronization at low temperatures, it is advisable to set the shutter at 1/25.

(6) Roll film must be advanced slowly and steadily to avoid static marks and breaking the film. For the same reason, filmpack tabs must be pulled slowly, steadily, and straight. Static markings

are caused by an electrostatic discharge and they appear on the developed film emulsion as marks resembling lightning, tree branches, or nebulous spots. When static difficulties occur, they can usually be traced to the use of film which has a low moisture content or rapid handling of the film which build up static electricity.

(7) Sheet-film holders are often a source of trouble when they become cold. The plush light-trap becomes rigid and does not close after the slide is withdrawn. This can be avoided by not pulling the slide all the way out. If this is not practical, cover the back of the camera with the focusing cloth when removing the slide, during the exposure, and while reinserting the slide. When reinserting the slide, do it squarely, not one corner first.

e. Selection of Film.

(1) In general, field photography in cold weather areas involves subjects of extremely low brightness scale and very high levels of illumination. For this reason, high-speed emulsions are not generally used outdoors. The best choice of film is a medium-speed material or even slower, finer-grained film.

(2) Under field conditions during periods of cold weather, one camera is all that one photographer can efficiently manage. Therefore, if pictures are desired in both color and black-and-white, a color negative film should be used. From the color negatives prints can be made in either color or black-and-white and color slides can be made from the same negatives.

5-23. Aerial Photography

Aerial photos of snow covered terrain will not disclose as much terrain detail as one of the same area barren of snow. On the other hand trails and tracks in snow show up in great detail on aerial photographs and are excellent sources of information.

Section VI. MAINTENANCE AND CARE OF EQUIPMENT

5-24. General

Standard types of signal communication equipment can be used at very low temperatures with satisfactory results if proper precautions are taken and the equipment is properly winterized. Provisions must be made in the operation plan to include the special maintenance requirements necessitated by operations in extreme cold. As a general rule, signal communication equipment should be installed and operated in a warm shelter. Warm shelters are an absolute necessity for maintenance personnel. The general principle of keeping equipment warm and dry, in addition to following winterization instructions closely, will insure the best possible performance of signal communication equipment. Further information relative to maintenance of signal equipment in northern latitudes is contained in Signal TB.

5-25. Rubber and Rubber-Like Compounds

Rubber and rubber-like compounds become increasingly stiff and brittle as their temperature is lowered. When cold, cordage should be flexed slowly and carefully in order to minimize breakage. Power cables and coaxial cable transmission lines should be warmed before they are laid in the open. Frequent failure of cables of these types, and of field wire, may be expected if it is necessary to recover and rereel them during extreme cold. Increased requirements for replacement should be anticipated. Where possible, contact of rubber items with fuels and lubricants should be avoided. Where feasible, rubber items should be warmed before flexing.

5-26. Radio Receivers and Transmitters

Upon exposure to extreme cold, radio receivers and transmitters adjusted for operation in a relatively warm place may exhibit, in their frequency determining circuits, changes of sufficient magnitude to impair their operation. Low battery voltage will also have a detrimental effect on frequency determining circuits. All radio operators must be trained to make frequent checks for proper frequency. It is particularly important that the operators at the radio net control stations be alert to this condition and that they require the secondary stations of the net to make necessary adjustments to keep them on frequency.

5-27. Microphones

Moisture from the breath freezes on the buttons and perforated cover plates of microphones, causing the instrument (telephone, radio, etc.) to become inoperative. Standard microphone covers are available and should be used in northern latitudes during periods of extreme cold. If the standard cover is not available, a cover can be improvised by using a thin cellophane or cloth membrane.

5-28. Mechanical Malfunctions

Plugs, jacks, keys, shafts, bearings, dials, switches, and camera shutters are subject to malfunctioning caused by the differential contraction of metal parts in extreme cold. The result is binding, difficulty in turning and adjusting, or complete locking of the part. In addition to the trouble caused by differential contraction, moisture condensation which freezes in such assemblies will also render them inoperative. Moisture condensation caused by localized heating may freeze in subassemblies during shutdown periods and may render them difficult to operate, or even inoperative.

5-29. Breathing and Sweating

Any equipment which generates heat during operation will "breathe" or draw in cold air as the equipment itself cools. If such heated equipment is brought into contact with extremely cold air, the glass, plastic, and ceramic parts may break. "Sweating" is the reverse of the process described above. If cold equipment is brought into contact with warm air, the moisture in the air will condense on the equipment and will subsequently freeze when the equipment is brought into the cold again. Cold equipment should be

wrapped in a blanket or parka before being brought into a heated shelter.

5-30. Wire Insulation

Extreme care must be taken in handling insulated wire and cable at subzero temperatures, as the insulation tends to become stiff and brittle and liable to cracking. Insulation is especially vulnerable at such points as field wire ties and splices. Rubber and plustic covered cables should be warmed before bending so as to minimize the possibility of breaking the insulation. Coaxial cable is particularly critical because the inner plastic insulation may crack. Standard friction and rubber tape lose their adhesiveness when subjected to extreme cold. Splicing of field wire and cables is a problem because the hands must be protected by mittens or gloves which restrict handling. Special cold-weather type electrical insulating tape is available and may be used without prewarming.

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CHAPTER 6

OTHER TACTICAL OPERATIONS

Section I. AIRBORNE OPERATIONS

6-1. General

The mobility and flexibility characteristics of airborne forces are ideally suited for the diversified areas of the north. While conventional doctrine is as applicable to the north as elsewhere, some modifications to operating procedures are required to overcome the limitations imposed on airborne operations by the extreme environmental conditions. The guidance contained herein should be applied in conjunction with basic doctrine published in FM 57-1.

6-2. Factors Affecting Airborne Operations

Limitations that apply to airbome operations in temperate zones also apply in the north, and in many instances are amplified. The primary consideration is the capability of the troop carrier aircraft. Some of the limitations are--

a. The effect of weather (blizzards, ice fog, whiteout).

b. Navigational difficulties caused by inadequate maps and charts and lack of natural landmarks and manmade structures.

c. The lack of adequate marshalling areas with warm shelters and suitable troop carrier bases.

d. The few hours of daylight for airlanded operations in winter.

e. The bulkiness of the clothing worn and equipment carried requires more aircraft space per individual. This necessitates an increase in the number of aircraft to transport an organization.

f. Maintenance difficulties resulting from sufficient maintenance shelters and decreased personnel efficiency.

g. Heavy snow or deep snow drifts on airfields and landing zones with associated snow removal problems.

h. Accumulation of frost, snow and ice on parked aircraft.

i. Difficulties in constructing landing strips in summer.

j. Uncertainty of radio communications.

6-3. Parachute Operations

The capability to deliver personnel by parachute is of particular importance in undeveloped areas where surface routes of communication are limited or nonexistent. Experience indicates certain operational and planning factors require special emphasis when airborne units are committed to parachuting in northern areas. In this connection, airborne commanders must familiarize themselves with the Arctic portion of TM 57-220.

a. Airborne forces employed in northern areas must be capable of self-sustaining operations for 72 hours without benefit of resupply. In this regard, it is especially important that primary and contingency plans be made for linkup, resupply, and exfiltration.

b. The number of personnel that can be parachuted from a single aircraft is considerably reduced because of the bulk of equipment and cold weather clothing used by paratroopers. For planning purposes the maximum number as listed in TM 57-220 should be reduced by 1/3. In computing weight factors the cold weather equipped parachutist should be computed at 800 pounds. Exiting time between parachutists is computed at two seconds.

c. The rigging of personnel and their equipment must be in a warm area. If this area is at a greater distance than 200 meters from the aircraft parking area, transportation is required.

d. Winter equipped parachutist should load by way of the ramp of the aircraft. To prevent possible accidents care must be taken to insure that the ramp is free of snow, ice, water, etc. This hazard is magnified on exiting the aircraft. Each aircraft should have equipment aboard to insure that the floor is as dry as possible prior to exiting over the DZ.

e. Careful consideration must be given to the selection of DZ. An open muskeg area that looks suitable on photographic and map inspection, will frequently prove to be covered with frozen hummocks of vegetation ½ to 1 meter (18" to 39") in height. Much of the northern areas of the world are covered with scrub pine, ranging from 1 to 10 meters (3' to 30') in height. These areas with sparse tree growth make

suitable DZ.

f. To avoid overheating personnel, aircraft cabin temperatures should not exceed 40° F. The heavy weight of the individual parachutist and his equipment will cause a more rapid descent than under temperate zone conditions. When the jump is to be made into a high altitude DZ, this rapidity of descent is magnified because of the thinness of the air.

g. DZ assembly procedures and the use of assembly aids are especially critical in northern operations where considerable difficulties are encountered in assembling in tree covered areas, deep snow, or during extended periods of darkness. Extensive training and rehearsals are required to overcome the problems of orientation after landing.

h. If the DZ is snow covered, all parachutists should drop with snowshoes or skis attached to their body as outlined in TM 67-220. This technique will hasten DZ assembly time and will aid in speedy recovery of heavy drop items.

i. Special effort must be made to expedite and insure the recovery of equipment that is delivered by parachute. Daylight drops and the use of colored parachutes, streamers, and smoke grenades are recommended; however, airborne commanders must designate personnel to spot dropped equipment and check for equipment aircraft aborts. The use of the Army assault team (AAT) or pathfinders in this role has proven to be practical.

j. The ahkio should accompany airborne units on the initial drop. The ahkio should contain the tent, 5- or 10-man, Yukon stove, fuel, and rations. These sleds should then be heavy dropped on load bearing platforms. The number of sleds to be loaded on one platform will depend on the type of aircraft and available type of platforms. Ideally, the sleds should not be loaded in less than platoon groups.

6-4. Air Transported Operations

The inadequacy of overland means of transportation dictates the utilization of aircraft for rapid and efficient movement of personnel, supplies, and equipment. Even in those areas where limited facilities for overland transportation are available, air-transportability can contribute to greater unit mobility.

6-5. Drop Zones and Landing Zones

The selection of drop zones (DZ) and landing zones (LZ) are affected by the following considerations:

a. Visual or photographic coverage. If possible, information should be confined by ground reconnaissance.

b. Swamps and muskeg soil conditions.

c. Availability of ice of sufficient depths for suitable DZ or LZ on lakes and other water surfaces.

d. Depth of snow and configuration of drifts.

e. Location of landing fields so that cold air drainage from surrounding hills doesn't drain down onto the airfield. This subjects the field to considerable ice fog, especially during takeoffs on cold days.

6-6. Marshalling

a. Protective shelters, such as hangars, are needed for the use of troops when they put on their parachutes.

b. During the loading phase, rapid motor transport should be provided between the marshaling area and the departure field. Properly coordinated loading and rapid aircraft takeoff also help hold to an absolute minimum the time personnel are exposed to cold and other elements. Protective shelters are controlled so that troops will not become overheated in the heavy clothing prior to exposure to extremely low temperatures.

c. To reduce the effects of slower loading and delays in aircraft departure, plans for loading operations are made to provide for compact aircraft parking near the supply and equipment storage areas.

d. Equipment and supplies that might be damaged or become temporarily inoperative by exposure to extreme temperatures and moisture are packed in special bundles. Supply agencies at the marshaling area must be capable of preparing and modifying equipment bundles up until the time final loading is completed. Equipment bundles to be free dropped need special preparation and protection. This may vary with the season. Every precaution is taken to reduce the recovery problem. Even with due precaution, there will be a high loss rate of bundles which are dropped in deep snow or in marshy tundra. Bright colored parachutes and streamers attached to bundles aid in recovery.

e. When loading, troops are cautioned to keep clear of propeller blast which picks up fine snow and drives it into clothing.

Section II. OPERATIONS ON PERMANENT ICE AND SNOW COVERED AREAS

6-7. Permanent Ice and Snow Covered Areas

a. Operations on permanent ice and snow covered areas may be required for the establishment of support and for protection of specialized activities. In such instances, operations normally will involve small units but the total effort required will be large because of the extreme difficulties of operating in such areas.

b. Operations on an ice cap are so different from other northern areas that different techniques of operation are required. The absence of usable resources, except ice and snow, necessitates that every item required be transported into the operating area. It is mandatory that personnel be provided with protection from high winds and extreme cold. As a result, support requirements will be extremely high. The construction of storage and maintenance shelters from ice and snow is particularly feasible in permanent ice and snow covered areas.

c. Specialized equipment for negotiating the areas is required. This equipment will include snow tractors, low ground pressure veicles, crevasse detectors, trailmarking equipment, navigational aids, living wanigans, and related items.

Section III. AMPHIBIOUS OPERATIONS

6-8. General

The extremes of weather may impose upon an amphibious attacking force conditions which severely limit, or make impractical, an amphibious assault against a defended beach in northern latitudes. The range of high and low tides and beach gradient present in the north must be carefully considered in planning operations. Once the attack is initiated, speed in landing troops and providing logistical support is of great importance. Logistical plans must include an alternate plan to supply by air should ice conditions change during a critical part of the operation. Plans should include the use of helicopters in an amphibious assault. Once ashore, the conduct of the operation will be the same as for any other attack in northern latitudes. FM 31-12 contains the basic guidance for Army participation in amphibious operations.

6-9. Factors influencing Amphibious Operations

a. Oceanographic Conditions.

(1) Sea ice is one of the factors affecting amphibious techniques in their adaptation to northern conditions. In any amphibious operation within sea ice areas, the amphibious task force commander should be given great latitude in determining where and when he should attack. Positive air protection must be provided as the force will be limited in evasive action. The force will probably be accompanied by icebreakers, and progress will be slow. Amphibious operations wherein ships are required to enter an icepack may have to be abandoned as impractical because shifting ice may close leads, immobilize ships, restrict landing areas, and, in some cases, form pressure ridges which are impossible, or extremely difficult, to negotiate.

(2) Within ice free areas, no departure from standard amphibious techniques is required except as the operations may be affected by climatic conditions and operating conditions ashore.

(3) Unnavigable ice consists of pack ice or landfast ice fields that are either impenetrable or

penetrable only by a large powerful icebreaker. Under such ice conditions an airmobile assault from ships can be used. In this case, the operations will be limited tactically and logistically in accordance with the limitations of the planes and helicopters. Another method is to use landing craft to move troops to the edge of the icepack for subsequent movement across the ice against an objective. Under these circumstances, the operation maybe of a limited nature since only light-armed, swift-moving, well-trained personnel can be used. Logistical support normally will be by air.

(4) Marginal ice areas include those areas that are negotiable by light icebreakers and areas free from pack ice but subject to drifting ice and scattered ice floes. This ice is continuously moving because of the wind and ocean currents. If a landing is to be executed within the pack area, the task force. commander must determine when to attack, basing his decision on ice conditions.

b. Effect of Northern Conditions on Personnel and Equipment.

(1) During the beach assault, waterproof suits must be provided troops and crews of landing craft to protect them from sea spray and, if a dry ramp landing cannot be made, from freezing sea water. Operation of all mechanized equipment, boats, amphibian tractors, and aircraft in subfreezing temperature is difficult. Provisions must also be made for freeing the landing craft ramps should they freeze during the movement ashore. Amphibian wheeled vehicles of the LARC type are unsuitable for landing operations either afloat or ashore due to the fragile hull and the difficult trafficability ashore. Therefore, the use of amphibian tracked vehicles is emphasized for the movement of both troops and supplies from ship to shore.

(2) Shore party operations may be restricted and efficiency reduced by low temperatures, since stations will be required for the exchange of wet clothing and for warm-up purposes. In shore-to-ship evacuation, casualties must be protected from the cold, sea spray, and sea water. Consideration should be given to beaching an LST or similar vessel for the use of the shore party as protection from weather.

6-10. Supporting Arms

a. Operation of the supporting arms, such as naval gunfire support ships and air support, both land and sea, will be hampered during periods of low visibility and during the long winter darkness. Considerable reliance may have to be placed upon electronic means for directing fire support.

b. The practicability of employing naval air is dependent upon the ability to provide necessary close range supporting bases, generally an aircraft carrier and other supporting ships which in turn must depend upon icefree conditions of the sea for vitally needed maneuverability. Because of the difficulties imposed upon air operations in northern areas, the highest degree of coordination is necessary between naval air and forces it is supporting. Among these difficulties are the following:

(1) Periodic decrease in visibility and adverse weather in northern maritime theaters limit air-ground support operations.

(2) Lack of detailed charts, identifiable terrain features, low visibility, and scarcity of good weather forecasts.

(3) Atmospheric disturbances which increase the communications difficulties for coordinating air with amphibious or land operations.

(4) Longer periods of maintenance and preparation.

(5) Heavy and cumbersome clothing which reduces efficiency of personnel.

c. Naval gunfire will operate with little decrease in efficiency expected in temperate zones. The temperature can be controlled on ammunition, such as the VT fused projectiles, enabling the ship to fire without encountering the difficulties experienced by artillery.

6-11. Supply by Water

a. A northern supply expedition by water, during icefree periods, is less difficult to execute than other methods of supply transport. Ships are self-sufficient, requiring no servicing or refueling facilities at their destinations. Supplies can be delivered on a large scale with a minimum of hazard to personnel and equipment as compared with other methods. Water movement provides bulk supply possibilities not found in any other form of transportation.

b. In the ocean areas of the north, movement possibilities vary widely from year to year depending upon the severeity of the preceding winter season. However, most areas of the Arctic Ocean bordering on land masses have about ten weeks each year when the ice permits passage of vessels. These periods usually occur during July, August, and September.

(1) The short summer season usually is long enough to melt most of the ice and snow on the land areas and to break up the southernmost portions of the polar icepack for several weeks. Poor visibility restricts observation, which is essential to picking a way through drift ice and the icepack, and also hampers cargo discharge when vessels must anchor several miles from shore. To guide landing craft which are discharging cargo, marker buoys are placed along the entire route from the ship to the shore.

(2) Navigation is restricted by the movement of the icepack, which is governed by winds, tides, and currents. Aerial observation by helicopter is essential for icebreakers because of the rapidly changing ice conditions. When the huge floes and chunks of ice are frozen together or packed solidly by the wind and currents, a powerful icebreaker is unable to force passage. Navigation is further hampered by the prevailing shallowness of the water off Arctic Ocean shores, and the

numerous, migrating sandbars which prevent vessels from standing in close to shore to avoid heavy ice and to discharge cargo. A serious lack of adequate hydrographic data is an additional hazard.

(3) Cargo discharge is retarded by the lack of sheltered harbors, the absence of wharves, and piers, and the distance the vessels must anchor from shore. Consequently, more equipment and manpower is needed than under ordinary circumstances since, in a matter of hours, the icepack may change so that the exit to clear water is blocked. Timing of the operations is another governing factor to overwater supply, because the periods of open water or accessibility of installations varies from year to year, supply expeditions must be on hand to take advantage of the leads and breaks in the icepack as they occur.

(4) Resupply by submarines operating beneath the polar ice may be considered when an insufficient ice free season exists. Deep water appraoches to off-load points, explosives to clear ice at desired load areas, and over-ice tractor haul or field pipe link from off-load point to land storage areas are required.

c. For operation on inland waterways, the principal equipment consists of towboats and cargo barges which have varying capabilities for transporting dry cargo or liquid petroleum products. However, navigation of inland waterways is restricted by shallow water and with sudden changes in channels due to migrating sandbars and ice action. There are also occasional spots which may require portaging. The limitations of inland waterways may be overcome in part by the use of air-propeller driven boats for high speed scouting or delivery of small quantities of supply, and/or by the use of air cushion vehicles operating over inland waterways and adjacent swamps and lakes.

Section IV. RIVERINE OPERATIONS

6-12. General

a. Riverine Environment. A riverine area is a land environment characterized by water lines of communication with an extensive network of rivers, streams, canals, swamps, or muskeg extending over broad, level terrain, parts of which may be inundated periodically or permanently. It may include sparsely populated swamps or forests, rivers and streams that have steep banks densely covered with undergrowth. Ocean tides may affect riverine areas near the seashore or far inland. In northern areas the riverine environment may be completely devoid of human habitation.

b. Northern Waterways.

(1) The northern regions are characterized by a vast network of rivers, lakes, and canals with sufficient depth to accommodate shallow waterway traffic. In the absence of road and railroad nets, these natural arteries may be a highly valuable complement to overland transportation, both in summer and winter. For summer operations, some inland waterways of North America and

Eurasia are navigable for thousands of miles. In winter, these waterways become ice routes.

(2) Major inland waterways in the area of northern operations include the Yukon and Kuskokwim in Alaska; the Mackenzie, Back and Thelon in Canada; and the Ob, Yenesei, and Lena in Siberia. The above does not include the thousands of miles of other potential inland waterways that occur in these countries and in Norway, Sweden, and Finland. On these major waterways, operations can normally be conducted within the context of true riverine operations with naval support, however, as the operation proceeds inland, the waterways become increasingly shallow and the use of naval support craft will give way to shallow draft assault and river boats.

(3) Northern waterways can be used during the entire summer season from breakup until freezeup. Operations should not be attempted after break-up until all the ice and debris has cleared from the waterway. Operations can be continued until freezeup and the waterways start to ice over.

6-13. Characteristics of Northern Inland Waterways

Northern inland waterways are characterized by the following:

a. Many channels (braided). Main river channels may change significantly from year to year.

b. Water is normally filled with silt, sand, and debris.

c. Current is normally swift (5 to 10 knots).

d. Rivers and streams are shallow (61 cm to 305 cm (2' to 10'). In glacier fed streams the depth of water may double between early morning and noon. This is because of the increased melting of the glacier caused by warmer daytime temperatures.

e. The rivers and streams will contain many sand bars.

6-14. Organization

a. Tactical Unity. Tactical unity should be maintained as far as possible when loading boats. Unit SOP must contain loading plans for all available boats. Personnel in the boat perform additional duties to fulfill the requirements for navigation, observation, rowing and poling, etc. These duties are assigned by the boat commanders.

b. Boat Commander. The boat commander is normally the commander of the largest tactical organization aboard the boat. As an example, if a squad is being carried, the squad leader is the boat commander. If no tactical unity exists in the boat team, the boat commander must be appointed from within the personnel on the boat. The boat commander is responsible for the overall operation of the boat to include its safe operation and tactical operation. To accomplish his mission in a satisfactory manner, the boat

commander must be trained in the fundamentals of boat operation and river navigation.

c. Boat Operators. To prevent loss of combat strength boat operators must be procured from resources outside the tacical units, i. e., the engineer company or the transportation company. In the brigade, during sustained operations, it may be advisable to form a provisional boat company, attaching the boats to maneuver elements as needed.

d. Boat elements. Normally, an element moving on the water consists of at least two boats to provide some depth, flexibility, and safety if one boat comes under enemy fire, is swamped, or is swept into obstructions. The number of men, weapons, and boats necessary for the movement depends on the mission. Units of more than eight boats normally form into smaller maneuver elements.

6-15. Basic Formations

The tactics of waterborne units are similar to those of other mounted and dismounted units. Normal formations (column, parallel columns, vee, wege, and echelon) are applicable to water movement. The situation, mission, and width of the river or stream influence the choice of formation (see FM 31-75).

6-16. Control and Coordination

A simple, rapid, and reliable means of boat-to-boat communication is necessary. Standard arm and hand signals (FM 21-60) are satisfactory, but waterborne elements require additional immediate-action procedures and backup communication means to insure smooth function. This normally can be accomplished with the squad and platoon radios. The commander assigns checkpoints along the route. These must be easily recognizable features, i. e., hills, tributary streams, etc. Reconnaissance aircraft communicate directly with the waterborne force either by radio or message drop. Use of a simple, rapid means of identification is necessary to coordinate the waterborne movement with other friendly forces in the area.

6-l7. Night Operations

Because of the difficulties encountered in reading the river and navigating, night operations should be conducted based on thorough prior reconnaissance and complete communication systems. To avoid operational losses, minimum light conditions should approximate twilight illumination.

6-18. Camouflage

Every effort must be made to camouflage boats and equipment. Camouflage nets and natural foliage can be used to camouflage the boat. Individuals can break up the outline of the boat by draping the poncho over their heads and the sides of the boat. At halts the boat should be hidden under overhanging trees or removed from the water and camouflaged on shore.

6-19. Offensive Operations

a. General. The concept of riverine operations on the major navigable waterways in northern areas is basically the same as in other areas of the world. Once the force leaves the major waterways and proceeds up the shallow, fast moving tributary rivers and streams, the operation comes under complete control of the Army. Army forces, supported by close air support aircraft, will conduct the waterborne operation utilizing Army watercraft and indigenous river boats.

b. Factors Influencing Operations. Operations will be influenced by the following factors peculiar to northern areas:

(1) The long hours of daylight during the summer in northern areas allow operations to be easily conducted 24 hours a day. This factor also allows the operation to be easily detected by the enemy.

(2) With few exceptions, major population centers are nonexistent along the navigable or tributary rivers in northern areas.

(3) Weather is unpredictable and can change rapidly.

(4) Maintenance requirements are greater especially on boat motors.

(5) Flooding may submerge or sweep away landing sites (piers, docks, etc.). During flooding periods the current may increase to a torrent making the river unnavigable. It may, in meandering streambeds, clog existing channels, cut new ones, or deposit shallow banks in channels and backwaters.

(6) Low water may reduce the channel depth below minimum requirements and reduce or temporarily eliminate the usefulness of the waterway as a means of transportation.

(7) All available forces must be employed in northern riverine operations. In the area of operations (AO), one element of the riverine force may enter the area by watercraft, another may employ airmobile tactics to enter the area, and another may proceed overland, either mounted or unmounted.

(8) Land and river navigation take on increased importance in northern riverine operations. This is caused by excessive declination, lack of identifiable landmarks, and the unreliability of the magnetic compass caused by local ore deposits and the nearness of the magnetic north pole. Reliance must be placed on the use of aerial photographs and air reconnaissance.

(9) The difficulty in navigation dictates the establishment of firm control measures. These will

take the form of boundaries, coordination points, phase lines, and no-fire lines. These control measures must be part of the unit SOP.

6-20. Fire Support

a. Fire support for Army waterborne operations will be difficult and in some situations nonexistent. Field artillery can support within range limitations. Because of the shallow depth and fast current of the rivers and streams, displacement and ammunition resupply may be expedited by helicopter. Field artillery units that are displaced by helicopter must be prepared to establish an all-around defense.

b. Attack helicopters can support the waterborne force subject to weather conditions, and radius of operation capability.

c. A high dependence must be placed on close air support. If this support is not available, the waterborne force must depend on its organic weapons as the only means of fire support. Every effort must be made to kill the enemy with artillery and/or air delivered weapons.

6-21. Combat Service Support

a. AS far as possible, units should carry all items of supply necessary to complete the mission. This includes rations, ammunition, and POL. If the length of the mission precludes this, resupply can be accomplished by helicopter within range limitation; air cushion vehicles; air boats; or a combination of all three. If time permits it is sometimes advisable to establish and prestock resupply points up and down the river. Resupply may also be accomplished by Air Force heavy drop.

b. Prescribed load lists (PLL) must be established for motors and related equipment. Special effort is required for stockage of nonstandard motors and equipment. This PLL must be made a part of the unit SOP. The list must contain items with a high usage factor, i.e., propellers, water pumps, spark plugs, etc.

c. Medical evacuation may be extremely difficult. Plans should be made for helicopter evacuation. If the waterborne force is operating out of helicopter range, casualties can be transported by boat to predetermined helicopter pickup areas.

6-22. Defense of Base Areas

The mission of units defending base areas in the northern riverine environment is to maintain a secure base from which to support and conduct offensive operations. For details concerning defense of base areas see FM 31-75.

6-23. Training

The most important single facet of conducting successful northern riverine operations is training (app B).

a. Boat Operators. The capability of the individual boat operator to operate his watercraft in a safe efficient manner spells the difference between success and failure. In addition to the primary boat operator, each boat should contain, as a minimum, one other qualified operator. The training course contains the following subjects:

(1) Fundamentals of river reading.

(2) River navigation.

(3) Characteristics and nomenclature of the outboard motor.

(4) First echlon maintenance of the boat, motor, and related equipment.

(5) Rules of water safety.

(6) Techniques of river charting.

(7) Chart sketching and sketching equipment.

(8) Boat operation.

(9) River patrolling.

(10) Individual equipment.

(11) Loading procedures.

b. Small Unit Leaders. Squad leaders should be as well trained in boat operation as the boat operators. Platoon leaders and company commanders should be trained in the techniques of river navigation and river reading.

c. Unit Training. Unit training starts with learning the fundamentals of riverine operations to include familiarization with the boats. SOP must be developed by each unit and should contain detailed loading plans for all types of watercraft available to the unit. (See FM 31-75.) Loading must be rehearsed until all personnel know their duties, their boat and associated boat equipment. All training afloat must be conducted under simulated tactical conditions.

6-24. Guidance

For detailed doctrinal guidance on riverine operations, see FM 7-20, FM 21-50, FM 31-75, and FM 61-100. For boat procedures see appendix D.

Section V. RAIDS AND REAR AREA OPERATIONS

6-25. General

In northern operations there usually are no continuous fronts. Units may operate independently many mile apart. Installations and communication centers are often isolated. Lines of communications, where they exist, are long and vulnerable to attack. Surprise is always a possibility, and security can only be guaranteed by accurate knowledge of enemy disposition, composition, movement, capabilities, and constant vigilance. The enemy is equally vulnerable. Conditions, both operational and environmental, facilitate raids on communications centers, headquarters; and installations of all types. Patrols, stay-behind forces, and special forces are well suited for these operations. Severe weather conditions enhance the effect of such operation.

6-26. Tasks

a. The primary tasks of long range patrols will be reconnaissance missions and raids in enemy rear areas. Their operation will be supplemented by the activities of small groups, airdropped or airlanded, for special or long term destruction and intelligence tasks.

b. As an integrated part of overall planning, combat patrols will be used in the attack, for wide encircling movements to ambush and harass enemy flanks and communications and to report on and obstruct the movement of enemy reserves.

c. In retrograde movement, stay-behind forces may be left to ambush reserves, destroy lines of communication, mine defiles, and demolisth bridges. They will obtain and transmit information on enemy strength, composition, and activity.

6-27. Control

Patrols and enemy rear area operations must be part of the overall plan. For this reason, control must be vested in the commanders responsible for their area of operation. When the tactical situation demands, special arrangements must be made for cooperation with, and recognition by, local troops so as to exploit fully the tactical potential of special operations groups.

6-28. Composition and Employment

a. Long range patrols have no fixed organization. Their strength, organization, composition, and equipment are determined by the particular mission.

b. Operations can be carried out in all weather and throughout all seasons. In the winter, skis or snowshoes will be used. In summer, movement on foot is possible in most areas.

c. The great distances necessitate increased use of aircraft for the transport, supply, and the evacuation of patrols, casualties, prisoners, or documents.

d. Patrols must be capable of rapid movement on foot or skis over long distances and must be able to operate without resupply for long periods.

To achieve this standard, a rigorous reduction in the weight of equipment and rations is necessary. The weight and number of arms must be kept to a minimum and firepower must be obtained by use of lightweight automatic weapons and grenades. Communication with the base is by long range radio.

6-29. Selection of Personnel

The effectiveness of long range patrols and intelligence groups, fundamentally, depends on their ability to live under rigorous conditions and on the speed with which they can move across country. A high degree of endurance and expertness on skis or snowshoes are of paramount importance. In addition, every man must be proficient in all those subjects classified generally under the term "survival." Personnel must be specially selected from men with a wide practical experience in the northern regions and be, if possible, volunteers. Included in each group should be at least one person with a knowledge of the language, the people, and terrain of the combat theater.

Section VI. SPECIAL FORCES AND PSYCHOLOGICAL OPERATIONS

6-30. Special Forces

a. The mission of the U. S. Army Special Forces is to--

(1) Plan and conduot unconventional warfare operations.

(2) Plan, conduct, and support stability operations.

(3) Plan and conduct direct action missions which are peculiar to Special Forces because of their organization, training, equipment, and psychological preparation.

(4) It is within the capabilities of the U. S. Army Special Forces to plan and conduct deep penetration missions to include--

(*a*) Attack of critical strategic targets.

(*b*) Collection of intelligence.

(*c*) Strategic target acquisition.

(*d*) Conduct direct action missions against sensitive targets as directed by higher headquarters.

b. The role of U. S. Army Special Forces is to contribute within their capability to the accomplishment of whatever missions and responsibilities are assigned to the U. S. Army. Within the framework of the contribution, the U. S. Army Special Forces group is a multipurpose force, which by organization, flexible command arrangements, tailored logistical and fiscal procedures, and highly trained personnel, can address a variety of missions. Special Forces must be constantly prepared to assume missions of an unconventional warfare (UW) nature during any intensity of conflict. Sustained unconvenitonal warfare operations require augmentation by combat support and logistical support units. Employment in other roles and/or to meet unusual requirements may necessitate augmentation or modification of TOE (MTOE).

c. When employed in northern operations, Special Forces are trained in mountaineering and survival in the harsh environment of the north. To support operational requirements, Special Forces will organize, train, and develop indigenous groups into guerrilla and paramilitary operations. When there is insufficient time and/or population to organize into guerrilla forces, U. S. Army Special Forces units may be employed unilaterally on special missions or against critical targets within the area of operations.

6-31. Psychological Operation

The extremes of weather, terrain, and climate encountered in northern operations present the commander and his PSYOP staff with unusual psychological opportunities. Every effort must be made to capitalize upon the fears and other vulnerabilities of an enemy force in this environment. PSYOP officers, utilizing their background and training, may also assist unit commanders and others in preparing information material and troop topics designed to alleviate unnecessary fear, stress survival techniques, and, in general increase the fighting potential of the soldier. PSYOP unit capabilities may be used to produce lierature, handouts, posters, and broadcasts to reinforce or supplement troop and command information (FM 33-1 and FM 33-5).

6-32. Enemy Target Audiences

The decentralized and dispersed nature of northern operations will present additional psychological vulnerabilities among enemy forces. The following target audiences are examples:

a. Isolated units removed from the main stream of activity for prolonged periods.

b. Small unit leaders operating with unaccustomed freedom and independence beyond the control of immediate political and military superiors.

c. Front line units that have too long endured the rigors of cold northern life.

d. Civilian inhabitants who have been forced to surrender already scarce fuel, food, or shelter to the enemy.

6-33. Themes

Examples of themes that are effective in northern operations in attacking hostile target audiences are those that stress--

a. Solitude, privation, and monotony.

b. Lack of equipment and comfort items versus United States abundance.

c. Personal dangers such as frostbite, loss of limb, cold injuries, and disease.

6-34. Media

Media considerations peculiar to the northern environment include--

a. "Blackouts" from the auroral effect or atmospheric static must be considered when planning and programing PSYOP radio broadcasts. Antenna erection in frozen ground and the effect of extreme cold on batteries are significant factors.

b. Snowstorms, muddy ground, and high winds, are detrimental to leaflet operations. Ground immobility, static winter quarters, and limited road networks are assets.

c. Planning for the use of loudspeakers should consider man portable devices, the application of existing vehicular-mounted loudspeakers to modes of transportation commonly found in the area of operations, and rotary wing or fixed wing aircraft.

Section VII. USE OF NONAIR DEFENSE WEAPONS AGAINST AIRCRAFT

6-35. Concept

a. The substantial low altitude air threat faced by units in the combat theater may be partially countered by aggressive use of the large volume of fire which nonair defense weapons, e. g., small arms and automatic weapons, can place against this threat.

b. Exercise of the individual and collective right of self defense against hostile aircraft must be emphasized.

c. Indiscriminate use of nonair defense weapons must be prevented. Engagement of hostile aircraft in immediate self defense will be most frequent and training emphasis should reflect this.

6-36. Rules of Engagement

In the absence of orders to the contrary, individual weapon operators will engage attacking aircraft; engagement of all other hostile aircraft will be on orders (based on SOP) issued through the unit chain of command and will be supervised by unit leaders. Nothing in this rule is to be taken as requiring actions prejudicial to accomplishment of the primary mission of the unit.

6-37. Techniques

a. Engagement of Low Speed Aircraft. In accordance with the rule of engagement, engage low speed enemy aircraft with aimed fire, employing the maximum weapon rate of fire. Aerial gunnery techniques generally applicable to all small arms and automatic weapons are presented in FM 23-65.

b. Engagement of High Speed Aircraft. In accordance with the rule of engagement, engage high speed enemy aircraft with maximum fire aimed well in front of the aircraft, and above its flight path, in order to force it to fly through a pattern of fire.

c. Use of Tracer Ammunition. Automatic weapons should utilize the highest practical proportion of tracer ammunition to enhance the deterrent or disruptive effect.

d. Massed Fire. Units should employ a massed fire technique when using small arms and automatic weapons in an air defense role, i.e., unit leaders should direct fires so as to mass the available fires against a selected target(s).

6-38. SOP Items

Unit SOP should cover, but not be limited to, the following items relevant to engagement of aircraft with nonair defense weapons.

a. Applicability. (Operators of designated weapons.)

b. Relation to Primary Mission.(Primary mission is never prejudiced.)

c. Relation to Passive Air Defense. (The necessity for aggressively engaging hostile aircraft is balanced with the requirement to place in proper perspective the tactic of withholding fire to preclude disclosure of position.)

d. Authority to Engage. (Authority to engage attacking aircraft delegated to individual weapons operators, except when explicitly denied. Authority to engage all other hostile aircraft on orders through unit chain of command, subject to local and theater SOP.)

e. Rule of Engagement. (Normally self-defense only against all attacking aircraft, or as ordered.)

f. Rules for Withholding Fire. (When ordered. When not positive that aircraft are actually attacking or otherwise hostile. When friendly aircraft or troops are endangered.)

g. Position Selection. (Applicable only to weapons specifically assigned an air defense role; e. g., designated single barrel caliber .50 machineguns.)

h. Firing Techniques. (Lead and superelevation. Massed fire. Maximum rate of fire. Maximum use of tracer ammunition.)

i. Unit Training Requirements. (Motivation and discipline. Gunnery. Aircraft recognition.)

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CHAPTER 7

TRAINING

Section I. GENERAL

7-1. Scope of Training

a. Units selected for employment in northern areas should have completed normal individual and unit training prior to beginning cold weather training.

b. Training falls into two categories--summer and winter. Because of the special factors introduced by the northern environment, training differs more widely from that of temperate zones. It demands higher standards of physical fitness, and emphasis is placed on conducting as much training as possible out-of-doors. Training to familiarize troops with special equipment must precede unit training in the application of northern techniques to tactical principles. Preliminary training in using special equipment can be taught without the environmental factors of snow and cold, thus gaining time for technical and tactical training. In all training, emphasis should be placed on operations conducted during hours of darkness. Training in summer is the same as in temperate zones except for environmental conditions.

7-2. Training Areas

Care must be taken in the selection of suitable training areas to insure that all possible conditions of climate and terrain, likely to be encountered during subsequent operations, are experienced during training.

7-3. Instructor Requirement

Provision of qualified instructor is a critical problem in preparing a force for northern operations. Minimum requirements are one officer for each company sized unit and two noncommissioned officers for each platoon or equivalent unit.

7-4. Training of Qualified Instructors

A preliminary course for unit instructors must be conducted before the commencement of northern training. This course must be supervised by instructors who are thoroughly experienced in the various techniques peculiar to northern operations. Practical field experience should be provided unit instructors prior to starting the unit training program.

7-5. Training Objective

To train individuals and units to accomplish their combat mission under all conditions of weather, climate, and terrain encountered in northern operations and to develop and stress leadership and individual initiative by small unit commanders. The standards of training must be high since units will often be in small groups. Leadership by small unit commanders and individual initiative must be developed and stressed.

Section II. WINTER TRAINING

7-6. General

The basic requirements for training in northern operations are the same in all seasons. Toughness, resourcefulness, initiative, and ability to live and operate in the field are required of each individual. In most respects troops trained during the winter are capable of conducting operations during any other season.

7-7. Training Period

Winter training is a task requiring a well-coordinated program and a competent instructional and administrative staff. For units that have completed advanced unit training, a training period of 12 weeks is desirable. Training for northern winter operations falls into the following phases (for technical units, some adjustment may be necessary between the indoctrination and specialist training):

a. Indoctrination training (common to all arms) ----------8 weeks

b. Specialist training ----------2 weeks

c. Unit/combined arms training (over and above in doctrination training) ----------2 weeks

A typical program for indoctrination training together with appropriate subject schedules for a unit is shown in appendix B.

7-8. Indoctrination Training

Individual and small unit indoctrination training should cover clothing, small unit living and cooking, weapons training, dismounted movement, snowshoe and ski training, land navigation, field fortifications, camouflage, and first aid and hygiene, as outlined in FM 31-70.

7-9. Specialized Training

a. Driving and Maintenance. The highest standards of driving and maintenance must be maintained. To overcome the obstacles encountered during winter operations, close supervision by officers and noncommissioned officers is required to insure that these standards are maintained. Special training is required in the use of winterized equipment, engine heaters, and other special devices; care of batteries; and treatment of fuel to avoid condensation (TM 9-207, TM 9-273 and TM 9-8662). Extensive practice in driving under the more difficult conditions of terrain, snow, and ice, and in recovery of vehicles is essential. Drivers must be trained to make on-the-spot emergency repairs and in the use of field expedients.

b. Communications. Commanders should be aware of the environmental factors that affect communications and the necessary measures to overcome them. All communications personnel must learn the special techniques necessary to prepare and maintain their equipment and communication nets at operational efficiency under all conditions.

c. Equipment Repair.

(1) The conditions of northern warfare cause a high rate of damage to all equipment. Unit mechanics will require training for repair work under these conditions and, either a higher proportion of mechanics than normal are provided, or special courses in field equipment repair must be organized for selected enlisted men.

(2) Individuals should be trained to make minor repairs to the special items of equipment (sleds, skis, and snowshoes) that are issued for these areas.

d. Navigators. In certain regions and for certain types of operation, the force may require personnel trained in celestial navigation using a theodolite or a sextant.

e. CBR Training. Training for operations under CBR conditions is best accomplished by integration of CBR situations and procedures into the normal training routine. Since CBR protection procedures will vary in extreme cold from those used in temperate climates, individuals must relearn masking, first aid, decontamination, operating in toxic atmosphere or on contaminated ground, and CBR defense in general as modified by extreme cold conditions.

f. Other Specialized Training. It is to be noted (app B) that special attention must be given to the training of radio operators, vehicle drivers, weapons crews, medical and engineering personnel, and specialists of

all other supporting arms and services. All specialists should have an indoctrination course. This training would provide for the necessary knowledge and proficiency in common techniques such as: use of clothing and equipment and the ability to move, live, and operate under northern conditions. The remainder of the training period must provide for instruction in those special techniques and functions peculiar to their specialty.

7-10. Officer and Noncommissioned Officer Training

a. Leadership. The qualities of leadership demanded of officers and noncommissioned officers by northern operations are far higher than those normally required for any other type of warfare. Fear of the area of operations must be overcome, and leaders must be impressed with the exacting nature of their responsibilities in this respect.

b. Land Navigation. All officers and senior noncommissioned officers must be proficient in dead-reckoning navigation. They should thoroughly understand the use of the magnetic compass in the North since it is the most common direction-finding instrument used by the individual and small unit.

c. Elementary Meteorology. Officers must be able to interpret meteorological reports since weather will be a major influence in the planning and execution of operations.

d. Bearing Capacity of Ice. Each officer and noncommissioned officer should be thoroughly acquainted with the various factors effecting the strength of ice and the rules or calculations necessary for determination of its bearing capacity.

7-11. Training Emphasis

a. Correct procedures must be emphasized at all times during training to insure that the basic techniques of northern operations are thoroughly mastered and correctly applied. Even the very minor errors must be pointed out and the proper corrective action demanded. If men are properly training during the training cycle, they will continue to perform the necessary tasks when confronted with the extreme conditions found in the area of northern operations. The troops must be impressed with the fact that their job is still "success in combat" and not one of survival.

b. Some of the more common areas requiring emphasis are--

(1) Keeping the body clean.

(2) Preventing dehydration, constipation, and overheating.

(3) Proper care of weapons and equipment.

(4) Taking positive action and improvising means of maintaining mobility when confronted with

obstacles or equipment failure.

(5) Proper care of feet.

(6) Importance of hot food.

(7) Troop safety to include carbon monoxide, fire hazards, and cold weather injury.

(8) Proper camouflage discipline.

(9) Preparation of sleeping areas.

(10) Movement at night or during conditions of low visibility.

(11) Importance of detailed, simple, and flexible plans.

(12) Land navigation.

(13) Rapid deployment and cross-country movement on skis and snowshoes.

(14) Route selection.

(15) Trailbreaking.

(16) Using the terrain and weather to advantage.

(17) Proper employment of weapons.

(18) First aid and self-aid techniques.

(19) Glacier crossing techniques.

(20) Mountain climbing skills.

Section III. TRAINING--OTHER SEASONS

7-12. Training Period

a. The period of summer training required for northern operations can be 6 weeks. Of this, 3 weeks are required for basic indoctrination and small unit training and 3 weeks for unit and combined training.

Engineers require an additional period of at least 2 weeks for specialist training.

b. The basic program suggested for winter training is suitable if adjusted by the elimination of those items peculiar to winter conditions and the substitution of those required for summer. The period to be allotted to inland waterways navigation is dependent on the standard of training of troops on arrival and must be adjusted accordingly.

c. The number of instructors required is the same as for winter training.

Section IV. HINTS FOR INSTRUCTORS

7-13. Avoiding Fear of the North

Most troops have an exaggerated conception of the danger, discomfort, and loneliness of the North. Avoid the natural tendency to enlarge upon such environmental hazards. Instructors must use every means in their power to insure that all men obtain a balanced perspective of northern operations at the earliest possible moment.

7-14. Training Environment

One of the principal objects of training is to accustom troops to the cold and living in the field. As far as possible, training should be conducted outdoors, and the training schedule developed with this goal in view.

7-15. Supervision

a. At the beginning of training, instruct troops in the "buddy" system for detecting frostbite, under which each man periodically inspects the face and hands of his neighbor. In spite of this, it is necessary, particularly during the early stages of training, for instructors to check troops frequently for frostbite, frozen feet or hands, and overheating. It is extremely important that all personnel thoroughly understand the meaning and effects of windchill and how to cope with it. For an explanation of windchill and its contributing factors see FM 31-70.

b. Before commencing a march, instructors must check to insure that each man has mittens, sunglasses, and other essential items of clothing and equipment. Particular care must be taken to check all squad equipment.

c. Frequent halts should be of short duration (25 minutes marching and 5 minute breaks) depending on the difficulties presented by the terrain and the condition of the men. Men should never be allowed to become cold when resting. If unit is breaking trail, rotation by personnel should be accomplished every 10-15 minutes.

d. On strenuous marches or in bad weather, a vigilant watch must be maintained for signs of exhaustion.

e. When establishing camp, leaders should make certain that no man who is damp with perspiration or who has wet feet is immediately placed on sentry or similar duty before drying off or changing socks. A continual watch must be maintained to insure that men do not endanger themselves by fire or expose themselves to carbon monoxide fumes.

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APPENDIX A

REFERENCES

A-1. Army Regulations (AR)

AR 310-25 Dictionary of U.S. Army Terms.

AR 310-50 Authorized Abbreviations and Brevity Codes.

DA Pamphlets (DA Pam)

DA Pam 310-1 Index of Administrative Publications, Regulations, Circulars, Pamphlets, Posters, JCS Publications and General Orders.

DA Pam 310-3 Index of Doctrinal, Training and Organizational Publications.

DA Pam 310-4 Index of Technical Manuals, Technical Bulletins, Supply Manuals, Supply Bulletins, and Lubrication Orders.

A-3. Field Manuals (FM)

FM 5-15 Field Fortifications.

FM 5-20 Camouflage.

FM 5-25 Explosives and Demolitions.

FM 5-26 Employment of Atomic Demolition Munitions (ADM).

FM 7-10 The Rifle Company, Platoons, and Squads.

FM 7-20 The Infantry Battalions.

FM 8-10 Medical Support Theater of Operations.

FM 8-55 Army Medical Service Planning Guide.

FM 17-15 Tank Units, Platoon, Company and Battalion.

FM 20-33 Combat Flame Operations.

FM 21-10 Field Hygiene and Sanitation.

FM 21-11 First Aid for Soldiers.

FM 21-13 The Soldier's Guide.

FM 21-15 Care and Use of Individual Clothing and Equipment.

FM 21-26 Map Reading.

FM 21-31Topographic Symbols.

FM 31-12 Army Forces in Amphibious Operations (The Army Landing Force).

FM 31-16 Counterguerrilla Operations.

FM 31-22 U.S. Army Counterinsurgency Forces.

FM 31-70 Basic Cold Weather Manual.

FM 31-72 Mountain Operations.

FM 31-75 Riverine Operations.

FM 31-85 Rear Area Protection (RAP) Operations.

FM 33-1 Psychological Operations-U.S. Army Doctrine.

FM 33-5 Psychological Operations-Techniques and Procedures.

FM 54-2 The Division Support Command and Separate Brigade Support Battalion.

FM 57-1 U.S. Army/U.S. Air Force Doctrine for Airborne Operations.

FM 57-35 Airmobile Operations.

FM 101-10-1 Staff Officer's Field Manual: Organizational, Technical, and Logistical Data-Unclassified Data.

FM 101-31-1 Staff Offficer's Field Manual: Nuclear Weapons Employment Doctrine and Procedures.

A-4. Technical Bulletins (TB)

TB Med 81 Cold Injury.

TB Ord 390 Cold-Starting Aid Kit.

A-5. Technical Manuals (TM)

TM 3-366 Flame Fuels.

TM 3-1040-204-14 Flamethrower, Portable, M2A1-7.

TM 3-1040-206-10 Flamethrower, Mechanized, Main Armament, Turret-Mounted, M7A1-6.

TM 3-1040-209-12 Flamethrower, Mechanized, Main Armament, M10-8.

TM 3-1040-211-12 Flamethrower, Portable, ABC-M9-7.

TM 5-330 Planning and Design of Roads, Airbases, and Heliports in the Theater of Operations.

TM 5-349 Arctic Construction.

TM 9-207 Operation and Maintenance of Army Ordnance Materiel in Cold Weather.

TM 9-273 Lubrication of Ordnance Materiel.

TM 9-1300-203 Artillery Ammunition.

TM 9-6140-200-15 Operation and Organizational Field and Depot Maintenance, Storage Batteries, Lead

Acid Type.

TM 9-8662 Fuel-Burning Heaters for Winterization Equipment.

TM 10-275 Cold Weather Clothing and Sleeping Equipment.

TM 21-300 Driver Selection and Training (Wheeled Vehicles).

TM 21-301 Driver Selection, Training, and Supervision (Tracked Vehicles).

TM 21-305 Manual for the Wheeled Vehicle Driver.

TM 21-306 Manual for the Tracked Combat Vehicle Driver.

TM 57-220 Technical Training of Parachutists.

A-6. Training Films (TF)

TF 5-2371 Field Engineering in the Subarctic, Part I, Winter Roads (27 min).

TF 5-2372 Field Engineering in the Subarctic, Part II, Winter Field Fortification (22 min).

TF 5-2373 Field Engineering in the Subarctic, Part III, Ice Mines, Ice Mine Fields, AT& AP Mines and Obstacles (21 min).

TF 5-3720 Basic Map Reading, Part III, Direction, Orientation, and Location Without a Compass (30 min).

TF 5-3721 Basic Map Reading, Part IV, Direction, Orientation, and Location With a Compass (30 min).

TF 7-1550 Combat in Deep Snow and Extreme Cold (21 min).

TF 7-2395 Basic Military Skiing, Part I, Selection and Care of Equipment (17 min).

TF 7-2396 Basic Military Skiing, Part II, Skiing Techniques (29 min).

TF 7-2397 Individual Fighting Techniques on Snow (23 min).

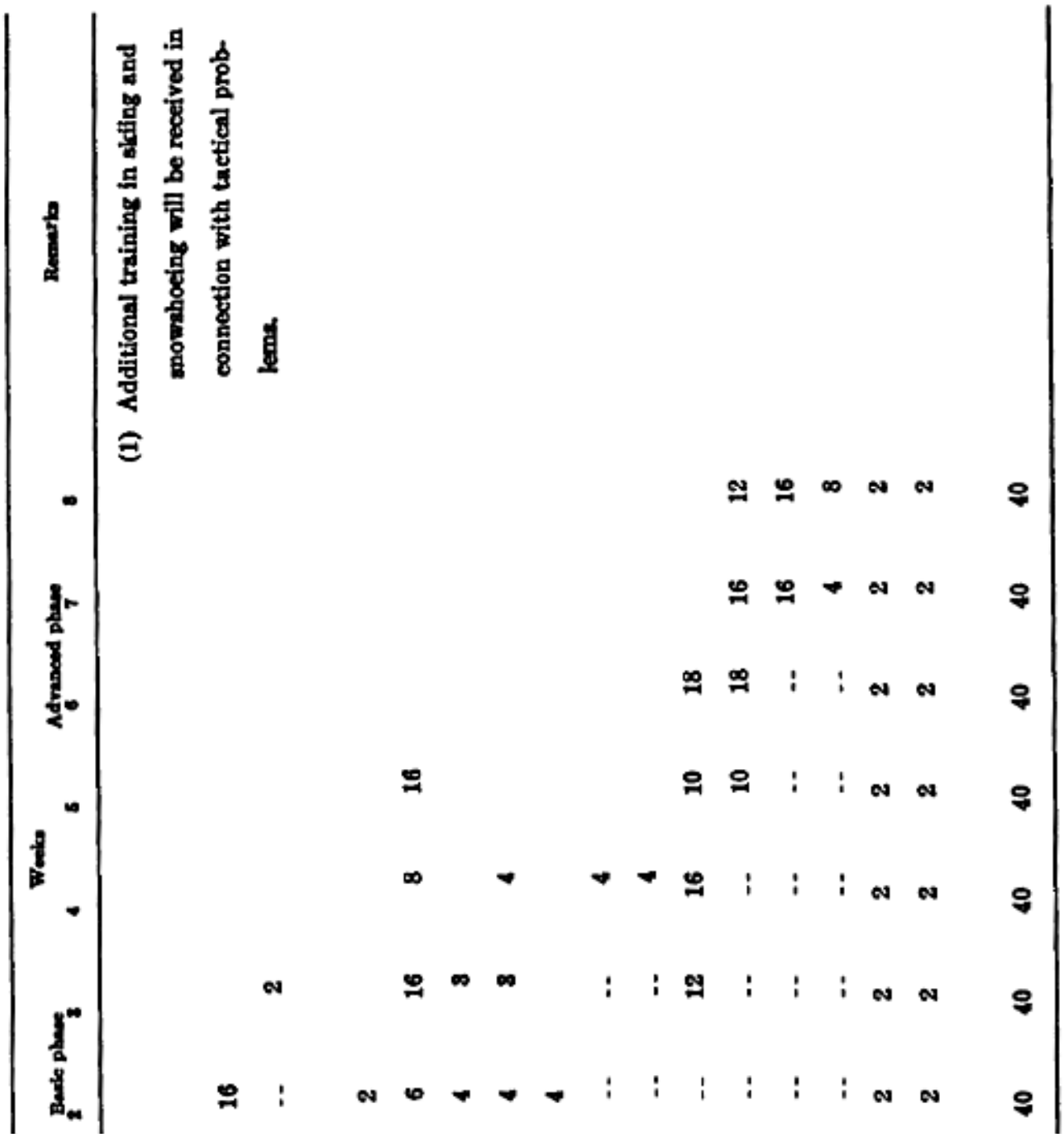
TF 7-7978 Firing Positions in the Winter (13 min).

TF 10-21 How to Use Cold Weather Clothing (14 min).

TF 31-2138 Sub-Arctic Winter Bivouacking (30 min).

APPENDIX B

SUGGESTED TRAINING PROGRAM FOR WINTER INDOCTRINATION



Basic phase 2	3	Weeks 4	5	Advanced phase 6	7	8	Remarks
							(1) Additional training in skiing and snowshoeing will be received in connection with tactical problems.
16							
--	2						
2							
6	16	8	16				
4	3						
4	3	4					
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--	12	16	10	18			
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40	40	40	40	40	40	40	

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Total periods 1

Reference and remarks	
ır, fitting ţ. Supply	TM 10–275, FM 31–70, TF 10–21.

Total periods 8

Reference and remarks	
ınd pack-	FM 21–15, FM 31–70, TM 10–275.
10-man;	FM 20–15, FM 31–70.
ı. Filling	FM 31–70.
and sled,	FM 31–70.
ammuni-	Instructor's notes.

Total periods 20

Reference and remarks	
ıd by na-	A general conference on all aspects, stressing the need for self-reliance and ways to get along in outdoor living. FM 31–70.
field ra- vernight.	FM 31–70.
	FM 31–70. TF 31–2138.
.....	FM 31–70, FM 31–71.

Item	Subject	Total hours	1	Basi 2
1.....	Clothing.....	1	1	
2.....	Equipment.....	8	8	
3.....	Living in the field.....	20	4	16
4.....	First aid and hygiene.....	6	4	--
5.....	Camouflage.....	3	3	
6.....	Snowshoeing (1).....	6	4	2
7.....	Skiing (1).....	54	8	6
8.....	March discipline.....	7	--	4
9.....	Land navigation.....	15	4	4
10.....	Weapons.....	4	--	4
11.....	Field fortifications.....	4	--	--
12.....	Road construction.....	4	--	--
13.....	Small unit training.....	56	--	--
14.....	Unit training and tactics.....	56	--	--
15.....	Battalion problems.....	32	--	--
16.....	Tests and competition	12	--	--
17.....	Maintenance of equipment.....	16	2	2
18.....	Commander's time.....	14	--	2
19.....	Arctic Leadership.....	2	2	
	Totals.....	320	40	40

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-70.

al daytime training. FM 31-70.

out following:
Sounds caused by man and units while skiing and snowshoeing.
Sounds of various type of vehicles.
Careless handling of lights, cigarettes, flashlights, opening of tent doors.

1-70, FM 31-71.

Total periods 6

Reference and remarks
-11, FM 31-70, TB Med 81.
-70, FM 8-10.
-70.
-70.

CLOTHING

Subject Schedule

Periods	Type of instruction	Subject
1	Conference	Principles of cold weather clothing and foot gear, fitt and adjustment. Use and care of sleeping bag. Sup economy in winter conditions.

EQUIPMENT

Subject Schedule

Periods	Type of instruction	Subject
1	Conference and Practical Work	Packing, adjustment, and carrying of rucksack and pa board.
2-3	Practical work	Pitching, striking, and packing of tent, arctic, 10-m and tent, hexagonal, lightweight.
4	Practical work	Stoves, Yukon and one burner. Coleman lantern. Fill and testing.
5-6	Demonstration and practical work	Loading and lashing of sled, scow type, 200 lbs., and sl 1-ton cargo.
7-8	Practical work	Loading of tentage, weapons, and basic load of ammu tion on sleds. Pulling exercise.

LIVING IN THE FIELD

Subject Schedule

Periods	Type of instruction	Subject
1	Conference	Living in a cold climate—utilizing the help offered by ture.
2	Conference	Demonstration of field rations. Tips on cooking field tions, melting snow, and keeping water overnig
3	Conference	Camp routine: 1. Organizing the work of tent teams. 2. Building temporary ski racks and latrines.
4	Conference	Camp security

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Total periods 3

5–7	Demonstration	Practical forestry: 1. Handling and caring for tools. 2. Cutting and trimming trees. 3. Temporary shelters. 4. Types of camp fires and safety precautions.	FM 31–70.
8–9	Demonstration and practical work	Winter bivouac	Practical da
10	Demonstration	Sound and light demonstration	Point out fo 1. Sou snow 2. Sou 3. Car ligh
11–20	Practical work	Overnight bivouac and security. Breaking camp during darkness.	FM 31–70,

rence and remarks

echniques and field fortifications.

Total periods 6

rence and remarks

l training in snowshoeing will
he conduct of tactical problems.
and rucksack should be carried.

Total periods 54

rence and remarks

equipment, blow torch, pinetar,
oard, projector, and screen. TF

F 7–2396.

wdrivers.

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FIRST AID AND HYGIENE

Subject Schedule

Periods	Type of instruction	Subject	
1–2	Conference	Discussion of first aid measures necessary to prevent frostbite, trenchfoot, carbon monoxide poisoning, and snow blindness, stress buddy system.	FM 21–11, F
3	Conference	Evacuation of casualties under winter conditions.	FM 31–70, F
4–5	Demonstration	Evacuation of casualties by sleds, improvised sleds, ski litters, tracked vehicles, cargo sleds and helicopters. Proper handling and transport of a casualty.	FM 31–70.
6	Practical work	Evacuation of casualties in defense; all normal and improvised means of transportation to be used.	FM 31–70.

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CAMOUFLAGE

Subject Schedule

Periods	Type of instruction	Subject	Reference
1	Conference and demonstration	Camouflage in winter	FM 31–70.
2–3	Practical work	Individual camouflage: 1. Men. 2. Weapons. 3. Positions.	FM 31–70. TM 5–349.
		Group camouflage: 1. Crew served weapons. 2. Tents. 3. Vehicles.	FM 31–70. TM 5–349. Integrate deceptive technic

SNOWSHOEING

Subject Schedule

Periods	Type of instruction	Subject	Reference
1–2	Demonstration and practical work	Fitting and adjustment of snowshoe bindings. Emergency bindings. Repair of bindings.	FM 31–70.
3–6	Demonstration and practical work	Snowshoeing techniques: 1. On level ground. 2. Over rolling terrain. 3. Ascending and descending. 4. Overcoming obstacles.	FM 31–70. Additional tra be received during the co Individual weapons and

SKIING

Subject Schedule

Periods	Type of instruction	Subject	Reference a
1–2	Conference and practical work	Nomenclature, use, and care of ski equipment; adjustment of bindings; use of ski waxes and climbers.	FM 31–70, Individual equi waxes, tools, blackboard, 7–2395.
3	Conference	Skiing techniques	Projector and Screen, TF 7–2
4–5	Conference and practical work	Adjustment of bindings and waxing of skis	Ski equipment and screwdriv
6	Conference and practical work	Ski drill	FM 31–70, Ski equipment.
7–8	Conference and practical work	Walking on skis with and without poles and with step turns.	FM 31–70, Ski equipment.

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9	Conference and practical work	The lunge	FM 31-70, Ski equipment.
10-11	Conference and practical work	One step	FM 31-70, Ski equipment.
12-14	Conference and practical work	Two step	FM 31-70, Ski equipment.
15-16	Practical work	Ski drill to include straight uphill climbing, side step, uphill traverse.	FM 31-70, Ski equipment.
17-20	Practical work	Ski drill to include side step traverse, herringbone, straight downhill running (concurrent with climbing steps).	FM 31-70, Ski equipment.
21-24	Practical work	Snowplow	FM 31-70, Ski equipment.
25-26	Practical work	Half snowplow	FM 31-70, Ski equipment.
27-28	Practical work	Pole riding	FM 31-70, Ski equipment.
29-31	Practical work	Side slipping	FM 31-70, Ski equipment.
32-40	Practical work	Snowplow turn	FM 31-70, Ski equipment.
41-44	Practical work	Bumpriding	FM 31-70, Ski equipment.
45-52	Practical work	Cross-country ski marches (adapting techniques to terrain).	All previous references. Ski equipment.
53-54	Practical work	Variations of cross-country ski steps	FM 31-70, Ski equipment.

MARCH DISCIPLINE

Subject Schedule

Total

Periods	Type of instruction	Subject	References and remarks
1	Conference	Winter marches and security	Stress overheating, importance of adequate liquids, security formations, control, and TF 7-1550, FM 31-70.
2	Conference	Trailbreaking and track discipline	Trailbreaking, halts and rest periods, track obliteration route selection, reading of tra 31-70, FM 31-71.
3	Practical work	Trailbreaking, reading and obliteration of tracks, deceiving tracks.	FM 31-70, FM 31-71.
4-7	Practical work	Cross-country march, march security, trailbreaking.	FM 31-70, FM 31-71. Integrate snowshoeing in all periods.

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LAND NAVIGATION

Subject Schedule

Total periods 15

eriods	Type of instruction	Subject	Reference and remarks
	Conference	Basic navigation—without compass	
	Conference	Basic navigation—with compass	
	Conference and practical work	Navigation in the winter. Dead reckoning, navigation log, pacing by using snowshoes and skis. Use of rope for measuring distances.	FM 21-26, FM 31-70, FM 31-71.
	Practical work	Daytime compass course	FM 31-70.
	Practical work	Night compass course	FM 31-70, integrate snowshoeing and skiing.

WEAPONS

Subject Schedule

Total periods 4

eriods	Type of instruction	Subject	Reference and remarks
	Conference and practical work	Firing positions in winter	FM 31-70, MF 31-7978, "Firing Position in Winter" (13 min.)
	Practical work	Firing	FM 31-70, Familiarization known distance range firing or trainfire. Concurrent training should include individual firing positions in snow; use of weapon supports of various types; and effect of small arms in deep snow, frozen ground, and against icecrete. Training should include emphasis on peculiarities of ammunition and weapons functioning in cold weather.

FIELD FORTIFICATIONS

Subject Schedule

Total periods 4

eriods	Type of instruction	Subject	Reference and remarks
	Demonstration and practical work	Preparing defensive positions: 1. Foxholes. 2. Crew-served weapons. 3. Use of explosives to facilitate digging.	FM 31-70 and TM 5-349. Attention should be centered on ways to camouflage the position during work, and ways of preparing improvised support for weapons. TF 5-2372.
	Demonstration and practical work	Obstacles in winter conditions: 1. Road blocks. 2. Concertina wire. 3. Mines.	FM 31-70, FM 31-71, TF 5-2373.

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ROAD CONSTRUCTION

Subject Schedule

Total periods 4

Type of instruction	Subject	Reference and remarks	Periods
ference	Planning, construction, and maintenance of winter roads.	FM 5-10, FM 31-70, TM 5-349, TF 5-2371.	1
onstration.	Organization, equipment, and function of road construction detail: 1. Detail varying from one rifle squad up to one rifle platoon; dozer operator and mechanic. 2. Tracked carriers, sleds, pioneer tools, and special equipment required. 3. Techniques of road construction. 4. Techniques used to reinforce ice and unfrozen ground. 5. Techniques used to maintain winter roads.		2 3-4 5-9 10-15
tical work	Route selection, construction, and marking of winter roads (to include construction of reinforcements and turnouts).	FM 31-70, TM 5-349.	

SMALL UNIT TRAINING

Subject Schedule

Total periods 56

Type of instruction	Subject	Reference and remarks	Periods
ference, demonstration, and practical work.	Combat techniques: 1. Firing positions. 2. Use of ski poles, skis, and snowshoes for support of the weapons.	FM 31-70, TF 7-2397.	1 2-4
onstration and practical work..	Interpretation of ski and snowshoe tracks in the field. Use of ski and snowshoe tracks to deceive the enemy.	FM 31-70, FM 31-71.	
tical work	Daytime patrolling: 1. On the route to the objective. 2. Activity in the objective area. 3. Return.	FM 31-70. FM 31-71. FM 31-71.	
tical work	Night patrolling: 1. Land navigation. 2. Infiltration through enemy security lines. 3. Ambush.	FM 31-70, FM 31-71. Another squad, scheduled to train in security of an outpost, will be used as Aggressor force.	1-2
tical work	Squad as outpost on open flank or in the gap between neighboring unit (night training): 1. Shuttle patrolling. 2. Activity of listening post. 3. Preventing infiltration.	FM 7-10, FM 31-70. Another squad, scheduled to train in night patrolling, will be used as Aggressor force.	3-4

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SMALL UNIT TRAINING (CONT'D)
Subject Schedule

Total periods 56

Instruction	Subject	Reference and remarks	Periods	
	Squad in delaying action: 1. Ski tracks made in advance. 2. Deceptive methods. 3. Arranging ambushes. 4. Mining of ski or snowshoe tracks.	FM 7–10. FM 31–70. FM 31–71. FM 31–71.	1.	Conferenc
	Squad in attack	FM 7–10, FM 31–70, FM 31–71. Short review of squad combat formations.	2.	Demonstr
	Squad in defense	FM 7–10, FM 31–70, FM 31–71.		
	Platoon as advance guard and trailbreaking party: 1. Trailbreaking. 2. Occupying critical terrain. 3. Flank security.	FM 7–10, FM 31–71.		
	Platoon as outpost on open flank (night training): 1. Perimeter defense. 2. Security tracks and shuttle patrolling. 3. Bivouac. 4. Use of trip flares.	FM 7–10, FM 31–71, Another platoon, scheduled to train in "infiltration," will be used as Aggressor force.	3–4	Practical
	Platoon infiltrating through enemy security lines and assembling at a given point behind enemy lines (night training).	FM 31–70, Another platoon, scheduled to train in "Platoon as an outpost," will be used as Aggressor force.		
	Platoon in attack in woods. An independent mission, such as capturing an enemy stronghold located on the flank or forward of the enemy FEBA.	FM 7–10, FM 31–71, Another platoon scheduled to train in "Platoon in Defense," can be used as Aggressor force.	Periods	
	Platoon in defense. An independent mission such as defending a road block.	FM 7–10, FM 31–71. Another platoon scheduled to train in "Platoon in Attack," can be used as Aggressor force.	1–4	Conferenc cal wor
	Platoon in delaying action. An independent mission such as a combat outpost withdrawing to the FEBA.	FM 7–10, FM 31–71. Attention should be paid to aggressiveness and thorough preparedness to execute the delaying action.	5–8	Demonstr
			9–12	Practical

UNIT TRAINING AND TACTICS
Subject Schedule

Total periods 56

Instruction	Subject	Reference and remarks		
	Peculiarities in defense in winter conditions	FM 31–71.	13–16	Practical
	Reinforced company in defense: 1. Selection of position. 2. Grouping. 3. Building and strengthening snow positions. 4. Camouflage and concealment. 5. One platoon in reserve. 6. Fighting.	FM 7–10, FM 31–70. 1. Positions must be low and well camouflaged. 2. Reserve platoon prepares counterattack, trails, and rear positions. 3. Tents are dug into snow in first concealed area behind forward positions.	17–20	Practical

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Company in bivouac: Security in bivouac of a separate company. 1. Moving to the bivouac area. 2. Complete bivouac arrangements. 3. Security: Perimeter defense. 4. Aggressor activity.	FM 31-70, FM 31-71. Company moves to the bivouac area and arranges perimeter security during the day. Security problems continue as night exercise.	21-24 Practical work
Company in delaying actions: 1. Preparing trails. 2. Moving of crew-served weapons on sleds. 3. Use of smoke. 4. Maximum use of mines, traps, and abatis.	FM 7-10, FM 31-70, FM 31-71. In deep snow the enemy follows tracks. Therefore, trails should be so made that the enemy is drawn diagonally into our fields of fire.	25-28 Practical work
Peculiarities in attack in winter conditions	FM 31-71.	29-32 Practical work
Envelopments with the company on the open flank of the battalion: 1. The envelopment should be used. 2. Trailbreaking party screen from assembly area to attack positions. 3. Objectives to cut the lines of communication of the enemy reorganization, defense, and road blocks. Remainder of battalion attacks rear of enemy.	FM 7-10, FM 31-71. In winter operations, the best objectives are often enemy lines of communication.	33-36 Practical work 37-40 Practical work
Reserve company in the attack: 1. To secure the open flank. 2. Preparations to strengthen the attack. 3. Reserve to be equipped with tracked vehicles for moving the company and, by skijoring rapidly, for parallel pursuit of envelopment. 4. Pursuit and cutting enemy communications.	FM 7-10, FM 31-71. Reserve company must be lightly equipped and have high mobility.	41-44 Practical work 45-48 Practical work
The company as advance guard: 1. Trailbreaking. 2. Flank security by dispatching detachment to critical points. 3. Close flank movements of the advance party and the support proper.	FM 7-10, FM 31-71. 1. Breaking the enemy resistance is characterized by close and rapid flanking movement. 2. When the advance party makes close flanking movements, the support proper may send a new platoon to follow the retreating enemy. 3. If the terrain is unsuitable for envelopment of the advance party, the support proper, or part of it, makes the envelopment.	49-52 Practical work 53-56 Practical work

Periods	Type of instructi
21-24	Practical work
25-28	Practical work
29-32	Practical work
33-36	Practical work
37-40	Practical work
41-44	Practical work
45-48	Practical work
49-52	Practical work
53-56	Practical work

General principles of using tanks, infantry and tank team in the attack.	FM 7-10, FM 17-15.	
Infantry and tank team in attack	FM 7-10, FM 17-15.	1 Conference 2-4 Practical work
Company as a raiding party: 1. M113 raid to the flank where the enemy security trail will be passed. 2. Escorting detachments to be formed to secure the crossing of the enemy security trail for the raiding party. 3. Raid in enemy rear area.	FM 7-10, FM 31-70, FM 31-71. To provide high mobility: 1. Light equipment. 2. The number of heavy crew served weapons to be reduced to a minimum. 3. Minimum number of sleds for evacuation purposes.	

Periods	Type of instructi
1	Conference
2-4	Practical work

TRAINING AND TACTICS (CONT'D)

Subject Schedule

Total periods 56

Subject	Reference and remarks		
vacuation of casualties.		5–10	Conference and practical work
ear guard, ambushes, mines, traps in withdrawal from action.		11–13	Practical work
eturning raiding party must not use old trails.			
as a screening force on the open flank in de-	FM 7–10, FM 31–71.	14	Conference
		15–17	Practical work
d company on the open flank as a screening and r force:	FM 31–71. Special attention paid to communications.		
utposts are placed on natural routes leading from enemy lines.			
erimeter defense of outposts, road blocks.			
system of contact patrols set up between outposts.			
trong and mobile reserve; trails from the location of reserves are opened to outposts.		18–21	Practical work
oncentration of the reserve and nearby outposts against the infiltrating enemy.			
econnaissance			
company problem:	FM 31–70, FM–71.		
to 20 km fast movement of the reinforced company with the aid of tracked vehicles to capture a key terrain feature.	During the march the men riding in tracked vehicles and sleds must be rotated with men skijoring.*		
asty defense.		22–23	Practical work
vernight bivouac.			
elaying action.			

BATTALION PROBLEMS

Subject Schedule

Total periods 32

Subject	Reference and remarks		
in the attack (on an exposed flank):	FM 7–20, FM 31–71.	24	Conference and demonstration
lovements from assembly area to the LD under cover of darkness.		25–30	Practical work
leasures taken to protect the open flank.		31–35	Practical work
isplacing the supporting weapons during the attack.			
eorganization and bringing the sleds and skis forward when the objective has been taken after final assault.			

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ense (both flanks open):	FM 7–20, FM 31–71.
: on high ground.	
shuttle patrols or outposts.	
uflaging of positions.	
e and its preparedness.	
combat patrols used for harass-	
hen preparing for attack.	

COMPETITION

Schedule

Total periods 12

ubject	Reference and remarks
bination of two phase race and	FM 31–70. In these races, platoon representatives are selected for company ski meet.
----------	FM 31–70.
e championship:	FM 31–70.
ountry race.	Competition should be company and battalion race for championship.

E OF EQUIPMENT

Schedule

Total periods 16

ubject	Reference and remarks
	2 hour period weekly.

ment.

IDER'S TIME

Schedule

Total periods 14

ubject	Reference and remarks
rs, must include subjects such c.	2 hour period weekly.

UNIT TRAI

Periods	Type of instruction	
		4. Evacua 5. Rear g draw 6. Returni
36	Conference	Company as a fense.
37–39	Practical work	Reinforced com security force 1. Outpos from 2. Perimet 3. A syst outp 4. Strong tion 5. Concen again 6. Reconn
40–56	Practical work	Two-day compa 1. 16 to 20 pany ture 2. Hasty 3. Overnig 4. Delayin

BA

Periods	Type of instruction	
1–16	Practical work	Battalion in th 1. Movem cover 2. Measur 3. Displac attac 4. Reorga forw after

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Total periods 2

Reference and remarks
ɔern operations, FM 31–70. e the personnel ficult service re-

3

THER TRAINING

VEHICLES)

Total periods 20

References and remarks	Training aids
FM 31–70, FM 31–71, TM 9–207, TM 9–273.	Training films as required. Appropriate vehicles.
FM 31–70, FM 31–71, TM 9–207, TM 9–273 and pertinent vehicle TM.	Training films as required.
TM 9–8662, TM 9–207	Heater assemblies and winterized vehicles.
TM 9–8662, TM 9–207	Heater assemblies and winterized vehicles.
TB ORD 390, TM 9–207.	Slave Kit M40.
TM 9–273, Lubrication, pertinent lubrication orders, Federal Supply Catalog C–ML–A; TM 9–207.	Samples of cold weather lubricants and related items. FB 9–221.
TM 9–6140–200–15, Operation Organizational Field and Depot maintenance of storage batteries, lead-acid type.	Charts contained in referenced technical manuals.

Periods	Type of instruction	Subject
17–32	Practical work	Battalion in perimeter defense (1. Organizing defense on h 2. Flank security by shuttl 3. Digging and camouflagi 4. Location of reserve and 5. Aggressive, strong comb ing the enemy when p

TESTS AND CO

Subject Sch

Periods	Type of instruction	Subject
1–4	Practical work	Cross-country race, or combinati firing.
5–7	Practical work	Ski patrolling
8–12	Practical work	Ski competition for brigade char 1. Cross-country race. 2. Two phase cross-country 3. Ski patrolling.

MAINTENANCE OF

Subject Sch

Periods	Type of instruction	Subject
1–16	Practical work	Care: 1. Skis and poles. 2. Snowshoes. 3. Tents and stoves. 4. Other winter equipment. 5. Clothing.

COMMANDER

Subject Sch

Periods	Type of instruction	Subject
1–14		Reserve for unit commanders, m as character guidance, etc.

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M 9–273, pertinent cal manuals.	Charts contained in TM 9–273.
l 9–9–273, Lubrica- t vehicle TM.	
l 21–301, TM 21–305 wheel vehicle driver. naual for full-tracked .	Training films as required.
l 31–70, TM 21–301, TM 21–305, TM 1–306.	Training films as required.
le TM. TM 9–207, M 31–71.	
le TM. TM 9–207; M 31–71.	

OF VEHICLES

Total periods 20

es and remarks	Training aids
l 31–70, FM 31–71.	Training films as required.
rication, TM 9–207, ly Catalog C–ML–A.	
l 9–207, TM 9–8662,	Heater assemblies and components.
M 9–207.	Heater assemblies, appropriate vehicles.

ARCTIC LEADERSHIP

Subject Schedule

Periods	Type of instruction	Subject
1–2	Conference	Principles of leadership as related to northern o proper training and discipline to enable the to meet the rigid standards and the difficult quired of northern operations.

SPECIALIST TRAINING

INCLOSURE 1

VEHICLE OPERATORS COLD WEATHER

Part 1

(WHEEL AND TRACK LAYING VEH

Subject Schedule

Periods	Type of instruction	Subject	
1	Conference and demonstration	Introduction and orientation to winter operation of wheel and tracked vehicles.	FM 3 TM
2–3	Conference and demonstration	Before, during, and after operation maintenance services necessary for completeness.	FM 3 TM TM
4–5	Conference, demonstration, and practical work.	Power plant heaters. Operation, use, and maintenance.	TM 9-
6–7	Conference, demonstration, and practical work.	Personnel heaters. Operation, use, and maintenance.	TM 9-
8–9	Conference, demonstration, and practical work.	Cold Starting Aid Kit M40 (Slave Kit) principles of operation, servicing, maintenance, and necessary precautions.	TB OI
10	Conference and demonstration	Lubrication—importance of the correct lubricant, correct amount, and application procedures.	TM 9- lubri Cats
11	Conference and demonstration	Batteries and tires — Effects of extreme cold. Cold weather servicing and maintenance.	TM 9 gani main lead

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S

Total periods 20

Training Aids	
	Slave Kit M40, appropriate vehicles.
atter- and	6TN and 2HN batteries.
71.	Low voltage circuit tester.
	Charts and graphs in TM 9–207.
ower ional cargo	GMC–M211, power pack transmission.

Total periods 4

Training aids	
70,	Actual specimens.
,	Actual specimens.

12–13	Conference, demonstration, and practical work.	Cold weather engine starting and warm-up period. Problems encountered and corrective action. Harmful effects of engine idling.	TM 9–207, TM 9– vehicle technical m
14	Conference and demonstration	Suspension and Power Trains — The effects of extreme cold on brakes, axles, gear boxes, and steering mechanisms.	TM 9–207, TM 9–9 tion, pertinent vehi
15–16	Conference, demonstration and practical work.	Winter driving problems encountered and corrective measures.	TM 21–300, TM 21–3 manual for wheel TM 21–306, maual vehicle driver.
17	Conference	Cross-country operations	TM 21–300, FM 31–7 FM 31–71, TM 9–207, TM 21–306.
18	Conference and demonstration	Problems peculiar to wheel vehicles in cold weather operation and corrective measures.	Pertinent vehicle T FM 31–70, FM 31-
19–20	Conference and demonstration	Problems peculiar to tracked vehicles in cold weather operation and corrective measures.	Pertinent vehicle T FM 31–70, FM 31-

COLD WEATHER ORGANIZATIONAL MAINTENANCE OF V
(WHEEL AND TRACK LAYING VEHICLES)

INCLOSURE 1

Part II

Subject Schedule

Periods	Type of instruction	Subject	References and
1–2	Conference, demonstration, and practical work.	Maintenance in extreme cold. Problems encountered and procedures to be utilized.	TM 9–207; FM 31–7
3	Conference and demonstration	Lubrication-cold weather lubricants, application and use.	TM 9–273 Lubricati Federal Supply Ca
4–5	Conference, demonstration and practical work.	Power plant heaters. Troubleshooting and maintenance.	TM 9–273, TM 9–20 TM 9–207.
6–7	Conference, demonstration and practical work.	Personnel heaters troubleshooting and maintenance.	TM 9–8662, TM 9–2

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Total periods 6

Training aids

Total periods 2

Training aids

Total periods 74

and remarks

INCLOSURE 1

Part II (Cont'd)

COLD WEATHER ORGANIZATIONAL MAINTENANCE OF VEHICLES (WHEEL AND TRACK LAYING VEHICLES)

Subject Schedule

Periods	Type of instruction	Subject	Reference and remarks
8–9	Conference, demonstration and practical work.	Cold Starting Aid Kit M40 (Slave Kit) use, troubleshooting and maintenance.	TM 9–207, TB ORD 390.
10	Conference and demonstration	Batteries-effects of extreme cold, proper charging, and maintenance procedures.	TM 9–6140–200–15, storage batteries lead-acid type operation and maintenance.
11	Conference, demonstration and practical work.	Low voltage circuit tester operation, use, and proper maintenance.	TM 9–207, FM 31–70, FM 31–71.
12–13	Conference, demonstration and practical work.	Effects of cold weather starting and warmup of internal combustion engines. Proper starting and warmup procedures.	TM 9–207, TM 9–273.
14	Conference and demonstration	Suspensions and power trains, preventive measures and maintenance.	TM 9–207, TM 9–273.
15–16	Conference, demonstration and practical work.	Hydramatic transmissions cold weather problems. Correct procedures developed and lubricants used.	TM 9–207, TM 9–1819, AC-power trains, TM 9–8024, organizational maintenance of 2½ ton cargo trucks.
17–18	Conference, demonstration, and practical work.	Items peculiar to wheeled vehicles during cold weather operation; malfunctions, failures, and preventive actions.	Vehicle TM. TM 9–207.
19–20	Conference, demonstration, and practical work.	Items peculiar to tracked vehicles during cold weather operation. Specific malfunctions, failures, and preventive procedures.	Vehicle TM. TM 9–207.

INCLOSURE 1

Part III

WEAPONS (SMALL ARMS)

Subject Schedule

Periods	Type of instruction	Subject	References and remarks
1	Conference and demonstration	Effects of extreme cold weather firing	Pertinent weapons FM. FM 31–70, 31–71; TM 9–207.
2–3	Conference, demonstration and practical work.	Maintenance of small arms weapons. Care, cleaning, and lubricating procedures.	Weapons FM; TM 9–273, 9–207, 9–273.
4	Conference and demonstration	Problems peculiar to small arms and corrective action-storage in extreme cold.	

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INCLOSURE 1

Part IV

WEAPONS (ARTILLERY) Subject Schedule

Periods	Type of instruction	Subject	References and remarks
1–2	Conference and demonstration	Effects of extreme cold on recoil mechanisms-warmup procedures.	Pertinent artillery FM and TM. TM 9–207, FM 31–70, FM 31–71.
3	Conference, demonstration, and practical work.	Lubrication-types of lubricants and uses.	TM 9–273.
4–5	Conference, demonstration, and practical work.	Maintenance of artillery weapons-care, cleaning, and lubricating procedures.	Pertinent weapons FM, TM. TM 9–273, TM 9–207.
6	Conference and demonstration	Problems peculiar to artillery weapons and corrective measures.	FM 31–70, FM 31–71, TM 9–207, pertinent weapons TM.

INCLOSURE 1

Part V

FIRE CONTROL (OPTICAL) Subject Schedule

Periods	Type of instruction	Subject	References and remarks
1	Conference and demonstration	Effects of extreme cold on optical equipment-proper handling and storage procedures.	TM 9–207.
2	Conference, demonstration and practical work.	Organizational maintenance and problems peculiar to optical instruments.	Pertinent instrument TM. TM 9–207.

INCLOSURE 2

INLAND WATERWAYS NAVIGATION (OPERATORS TRAINING)

Periods	Type of instruction	Subject	Reference and rem
1	Conference	Significance of inland waterways: 1. Inland waterways in northern areas. 2. Use of waterways in underdeveloped areas. 3. Influence of inland waterways on tactical operations.	FM 31–71.

INLAND WATERWAYS NAVIGATION (OPERATORS TRAINING)

Total perio

Type of instruction	Subject	References and remarks	Training aids
s, training film, and ration.	River navigation and basic boat operation: 1. Fundamentals of river reading. 2. River navigation. 3. Characteristics and nomenclature of the boat. 4. Characteristics and nomenclature of the outboard motor. 5. First echelon maintenance of boat, motor, and related equipment. 6. Rules of water safety.	TM 5–210. FM 21–11. Operation instructions manual for outboard motor.	
------------------------	River charting: 1. Techniques of river charting. 2. Chart sketching and sketching equipment.	FM 21–31.	
ork----------	River navigation: 1. River charting. 2. River patrols. 3. Tactical river navigation exercise. 4. Boat operation. 5. Boat and equipment maintenance.		

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INCLOSURE 2 (Cont'd)

Periods	Type
2–4	Conference, tra demonstratio
5	Conference
6–74	Practical work

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APPENDIX C

COMMANDERS' GUIDE LINES FOR NORTHERN OPERATIONS

C-1. Leadership

a. Commanders at all echelons must know, understand, and appreciate the problems of northern operations.

b. Actively supervise, keep abreast of the important details in tactical operations, and coordinate closely with adjacent and supporting commanders.

c. Forceful action is the key to success of the leader in the north.

d. Insure your command is safety conscious. Check for fire hazards--especially gasoline handling, carbon monoxide poisoning, frostbite, and safe driving habits.

e. Planning is one of the most essential elements for the successful conduct of northern operations. Planning time can be shortened by the use of SOP. A workable, simple, well-rehearsed SOP is mandatory for all units down to include platoon level.

f. Most of the disabling problems associated with winter operations in northern areas can be avoided if commanders at all echelons are knowledgeable concerning the individual soldier's response to stress and fatigue.

g. Health is of primary importance. Without dynamic personal leadership the average soldier in northern operations becomes lethargic, dehydrated and undernourished with resultant mental and physical degeneration. To prevent this, commanders must insure that personnel consume adequate water and nourishment, and practice good personal hygiene habits.

C-2. Tactics

a. Mobility must be considered one of the cardinal principles of operations in the north. True mobility can only be obtained through proper use of all aviation support, oversnow equipment, and tracked vehicles.

b. Rapid movement of small units with adequate firepower, mobility, and communications plays the vital role in the success of northern operations. Operational planning must include the use of vertical envelopment and wide flanking attacks to exploit the principle of surprise.

c. Because of vulnerability of forces in daylight, brought on by slow movement and problems of concealment, night operations should be a prime consideration.

d. Troops in northern operations are particularly dependent upon their lines of communications, whether by air, road, water or trail since supplies and equipment are required to maintain operational effectiveness. An enemy can be defeated by interdiction of his lines of communication, by the interposition of forces between his base of supply and his forward elements, or destroyed by air operation.

e. The construction of an adequate ground lines of communication to forward elements is prohibitive in terms of engineer effort required. Therefore, emphasis must be placed on the following: air supply and resupply; use of low ground pressure vehicles; and, in some instances by foot.

f. Combat effectiveness is most difficult to maintain unless troops are kept warm, fully hydrated, and in condition to fight. Thus, a force that is exposed to the elements for long periods and not accompanied by warming equipment and other essential support is in an ideal position to be vulnerable to counterattack.

C-3. Communications

a. The communications net is the commander's nerve center. Communications provide control; control permits command. Unceasing effort is required to maintain the flow of traffic.

b. Communications is a system or series of systems which include tank, infantry, artillery, and air communications vets. All alternate means must be employed to provide continuous communications to all elements of the task force.

c. Use aircraft for radio relay and message delivery.

d. Battery vests or other suitable means must be used to keep batteries warm.

e. Plan a forward maintenance capability.

f. Minimum variation in radio location has considerable effect on transmission ranges; try another

transmitter site if unable to transmit or receive.

g. Because of reliance on radios, be especially aware of communications security. Use appropriate codes and keep traffic to a minimum.

C-4. Artillery and Fire Support

a. Close and continuous personal contact between the brigade commander and the artillery commander is essential to permit displacement with minimum instructions and to insure continuous fire support.

b. Forward observers must be properly equipped and wholly responsive to the infantry company commander's needs. He must remain in close and continuous personal contact. Infantry and artillery information must flow via both infantry and artillery means.

c. Artillery FO and forward air controllers should use Army aircraft to coordinate and direct fire support where feasible.

d. Helicopters should be used whenever possible for rapid displacement of artillery.

C-5. Aviation

a. Task force air officers should be used to maintain the status of all assigned aircraft and to direct maximum employment which will insure constant productive utilization of aircraft during those hours in which aircraft can be flown.

b. Payload capability of aircraft is reduced in the Arctic because of added weight of ski installations and required survival equipment.

c. Rotor systems and engine exhaust often cause ice fog which may create delays in getting aircraft airborne. For this reason, use prepackaged loads to save ground time.

d. Use lakes for airfields to save construction time.

e. Plotting accurate ground positions is difficult in terrain with few recognizable landmarks. Use pilots to assist in determining unit positions because of their ability to see the units in their relationship to other landmarks.

f. Arrange for commanders to reconnoiter terrain from the air. Use aircraft to guide moving columns.

g. Plots should habitually monitor command nets and offer to relay communications.

h. Aircraft should be employed on station as an aerial relay for communications where required.

i. Aircraft loads must be carefully planned and loaded during periods of nonflying weather to permit immediate dispatch at first break in weather or light.

C-6. Engineers

a. Make maximum use of engineer support available. Engineers are vital because of; water supply, road and bridge construction, atomic demolition munition (ADM) terms, construction and neutralization of barriers, obstacles, fortification, construction of airfields, and camouflage.

b. If an engineer staff officer is not available, use attached engineer commanders to coordinate staff planning and the overall engineer effort.

C-7. Intelligence and Security

a. Make maximum use of all intelligence collecting agencies, with emphasis on use of Army aviation.

b. Cross-country navigation is extremely difficult. Use Army aviation to assist in maintaining direction. Do not rely solely on maps and compass.

c. Route reconnaissance must precede any troop movement. Terrain obstacles often make the "long way around" the best route.

d. Be especially aware of sound and light discipline in forward areas.

e. Emphasize deception. (Effective camouflage and concealment are extremely difficult.)

f. The isolation and destruction of widely separated guerrilla forces requires forceful action on the part of commanders. The adoption of conventional tactics with emphasis on the seizure of terrain will not substitute for the isolation, fragmentation, and capture of guerrilla bands.

C-8. Logistics

a. Preventive maintenance requires much additional time and effort and must be a matter of major concern and emphasis by all members in the chain of command.

b. Winter driving and operation of equipment must be stressed.

c. Plan logistical support in great detail even for small unit operations.

d. Insure that the command is provided adequate support to include sufficient heat, food, clothing, sleeping gear, tentage, POL, and ammunition resupply.

e. During extreme temperatures, plan additional time for accomplishment of tasks. Experience has shown that five times the norm may be required.

f. Frostbite causes casualties; do not underestimate effects of cold.

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APPENDIX D

BOAT PROCEDURES

Section I. BOATS AND EQUIPMENT

D-1. Northern Riverine Boats

a. Type of Boats. Northern riverine boats are characterized by shallow draft and minimum clearance and good maneuver capability. The boats may be self-propelled or towed, with or without cargo carrying capability. In addition to the types of craft used by engineer units for the tactical movement of troops and their accompanying supplies in river crossing, and the types of craft used by transportation units for the administrative movement of troops and equipment during operations on inland waterways, the movement of troops with supplies requires a different type of craft for northern operations. Indigenous boats of various types can be used for northern riverine operations. One desirable river boat presently in operation in Alaska is 950 cm (31') long and weighs between 600 and 900 pounds (fig D-1). It has a minimum height of 70 cm (27½") and a loaded draft of 25 cm (10"). The boat is made of wood covered with fiberglass. It is ruggedly constructed, quickly and easily repairable, and can be maneuvered at high speed in swift water. The boat is capable of carrying an infantry squad fully equipped (total payload 4,400 pounds) and includes a mechanical lift to raise the motor over obstructions when in shallow water. With a 50 hp motor with a short shaft, these river boats, normally, can navigate any of the typical rivers found in northern regions. Another type of riverboat (fig D-2) is made of marine aluminum. This boat is 792 cm (26') long, 51 cm (20") high, has a loaded draft of 20 cm (8"), and weighs 770 pounds including the motor and motor lift.

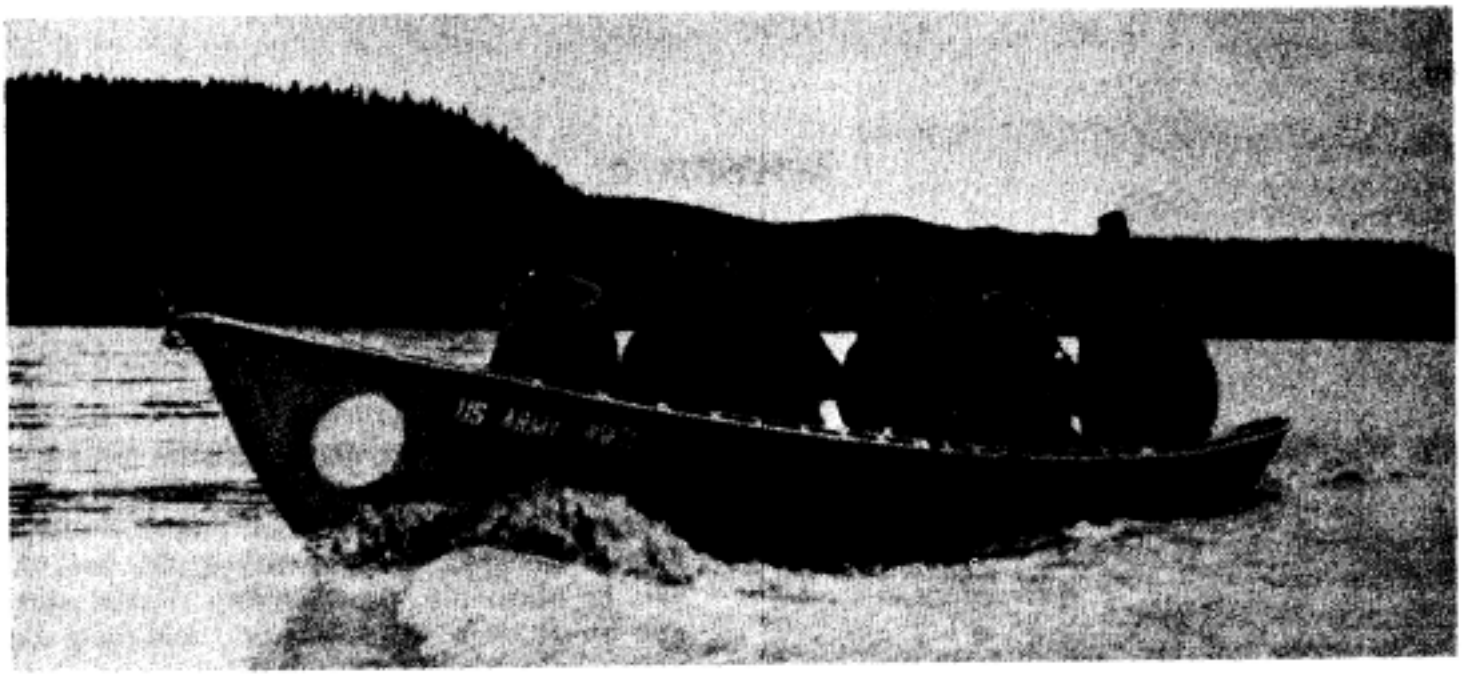

Figure D–1. Wood/fiberglas river boat.

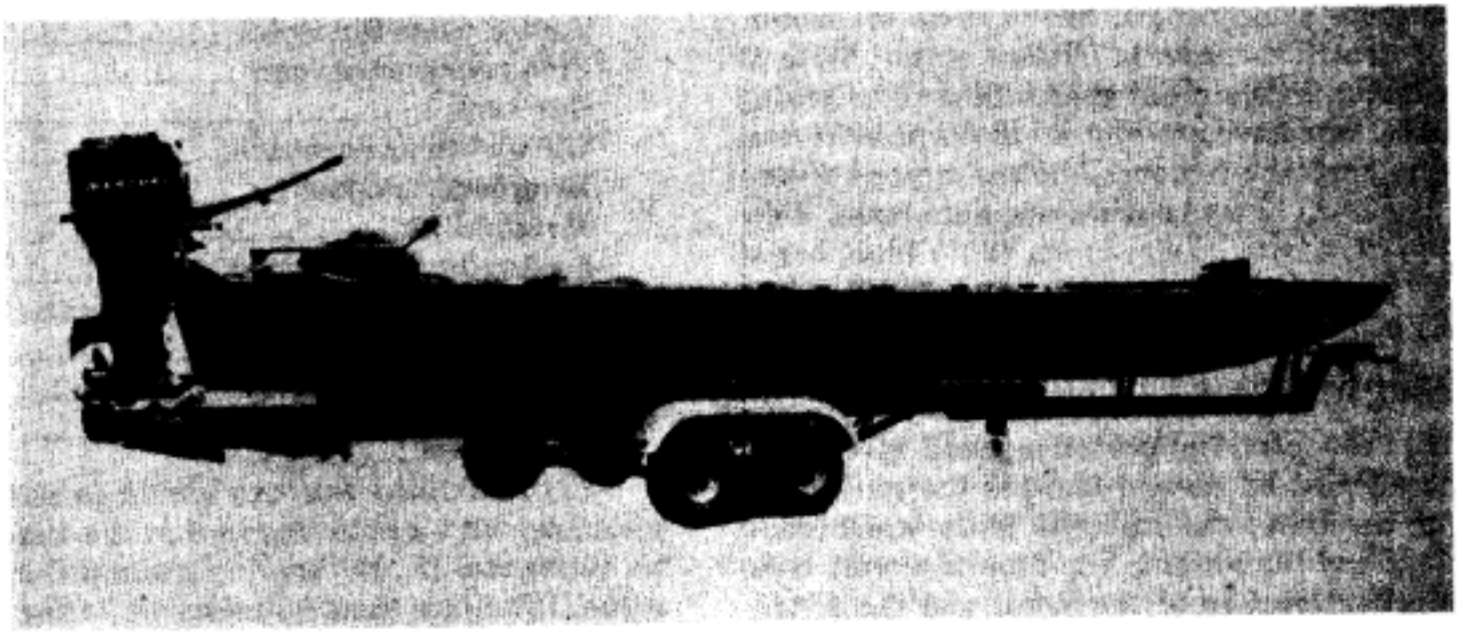

Figure D–2. Aluminum river boat.

b. Boat Selection.

(1) The performance of a small river-type boat is effected by several factors: the conformation of the boat; the material from which constructed; and the weight. The type of motor, type of propeller, location of the motor and the distribution of weight in the boat should be the determining factors in choosing a specific type of craft. When considering the characteristics desired in a boat for military use, the character and velocity of the rivers on which the boat might be used has to be considered. The capacity of the boat must also be taken into consideration.

Where secrecy and stealth are prime factors, inflatable boats should be considered.

(2) Nomenclature of boats and parts generally are standard. The front is the bow and the rear is the stern. Starboard and port are the right and left sides, respectively. The bow plate is the part of the boat to which the anchor and rope are connected to the craft. The carrying handles are along the inside of the gunnel at the top of the boat and are used to lift and carry the boat.

c. Stowage.

(1) Items of boat equipment are stowed according to approved load plans for rapid inventory and accessibility. Typical items in each boat are--

Anchor with 914 cm (30′) of line)	1
Mooring lines, 300 cm (10′) with eye on each end	2
Balling can	1
Repair parts for motor	1 Set
Five-gallon water can	1
Gas cans	2
WP and smoke grenades	4
Emergency rations	1 Case
First aid kit	1
Seizing line (914 cm (30′))	1
Flashlight with colored lens inserts	1
Camouflage net	1
Paddles (6) or oars (4)	-
Poles (36 cm (12′))	2

(2) Individual weapons should be attached to personnel with a light line so that the weapon can be recovered if the boat is swamped or overturned. The line should be secured to the suspenders with a quick release so that it can be dumped quickly if there is danger of drowning. The line should be 300 cm (10') long unless known steam depth indicates otherwise.

(3) Personnel securely stow and lash other supplies, equipment and crew-served weapons to prevent their loss or injury to personnel if the boat capsizes. Crew-served weapons and squad and platoon radios have a marker buoy and line attached to assist in retrieval. The buoy will have to be improvised locally. It should be about the size of a softball and can be made of any material that will float. Empty plastic bottles can be used in the absence of a satisfactory buoy. Each boat in the formation carries a variety of supplies and equipment so that the loss of one boat does not result in abortion of the mission.

D-2. Care of Boats and Motors

The key to dependable service from boats and motors is meticulous organizational maintenance and proper operation. A boat or motor used properly in normal operations more likely withstands the abuse it gets under combat conditions. Recommended precautions in the use of boats and motors are--

a. Proper Operation.

(1) Operate at moderate speeds to slow normal wear and deterioration of both boat and motor.

(2) Avoid hitting floating objects and sandbars.

(3) Do not allow the motor to run for long periods at idle or very slow speed. Carbon builds up rapidly in slow-running, 2-cycle engines.

(4) Slow the engine before changing from neutral to forward or reverse. A fast improper shift can cause engine breakdown in a critical situation.

(5) Allow the motor to warm up before operating at high speed. Accelerate and decelerate smoothly to avoid straining the engine.

b. Preventive Maintenance.

(1) Keep the boat and motor clean and lubricated according to the technical manual (TM) for the item. Particular emphasis is necessary on boat fittings, underwater body, and motor lower unit.

(2) When operating in brackish or salt water, take the boat out of the water after use. Clean the bottom regularly and flush the motor with clean, freshwater.

(3) Include a set of spare spark plugs with each motor. Operators remove, inspect, and clean or replace them according to the TM for the particular motor.

(4) If the boat strikes an object in the water, the hull and motor lower unit require inspection, both for cracks and for damage, to the propeller, propeller cap, cotter key, and shearpin.

(5) Handle the fuel line with care to prevent damage where it joins the connectors.

c. Motor Modification. Motors for use on the silty shallow waters prevalent in northern areas should be modified by the addition of a heavy-duty water pump and the reinforcement of the skeg on the motor lower unit.

Section II. RIVER NAVIGATION

D-3. Navigation Techniques

The techniques discussed in succeeding paragraphs are applicable to all northern area rivers and streams.

a. The waterways throughout the northern area of operations are potential lines of communication for operations in these areas. Unlike motor highways, where changes in route are made slowly by men and machines, the route changes in the rivers are made by nature, sometimes, quickly and in accordance with nature's own rules. On the motor highways, signs are placed by man to indicate detours, curves, dips, bumps, obstructions, and safety limits of speed. On the waterways, nature places her own signs to indicate the same thing, but the signs are in nature's language, and the boat operator, who can cruise successfully and easily, must learn that language and how to read the signs.

b. The changes in current, channels, locations of obstructions, and depth of the river may occur annually, monthly, weekly, daily, and even in a matter of hours. This is particularly true of the northern glacial streams. For this reason the boat commander and boat operator must always be on the alert. They cannot depend upon their memory of yesterday's channels, for today's channels may be different. They must know and understand the basic principles of river reading--of reading the water.

c. The waterways of the north are often fed by glacial tributaries which flow rapidly and carry with them a great amount of silt. Much of the riverbank and much of the riverbed is made up of deposited silt that is easily cut and reformed by the current. In the forming process, sandbars are formed. The fast current at certain periods moves small stones to form gravel bars. Banks are undercut causing trees to topple completely into the river where they float until caught on sandbars, starting log jams. Some topple only partially into the water and are still held to the bank by the roots. During high water, these trees, still connected to the bank, may be just on or under the surface (sleepers), or they may be hanging above the water (sweepers). Such trees must be constantly avoided.

d. Each of these obstacles-- sandbars, gravel bars, sleepers, sweepers-- may be avoided because they have a sign, made by nature, either on the bank or in the water that points to their presence.

e. The boat commander and the operator must watch the surface of the water ahead. Certain general rules are as follows: A lightly rippled surface usually indicates shallow water. If there is a wind blowing, of course, the surface of even deep water may be rippled, but lightly rippled water where no wind is blowing indicates shallow water, sandbars, or gravel bars. A long, undulating wave, however, indicates deep water and fast current. The "deep water wave" is formed by a combination of deep water and fast current. A smooth surface usually indicates deep water and slightly less velocity.

f. A V in the surface of the water generally indicates an obstruction, either a rock, log, or tree, that is lying parallel with the direction of current The combination of current velocity and size of the obstruction determines the size of the V. It should be remembered that the V is only an indication of the size of the portion of the obstruction lying very near the water surface and is not indicative of the total size of the obstruction.

g. A "roiled" surface at a particular point usually indicates an obstruction such as a log or tree, lying perpendicular to the direction of current at, or within a few inches of the surface.

h. Whenever a tributary feeds into the main body of a river or stream, a sand delta will be found. The actual location and extent of the sand delta will be dependent on the current velocity of the main stream versus the current velocity of the subsidiary stream, by the angle of joining, and by the composition of each stream and their bottoms and banks. Heavily silted rivers create greater sand deltas than do lightly silted streams.

i. Generally, banks that are sharp and meet the river at a sharp angle indicate deep water. Gently sloping banks indicate shallower water.

j. In general, the greatest velocities of current and the steepest gradients are found nearer the source of the river. Velocities may vary at all points of the river within short stretches or between points across a channel. Flow is swiftest where the channel is constricted and slowest where the stream can spread out broad and shallow. In a meandering stream, centrifugal force throws the water to the outside of curves so that generally the deepest water is near the outside of the curve. For this reason, the boat operator should stay on the outside of curves. Normally this is where the high bank is located, which generally is an indication of deeper water. Sandbars and shallow water will be found on the inside of curves. Even with this general rule, the boat operator must be alert for underwater obstructions that are not visible. These obstructions can be present even in the deepest channels.

k. The best points to remember when selecting a channel is that it should be the one with the least ripples, near the steepest bank and in the fastest current.

l. It should be remembered that a river can be read much easier when going upstream than when going downstream. In addition, when moving upstream, the operator will find that he has more control of the boat and his speed is somewhat less than it could be if he were going downstream.

Section III. BOAT HANDLING

D-4. General Procedures

a. The operator must place himself so that he can constantly see the river course and water surface. In most small boats where the operator is in the rear, he can and should stand. In a sitting position the operator cannot see obstructions. By the same token, other occupants of the boat should remain seated so they do not obstruct the view of the operator and so they do not suddenly shift the balance of the boat.

b. The operator should avoid ripples, boils, and other indications of fast disturbed water. These can sink the boat or force it into obstructions that may tear out the bottom. In cold, fast, and silty water, a man cannot survive long.

c. The operator must avoid "sweepers" and "sleepers." These trees are dangerous since a collision with them may cause the boat to overturn or be damaged. An overturned boat in sleepers is doubly dangerous since the branches can puncture pneumatic life vests or the man in the water may be caught and held under.

d. When passing from one stream to another, while moving downstream, the boat operator should proceed downstream past the stream into which he desires to turn, make a turn, then proceed upstream a short distance and turn into the flow of the new current. This will reduce the possibility of the boat running aground on a sand delta.

e. The operator should not go into extremely fast water at full throttle. The motor should be throttled down to half speed until the operator is certain of what lies ahead.

f. Emergency procedures to be followed in the event of a power failure:

(1) The boat should be kept in the center of the river if at all possible, with the bow held upstream until the difficulty is corrected.

(2) If the boat is in calm water or in a slow moving stream, the anchor may be thrown out.

(3) When the failure cannot be corrected, the boat will be landed at the nearest shore for necessary maintenance and repair.

D-5. Procedure for Shoving Off From Shore

a. In order for the boat operator to get away from shore safely and without damage to the boat and motor, each individual in the boat must be briefed on the position he is to occupy and duty he is to perform. This is the responsibility of the boat commander, and no duty will be performed until ordered by him.

b. The boat commander must make an estimate of the situation confronting him each time he is ready to leave shore. He must check the depth of the water, any obstruction to the boat's progress when shoved off, brief his crew, and see that they are ready to carry out his orders.

c. When this is accomplished, the boat commander will have the anchor man place the anchor in the boat and hold the bow of the boat into shore by the bowline. With the motor lift in the raised position, the operator will start the motor in neutral and order the anchor man to shove off.

d. With a firm grip on the bow of the boat, the anchor man will walk down stream with the bow until the stern swings well out from the shore. He will then shove the boat toward midstream, pushing the bow up stream as he jumps aboard.

e. As the boat swings around parallel to the shore, the operator shifts the motor into forward gear and

slowly lowers it, by use of the lift, into the water. As the rearward motion of the boat is halted by the thrust of the motor, the operator slowly swings the operating handle toward shore, thus forcing the bow farther away from shore. This must be accomplished at slow speed to prevent the stern from swinging back into the shore. When the bow is at an angle from the shore the operator checks to see that all individuals in the boat are properly seated before increasing speed.

f. In shallow water, it may be necessary to row or pole the boat to deeper water before putting the motor in gear.

D-6. Procedure for Landing the Boat

a. Improper landing procedure may cause the boat to run aground with such force that damage is caused to the bow or bottom of the boat, and to the motor if the water is shallow.

b. When approaching the shore for a landing, the boat is angled upstream toward the shore. The speed of the boat is controlled, so that a very slow approach is made. A landing point should be carefully selected by the boat commander to insure that no logs, rocks, or other obstacles which could damage the boat or motor are present.

c. If the water is deep enough to approach the shore under power, the operator will very slowly ease the bow toward the landing point. The boat commander will instruct the anchor man to be ready to secure the bow of the boat to shore. As the bow touches shore, the anchor man leaves the boat carrying the anchor as far as the anchor line permits and places it on the ground. If the boat can be securely tied to a tree or other natural object, the anchor is left in the boat and only the tie-line is carried ashore.

d. To hold the boat in position until it is secured to shore, the operator swings the operating handle upstream until the boat is perpendicular to the shore. When the boat is secured, the motor is shut off and raised from the water.

e. When approaching shore in shallow water, the motor is stopped and raised from the water. If enough momentum has been maintained on the approach, the boat will continue on to shore. If not, it may be necessary to row or pole the remaining distance.

f. As far as possible, the boat commander should pick landing areas that will allow the troops to debark on dry ground.

D-7. Rowing, Poling and Lining

a. General. There are times when mechanical power cannot be used to move a boat upstream or downstream. Motor failures, obstructions, shallow water, or accidental cutting of fuel lines will cause an individual, or small unit, to rely on other methods to continue their movement. Under these conditions, the boat may be moved by rowing, poling, or lining.

b. Rowing. When rowing, certain practices should be followed: First, the oars are secured upon order of the boat commander. Second, the oars should extend an equal distance from the oar locks. The depth of the bite taken by the rower should be equal on each side of the boat unless a turning movement is being attempted. Third, stroking by all rowers should be coordinated. On the return stroke, the oar should be feathered until it touches the water. Rowing is a simple process, but it takes practice. Rowing may be necessary to eliminate motor noise when the tactical situation requires such security measures. At such times, the oar locks should be muffled to further reduce noise.

c. Poling. Under certain circumstances, rowing may be difficult or impossible because of shallowness of the water or because of obstructions in the water. In such circumstances, poling will normally be relied upon. Poling is a slow and laborious process. It was the principal means of movement on some of the northern rivers during the early frontier era. When poling, the oars and boat hook may be used as poles. They may be used to keep the boat clear of obstructions while allowing the boat to go downstream, or, when the current is slow enough and water level low enough, poling may propel a boat upstream. If the intention, is simply to ward the boat away from obstructions, polers place themselves in the boat so they can plant the end of their pole on the obstruction and simply shove the boat clear. If the intent is to pole upstream, two methods may be used.

(1) First, the poler places himself in the proper position in the boat, plants the pole on the bank or stream bottom, and pushes to the limit of the pole. The pole is then lifted from the water. The process is repeated by moving the pole forward in the water.

(2) Another method is to start at the bow of the boat, plant the pole on the bottom, and walk to the stern, pushing the pole. Return to the bow and repeat the process. This is practical only when the water is low and sufficient polers are available to maintain continuous push.

d. Lining.

(1) There may be occasions when water conditions make it unsafe to use the rowing or poling method. Then another process known as "lining" may be used. Lining is the process of attaching a rope to a boat and providing the motor power with men. Before resorting to lining, the boat operator should ascertain that it is absolutely necessary. The operator should beach his boat and walk the river bank to inspect the channel ahead to make sure that there is not sufficient water to allow the use of the motor, or that the course is so obstructed and water conditions dangerous enough to justify use of the rope either with or without aid of the motor.

(2) Lining can be accomplished under some conditions by the boat operator alone but in most cases will require a minimum of two men. Single man lining can only be done in relatively quiet water, Where water is fast or where boat guidance is critical, more than one man is required. The current velocity, boat size, and load, will determine the number of men required.

(3) One or more ropes are required when lining and the ropes should be as long as possible without becoming too much of a drag on the man pulling the boat. A rope of approximately 30 meters (100 ft) in length is the most desirable, although shorter ones may be used. If only one rope is utilized, it is tied securely on the bow of the boat for both upstream and downstream movement. If two ropes are available and men are available to use them, one rope is secured to the bow and the other to the stern.

(4) The man, or men, providing the motive power grasp pull only on the bow line; the stern line is used only for control. Ropes are not tied to the pullers, since a slip of the foot on the part of the puller may allow a boat in fast water to get away and drag the puller into the stream. Loops may be made at the end of the rope, and at other points, which allow the pullers to place the loop over one shoulder only so that it may be quickly disengaged.

(5) Before starting, a reconnaissance is made of the bank and bed of the stream. A tentative route for the pullers and for the boat is selected. Pullers try to avoid banks that are heavily wooded or contain sweepers that extend into the water. Trees growing along the water edge which will force the puller to work the rope around the tree should be avoided. This may require that the pullers ford the stream from time to time. Fording spots should be picked in advance.

(6) When selecting a route, look for obstructions in the water which will have to be avoided by the boat. Avoid muddy and crumbling banks, if possible, and try to determine where the critical points occur. In some cases, where tree growth is restrictive or where neither bank can be used because of height or some other reason, it may be necessary for the pullers to operate in the water. Shallow areas with good footing that are free of underwater logs or other obstructions should be chosen.

(7) The operator remains in the boat and may, if additional men are available, keep one or more men with him to assist in guiding the boat. If the motor is operating, the operator will use the motor to provide steering and additional motive power. If the motor is not operable, the operator will steer with an oar from the stern or will use the boat hook from the bow. Water conditions will determine where the operator stations himself. If the operator has help in the boat, normally he will station himself in the bow where he can best see what is immediately ahead and under the boat. The helping man is placed at the other end of the boat, and equipped with an oar. The operator is responsible for steering the boat into the easiest water, past obstructions, or into channels where flotation is possible. He must also be on the alert to attempt to control the boat and steer it to a landing in the event that the pullers lose their rope in fast water. He must keep the boat sufficiently far from shore to insure that the rope is not entangled in shore growth. He attempts to keep the boat at a position where the rope proceeds directly to the pullers over water rather than at an angle where it can become entangled.

(8) In extremely fast water, it may be necessary to use a pulley system to get the boat upstream.

(9) Lining downstream is done only when water conditions are such that it is dangerous to allow the boat to proceed without external control. Extremely fast water in congested channels may require lining. On the other hand, negotiation of rapids may be more dangerous with a rope attached than is a free run. The operator must make the decision based on a study of the water. If a rope is used, it must be used from a position on the proper bank so that the boat will not be swamped or swept into rocks or obstructions. The boat must not be held against really swift water to the extent that water will sweep over it and sink it. In many cases, it may be necessary to put a single turn of the rope around a tree or boulder so that more control is exercised. In other cases, it may be necessary that the boat move freely, with the men on the shore running alongside to provide pull at the proper moment to avoid a particularly dangerous obstacle, or move it around an excessively short turn.

(10) When a second rope is attached to the boat, it is used to assist in turning, and is a safety measure to avoid losing too much ground if the pullers lose their rope. The man on the second rope is prepared at all times to snub the rope on a tree or boulder to stop the boat if it should get out of control. He must use judgement as to when and when not to snub. He continually shortens or lengthens his hold on the rope, as river conditions dictate, to insure that snubbing will not pull the boat onto obstructions or into swamping position. In some water, it may be advisable not to attach the second rope but to plan on attempting to ride the boat downstream to a safer area if it gets away from the pullers. Bank conditions, water velocity, and obstructions will govern what action is taken.

D-8. Anchoring

a. The Danforth anchor is the anchor most generally used. This anchor has good holding capabilities in all types of stream bottoms.

b. The anchor is attached to the boat by 914 cm (30') of line. However, the length of the anchor line is dictated by the depth of the stream or river. As a rule of thumb, the line should be three times longer than the depth of the river.

c. When deploying the anchor the bow of the boat is faced upstream. The boat should be held against the current with no headway. The anchor is then lowered into the water until it touches bottom. The boat is then allowed to slip slowly downstream. When the anchor man is assured that the anchor is holding on the bottom he will notify the boat operator who in turn will allow the boat to slip downstream until it snugs up on the anchor line. The anchor should not be used in a fast moving stream because of the danger of the anchor snagging suddenly and pulling the bow under. The anchor will not be dropped under any circumstances except on the order of the boat commander.

d. To release the anchor, the boat is moved slowly upstream. The anchor man recovers the line until the boat is directly over the anchor, at this point the anchor should release from the bottom. If it does not it may become necessary for the anchor man to secure the line in the boat and then allow the boat to

proceed on upstream until it pulls the anchor free.

Section IV. SAFETY

D-9. General

Proper safety measures are paramount to success in riverine operations. Personnel must be trained in these safety measures until they become second nature.

D-10. Safety Measures

a. Remove all heavy equipment when entering the boat. Tie it to sides and bottom.

b. To avoid slipping, use caution when entering and leaving the boat.

c. Never tie personnel to the boat.

d. Wear life preserver at all times while in the boat.

e. Remain seated in the boat and keep all movement to a minimum.

f. Keep a coil of rope handy to assist anyone who falls overboard.

g. A man who falls overboard should inflate his life jacket (if equipped with a pneumatic jacket) and head for shore. Care must be taken to insure that inflatable jackets are not punctured by tree limbs or branches in the water.

h. All personnel require training to react to the call "man overboard." When a man is seen in the water, shout "Man overboard," adding "port side" or "starboard," as the case may be. The rescue boat should approach the man in the water from the downstream side.

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APPENDIX E

MEASUREMENT CONVERSION FACTORS

Multiply	By	To Obtain
Centimeters	.03281	Feet
Centimeters	.3937	Inches
Meters	3.281	Feet
Meters	39.37	Inches
Meters	1.0936	Yards
Kilometers	.62137	Miles
Inches	2.54	Centimeters
Inches	.0254	Meters
Feet	30.48	Centimeters
Feet	.3048	Meters
Yards	.9144	Meters
MPH	1.6093	KmPH
MPH	.8684	Knots
Knots	1.1516	MPH

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GLOSSARY

Abatis--

Similar to a windfall. Trees are felled at an angle of about 450 to the enemy's direction of approach, The trees are left attached to the stump to retard removal Along trails, roads and slopes the abatis will cause considerable difficulty to the enemy's capability to ski and move vehicles.

Ablation--

The combined process (such as, sublimation, melting or evaporation) which removes ice and/or snow from the surface of a glacier, snowfield, etc.

Accumulation--

Net gain of snow or ice during a specific period of time. The opposite of ablation.

Ahkio--

Boat-like sled used for pulling squad equipment.

Blizzard--

A severe weather condition characterized by low temperatures and strong winds bearing great amounts of snow. The National Weather Service has established the following criteria: Winds 28 knots (32 mph) or higher, low temperatures and sufficient snow to reduce visibility to less than 152 meters (500 ft).

Breakup--

Period of spring thaw during which the ground surface is excessively wet and soft, and ice is disappearing from streams and lakes. Duration of the breakup period varies usually from one to six weeks depending on regional and local climatic conditions. The breakup season causes difficult movement problems.

Chilblains--

A cold injury which causes lesions--usually on the hands--caused by prolonged or repeated exposure to mild humid cold.

Chinook--

The name given to a foehn on the eastern side of the Rocky Mountains, hence, a warm dry wind on the lee side of a mountain.

Cold Injury--

An inclusive term applied to injuries resulting from cold. The most common are frostbite, trenchfoot, immersion foot, and chilblains.

Cornice--

An overhanging formation of snow, usually on a ridge or at the top of a gully on a mountainside.

Crack--

A fissure or crevice in a rock or ice formation.

Crevasse--

A fissure or rift in glaciers, shelf ice, or other land-ice formations, caused by thermal changes in the ice or by motion of the ice over underlying obstacles.

Dry Snow Zone--

Zone of ice cap where maximum temperatures are not high enough to cause melting.

Fast Ice--

All types of ice, broken or unbroken, attached to the shore, beached, stranded, or attached to the bottom in shoal water.

Freezeup--

Period during which the ground surface freezes and ice cover forms on streams and lakes. This period varies from one to three months depending on regional and local climatic conditions. Maintaining mobility during this period becomes easier as the period progresses.

Frostbite--

A cold injury caused by freezing of the tissues.

Frost Boil--

Accumulation of excess water and mud in subsurface materials during spring thawing. Usually it weakens the surface and may break through, causing a quagmire.

Frost Line--

(See Frost Table.)

Frost Mound--

A localized uplift of land surface caused by frost heaving or by ground water pressure. Also called

earth mound, earth hummock, pals, pingo, or pingok.

Frost Table--
More or less irregular surface that represents the depth of penetration of the winter frost in the seasonal frozen ground. It may or may not coincide with the permafrost table.

Fuel Tablets--
Concentrated chemical fuel dispensed in tablet form for heating rations.

Glacier--
Any field or stream of ice of land origin. It may be either active or stagnant.

Greyout--
A phenomenon which occurs over a snow covered surface during twilight or when the sun is close to the horizon. The result is an overall greyness to surroundings causing a loss of depth perception. Greyout is similar to whiteout except that during greyout the horizon is distinguishable.

Icecrete--
A mixture of sand, gravel, and water, frozen and used as a concrete substitute.

Ice Field--
A stagnant glacier.

Ice Fog--
A type of fog composed of suspended particles of ice, partly ice crystals 20 to 100 microns in diameter. It is formed by introduction of water vapor into clear, calm air of low temperatures. Ice fog normally will be found in the vicinity of populated areas of temperatures of -35°F., or lower, but may occur at temperatures as warm as -20° F. Ice fog increases in frequency with decreasing temperature until it is almost always present at air temperatures of -50°F. in the vicinity of a source of water vapor. Ice fog may form over a body of troops, herd of animals, bivouac areas, motor parks, airfields, convoys, and gun positions during firing.

Immersion Foot--
An injury resembling trench-foot caused by prolonged immersion of the extremities in warm water (up to 70°F.).

Layer Principle--Attaining additional insulation by trapping dead air in the space(s) between successive layers of clothing. Two or more thicknesses of clothing, with intervening air space, provide greater insulation than the same thickness of clothing of the same material in a single layer.

Muskeg--

Poorly drained organic terrain which is characteristic of the Subarctic, covered with a thick, resilient carpet of water-sodden mosses and tussocks, and underlain by a high water table, peat of variable thickness, and often permafrost.

Permafrost--

Permanently frozen ground. A thickness of soil or other surficial deposit or even a bedrock at a variable depth beneath the surface of the earth in which a temperature below freezing has existed continuously for thousands of years.

Poling--

A pushing movement of arms and body with the ski poles against the snow to increase momentum in the slide. Single poling is referred to when each pole is used alternatively to obtain this propulsion. Double poling is the use of both poles at the same time.

Sastruga--

Zastruga (Russian)--
One of a series of long parallel snow ridges, occurring on the open plains and formed by the action of winds.

Skijoring--

Troops mounted on skis and towed behind vehicles.

Slough--

Part of the natural drainage system for either an area or a stream. Water will sometimes back up into this area leaving ponds and temporary streams. Generally the surface will be muddy and covered with vegetation of all types.

Snow Bridge--

The snow mass that sometimes covers the surface opening of a crevasse.

Tractor Sled Train (for oversnow movement)--

A train usually composed of cargo sleds and wanigans and towed by track laying or other type oversnow vehicles.

Treeline--

The upper limit of erect trees in mountainous regions or the northern limit of erect trees in the Arctic.

Trenchfoot--

A cold injury caused by prolonged exposure to a cold environment (near freezing) that is damp or wet.

Tundra--

A flat or gently rolling area with a muck or rock surface over permafrost and consisting of a low mat of grasses, shrubs, and other plants. This area is found above or north of the treeline.

Tussock--

A tuft or clump of grass or sedge.

Whiteout--

A condition of visibility which exists when an overcast sky prevents shadows, and snow covered terrain reflects light at about the same intensity as the sky causing the horizon to be undistinguishable and the recognition of irregularities in terrain very difficult. Only dark objects can be seen. Fog, ice fog, and blizzard conditions will sometimes create a similar situation.

Windchill--

The combined cooling effect of wind and air temperature on heated bodies.

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By Order of the Secretary of the Army:

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