mouth so they can be held in place and easily/quickly removed.

When temperatures drop, the pressure on the hydraulic accumulator of the

independent thermal viewer must be lowered, or its pump will work too hard and wear out quickly. The image transfer assembly also needs attention when the seasons change to preclude excessive purging and desiccant changes. Proper pressures are listed in updated TM 9-2350-259-20.

DIGITIZED EQUIPMENT

Liquid crystal displays (LCD) are sometimes affected by extreme cold, causing erratic readings. Do not force switches and knobs on equipment. Thawing may be needed if accumulations of snow or ice have interfered with operations.

Chapter 5
Small Arms

Section I
Cold Weather Problems

CLIMATIC CONDITIONS

Just as with larger weapon systems, severe cold can adversely affect small arms. Special care and procedures must be followed to keep them functioning properly.

Cold-Dry Conditions

Exposed metal surfaces require more frequent applications of smaller amounts of lubrication in order to remain fully functional in the cold-dry air.

Condensation

Condensation forms on weapons when they are taken from the cold into any type of heated shelter. This condensation is often referred to as *sweating*. When the weapon is later taken out into the cold air, the film of condensation freezes. This is especially serious when it occurs in the internal parts of the weapon, and stoppages and malfunctions result. When weapons are taken into heated shelters for cleaning purposes, *sweating* may continue for as long as one hour. When time permits, wait one hour, remove all condensation, and then clean the weapon.

Any opening that allows air to enter can also be a condensation problem area. When in combat, leave winterized weapons outdoors and covered. An alternative method is to place individual weapons between the tent and tent liner. This method allows for rapid access to the weapons, provides security, and still protects the weapon from excessive condensation. Special cleaning procedures reduce problems caused by condensation. When enemy contact is imminent, the interior climate of troop compartments of transportation systems (especially aircraft) should be maintained close to freezing (32°F). This prevents overheating of troops dressed in the cold regions uniform. It also prevents moisture from condensing and refreezing on weapons as troops debark into the cold from warm aircraft and vehicles. Soldiers and aircraft crews must exercise caution when loading soldiers after periods of heavy exertion. Sweat buildup and body heat of soldiers loaded on an aircraft can cause extreme and rapid fogging of the aircrafts windshields, blocking pilot vision. Soldiers preparing for extraction should ventilate their uniforms and remove as much body heat buildup as possible.

Maintenance procedures may require modification to reduce problems created by condensation. For example, the operator is not normally allowed to disassemble the buffer assembly of his M16A2 rifle. However, such disassembly may be necessary to prevent rifle stoppages due to condensation and

refreezing.

Despite precautions, weapons parts may still freeze. If they do, slow and careful manual operation may free them and prevent breakage.

Snow and Ice

Blowing snow tends to get into working parts, sights, barrels, magazines, and ammunition, especially when moving in deep snow under combat conditions. Use covers and muzzle caps when available, but remove them prior to firing.

Visibility

Blowing snow and ice fog inhibit soldiers' abilities to acquire and engage targets with small arms. Also, weapons fire creates a pall of ice fog that can hang over the weapon position, not only blocking the gunner's vision, but revealing the position to enemy gunners.

FUNCTIONING DIFFICULTIES

Cold adversely affects the functioning of small arms. Care must be taken to identify problems and apply corrective action.

Sluggishness

A common weapons problem in cold weather is sluggish operation. Normal lubricants thicken at low temperatures, and stopped or sluggish action of firearms results. During the winter, weapons must be stripped completely and cleaned with a dry-cleaning solvent to remove all lubricants and rust prevention compounds. Below 10°F, LAW helps moving parts slide better than CLP or LSA. These products provide proper lubrication during the winter and help minimize freezing of snow and ice on the weapons.

Breakages and Malfunctions

Another problem the soldier faces in severe cold is a higher rate of breakage and malfunctions. This can be attributed primarily to the cold, although snow in weapons can also cause stoppages and malfunctions. The hardened metal parts of automatic weapons are more brittle than soft metal in cold temperatures. When the weapon is fired at sub-zero temperatures, parts can break within the first few rounds. Short bursts warm the gun to a normal firing temperature. Weapons should first be fired at a slow rate of fire. Once the parts have warmed up, the rate of fire may be increased to the normal cyclic rate.

Emplacement

Most crew-served infantry weapons need a natural base or gun platform to fire accurately. In warm weather, the ground provides a solid base and yet has enough resiliency to act as a shock absorber. If the weapon is emplaced on solid, frozen ground, there is no "*give*". All the shock of firing is absorbed by the weapon itself, resulting in damage. Also, the slippery surface of the frozen ground may allow the weapon to slide.

If the snow is not too deep, and if time permits, tripods should be positioned by expedient means to keep them from moving. Lashing the tripod feet to logs that rest on pine boughs or brush, or using the ahkio (sled) as a firing platform, are methods of stabilizing tripods.

Section II
Effects of Cold on Small Arms and Ammunition

PRECAUTIONS

When using weapons or handling ammunition in severe cold, the operator should wear gloves or trigger-finger mittens with liners.

Sudden changes in temperature can cause plastic handgrips, like those on the M203 grenade launcher, to crack. Wrapping the weapon in a blanket or poncho before bringing it from a cold to a warm area helps warm it gradually.

PISTOLS

When using pistols in cold weather, difficulties that arise can include damage to moving parts and firing the pistol wearing arctic mittens. Malfunctions can be caused by snow or ice-plugged clips.

RIFLES

Malfunctions and breakages are 3 rifles may be caused by snow or ice-plugged magazines. Apply LAW to prevent bipods from freezing in position. Although all rifles create ice fog, the signature effects are minimized since the firer can change position.

MACHINE GUNS

Machine guns (MGs) break and malfunction at a high rate in cold weather. Gun crews must carry extra sears and bolt parts. One common malfunction that occurs early in firing is short recoil (bolt does not recoil fully to the rear). The prescribed immediate action for the particular weapon should be applied. As the metal warms, the problem will diminish. A second type of malfunction is caused by the freezing and hardening of buffers. This in turn causes great shock and rapid recoil, thereby increasing the cyclic rate. When this happens, parts usually break.

Condensation causes parts to freeze. All internal parts and friction surfaces of MGs should be coated with LAW. These weapons have fewer malfunctions when fired cold and dry if sub-zero lubricants are not available. Firing should consist of short, two- or three-round bursts fired at close intervals. Since ice fog greatly impairs the gunner’s vision along his line of sight, crews must prepare two or three alternate gun positions.

After changing barrels, if the hot barrel is laid directly on snow or ice, it may warp or disappear in deep snow. A tarp or poncho keeps barrels from warping or disappearing.

AMMUNITION

Cold weather does not materially affect the performance of small arms ammunition. Ammunition should be kept at the same temperature as the weapon and should be carried in bandoleers. Additional ammunition should be protected in the pockets of the parka or rucksack.

Ammunition, clips, and magazines must be cleaned of all oil and preservative and must be frequently

checked. Remove all ice, snow, and condensation. Keep cartridge containers, magazines, and ammunition drums closed to prevent the formation of rust or ice.

Store ammunition in original containers. Raise storage containers off the ground and cover them with tarpaulins, ponchos, salvage tents, or any other material that affords protection from the snow. Ammunition so stored should be marked to assist with relocating it if the storage containers become snow-covered.

Resupply in cold climates is also difficult, especially the resupply of heavy, bulky ammunition. All soldiers must practice ammunition economy and fire discipline to reduce resupply requirements. Loaded clips, magazines, or single rounds dropped into the snow are often lost. Careful handling of ammunition is essential.

Chapter 6
Communication and Information Systems Equipment

Section I
Cold Weather Problems

PHENOMENA

Certain climatic conditions affect communications and communications equipment in cold regions. These include: cold temperatures associated with dry air, condensation resulting from relatively rapid temperature changes, frozen surfaces, snow and ice, visibility, and electromagnetic conditions.

Cold-Dry Air

In cold-dry air,cold-soaked equipment is especially difficult to assemble. Increased attention to detail, patience, and special preparation to prevent damage is required. This includes working with tight connections, electrical contacts, inflexible cables, power cords, grounding, control knobs, rubber covers, binding posts, and other moving parts. Assembly of equipment is also complicated by the bulky gloves or mittens worn by operators and maintainers.

As mentioned in Chapter 1, cold markedly lessens the operational life of batteries. At -40° F the storage battery for the radio sets SINCGARS cease to operate, resulting in lost codes, and requiring reloading after rewarming. The dry air, coupled with the wind and cold, can cause considerable buildup of static electricity on nonconducting surfaces. This buildup can be a hazard to operators and technicians, as well as to equipment. Temperature inversions that occur on the coldest days in cold regions degrade frequency modulation (FM) communications signal strength drastically. This must be considered when planning troop dispositions and locations of command and control centers.

Condensation

Rapid changes in relative temperature cause cold-soaked equipment to sweat and frost up when moved rapidly between warmth and cold. Electrical contacts are especially susceptible. Also, frosting from the breath of the operators can render microphones inoperable.

Frozen Surfaces

Frozen surfaces serve as heat sinks and rapidly cool equipment. A good rule is to keep all communications equipment off the ground. Adequate grounding is important on many pieces of communications equipment, yet is very difficult to achieve on frozen surfaces.

> NOTE: Standard grounding systems will require considerable effort to construct, and in some cases prove to be impossible. Shaped charges, coupled with water-saturated salt/soil backfill poured over the grounding device, provide one of the best means for penetrating frozen earth.

Extraction of grounding devices is more than likely possible only after seasonal thawing. Use of existing

grounds (pipes, established grounds, and buried steel) is desirable, as long as the pipes are not conduits for gas or flammable liquids.

Snow and Ice

Snow and ice can get into any unprotected openings in equipment. Use the equipment covers provided for most communications equipment. Signal attenuation due to ice on antennas is also

common in cold regions. Drip loops for overhead connections, especially power connections, are required. Since small items dropped in the snow are easily lost, more frequent inventory of sets and kits is advised.

Visibility

Prolonged hours of darkness affect communications equipment operation and maintenance in several ways. Inventory, assembly, and disassembly in the dark are difficult and time-consuming, especially when wearing required gloves or mittens. High frequency (HF) wave propagation markedly deteriorates with changes occurring in the ionosphere as darkness approaches. Lower frequency assignments that need longer antennas are also required. A good day of HF communications between stations 100 kilometers or more apart might be limited to only six hours.

Electromagnetic Conditions

The Aurora Borealis activity can cause noise, suppress signals, and cause unusual wave propagation in radio communications. While electromagnetic interference does not damage equipment, planners must anticipate this degradation in choosing unit locations. Fading and severe static can cause speech secure devices, such as the KY-7, to lose signal, requiring numerous retransmissions of long messages.

Units reportedly use Aurora activity to gain greater range for HF radio by reflecting directional signals off the light fields. However, this innovative use of conditions is the exception. The greater magnetic declination angles encountered as one moves farther north also greatly affect radio communications positioning and orientation of directional antennas. These problems increase the need for strict supervision.

The most effective tactical ground system for use in frozen ground is the Surface Wire Ground System (SWGS). This system consists of pins connected together with cable to form a grounding grid. Typically, the best grounding that can be obtained with either a six-foot grounding rod or the SWGS is about 3,000 ohms of resistance.

Section II
Operation and Maintenance of Communications and Information Systems

RADIO SYSTEMS

Several considerations for radio equipment were addressed in the previous section. A good rule to follow and enforce is to handle all communications/electronic equipment very carefully when cold. A radio dropped on cold ground or thrown into the back of a vehicle is easily damaged. Control knobs may be sluggish or even frozen and require careful handling.

Even well-maintained equipment requires considerable warmup time. For example, 15 to 20 minutes warmup before voice transmission may be required, and a cold-soaked AN/GRC-42 radioteletype system might require warming for three to four hours. Keeping equipment as warm as possible can be achieved with careful planning and innovation. Use chemical heat pads and styrofoam to keep equipment, especially speech secure devices, operational. Placement of radios and switchboards off the ground and away from exterior tent or shelter walls is advisable.

Another hazard is, ironically, too much heat. Needless damage to equipment is often incurred by improperly placing the equipment too near shelter heat sources, such as a stove or heater. Electronic components and insulators can easily melt or burn, and some batteries explode when thawed too close to a heat source.

Lithium batteries, like the BA-5598 for the radio set SINCGARS, are especially effective in cold weather and do not need warming at temperatures above -20° F. Dry cells should be kept warm until needed. Extra batteries can replace cold batteries in use; after warming, they can be used again. Batteries should not be installed in idle equipment. Plastic pins on battery connections get brittle in the cold; install them carefully.

Each user of a portable manpacked radio should carry the handset inside at least one layer of clothing to prevent the push-to-talk button from freezing. This requirement, combined with the operator wearing a parka hood, severely hampers the ability to hear incoming transmissions. This may be overcome by using external speakers such as the LS-454/U. Use plastic coverings, such as battery packaging, to cover the mouthpieces of handsets. These should be used even with the presence of moisture shields to keep moisture from the operator's breath from freezing the handset. An excellent alternative is the standard nonlubricated prophylactic slipped over the handset. A wool sock over the handset keeps snow and ice out and protects the operator from direct contact with cold plastic and metal. Placing an unthawed handset directly against lips or ears can cause physical injury.

Anticontact gloves should be available and used when touching cold metal equipment. Cold injury and loss of surface skin can occur after the briefest of contact with cold handles, knobs, and surfaces. Also, common tools, such as the TL-13A lineman's pliers, should have handles wrapped in plastic or tape to provide protection.

Spare connectors, cables, handsets, and antennas should be readily available for replacement when failures happen. Metals and plastic become remarkably brittle and crack and break easily in the cold. Friction tape is advised rather than plastic tape, which loses its adhesiveness in the cold.

Vehicular radios also require careful attention. Small physical shocks can cause whip antenna damage when in the upright position. Radios should be warmed for three to four minutes on low power before changing to high power settings or transmitting. The vehicle for the particular radio being used should be cycled periodically IAW its -10 series manual when temperatures dip below -30° F. The vehicle, when cycled, should be idled at approximately 1,200 RPM. Otherwise, the high discharge rate necessary to operate both the radio and the heater soon wears out vehicle batteries.

ANTENNA SYSTEMS

Attention to proper assembly of antennas is a commonly overlooked requirement in the cold and dark. Shortcuts and failure to follow prescribed instructions often result in interruption or degradation of communications and damage to equipment. The RC-292 and OE-254 antenna masts must be erected with enough sections to ensure necessary height.

Erecting

Standard stakes are often useless in frozen ground. GP-101 cold-weather stakes can be ordered for the RC-292, or the GP-112 for the OE-254. Because they are slimmer than standard stakes, they do not hold as well when the ground thaws. Heavy 12-inch steel tent pins have been used successfully. Tree and rock tie-offs are also acceptable. Another method for erecting an FM antenna is to guide the mast carefully alongside a tree and secure it to the trunk using one of the attached guy lines. Exercise care not to damage any of the elements, cable, or mast sections upon erecting.

Proper inventory of unused hardware is essential since parts are easily lost in snow and darkness. Care must also be taken not to let moisture accumulate due to condensation or precipitation and ground out the antenna

against the trunk.

NOTE: Prior to assembly, expose antennas to the cold to prevent sweating and freezing. This prevents problems with disassembly.

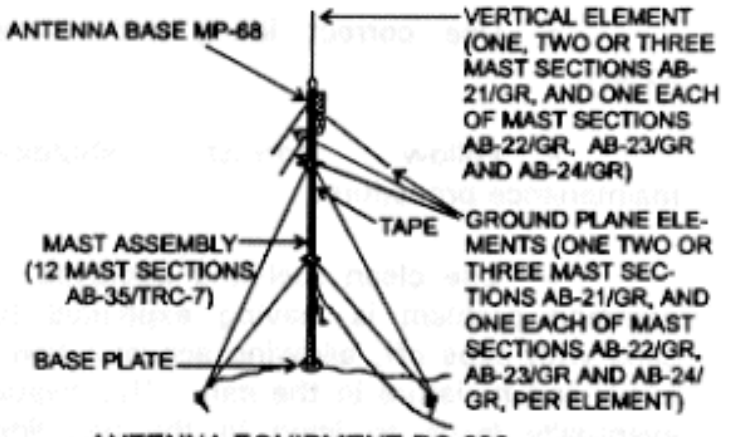
Keep the mast sections clean and free of foreign matter. Lubricate the male and female ends of each mast section only with silicone lubricant. After applying the silicone and joining the sections, back off the joints by approximately one turn as a precaution against sticking.

The RG-213 coaxial cable is recommended over RG-8 cable; the latter becomes brittle and cracks at temperatures below -20° F. Spare cable connectors and adaptors are recommended, since damage and loss are common. Loop and tape coaxial antenna cable near the top of the mast to ease pressure on the connector. Tape the cable at intervals along the mast to prevent the whipping action of the wind from causing damage to the antenna. Tap the mast periodically to shake free snow and frost accumulation, which can degrade transmission signal strength. Make guy lines in a manner to prevent tripping on the antenna guys and disabling the antenna.

Keep ceramic bowls dry because water collects in them during warm weather. When temperatures drop, they freeze, causing the more brittle glass to crack. Applying silicone where the two bowl halves join assists in sealing against further cold damage.

Length

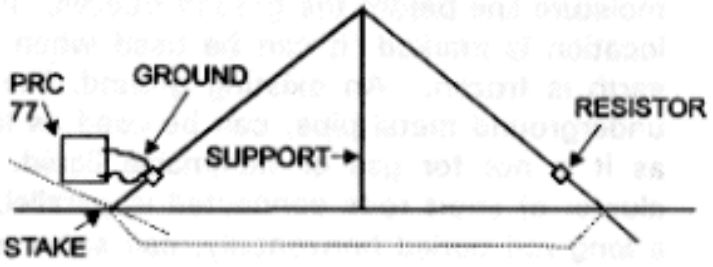
HF and long wire antennas can approach 75 meters in length, depending on the frequencies used. Attention to measurement is critical. The same applies to FM antennas. For the RC-292, the appropriate numbers of elements for radians and ground plan sections are given in Figure 6-1.



ANTENNA EQUIPMENT RC-292

RC-292 ANTENNA CONFIGATIONS

OPERATING FREQUENCY	Number of Antenna Sections Required	Type of Section Used				Number of Ground Plane Sections Required	Type of Ground Sections Per Element			
		AB 21/GR	AB 22/GR	AB 23/GR	AB 24/GR		AB 21/GR	AB 22/GR	AB 23/GR	AB 24/GR
20 to 27.9	6	3	1	1	1	18	3	1	1	1
27 to 38.9	4	1	1	1	1	15	2	1	1	1
38 to 54.4	3	0	1	1	1	12	1	1	1	1
30 to 36.5	4	1	1	1	1	15	2	1	1	1
36.5 to 50.5	3	0	1	1	1	12	1	1	1	1
50.5 to 75.9	2	0	1	1	1	9	0	1	1	1



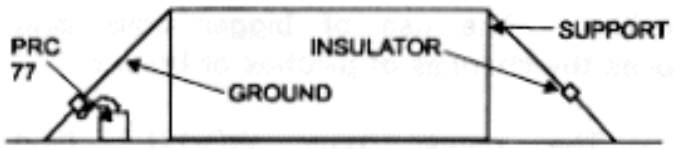
VERTICAL HALF RHOMBIC ANTENNA

Used with primarily with FM radios in lightly wooded areas.

Length.....	4 wavelengths of operating frequency, with a 11-meter lead-in.
Range.....	2 to 3 times normal range of set.
Height.....	13 wavelengths of operating frequency.
Resistor.....	400 to 700 ohms.

RADIATION WITHOUT RESISTOR

RADIATION WITH RESISTOR



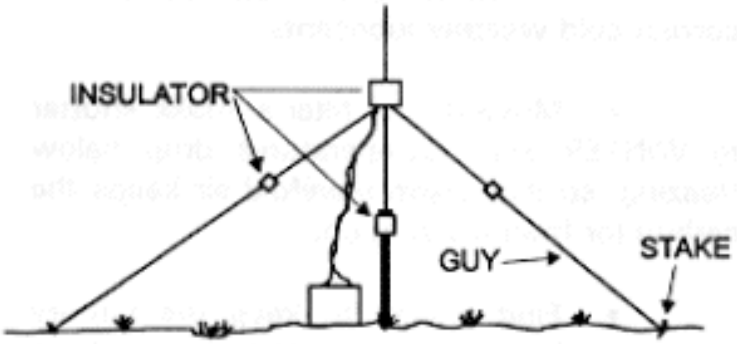
LONG WIRE ANTENNA

LONG WIRE ANTENNA. This antenna is used with both AM and FM radios to increase the range. It is normally used in open terrain where it can be constructed with ease.

Length.....	2 to 7 wavelengths of operating frequency.
Height.....	3 meters.
Range.....	2 to 3 times operating range of set
Resistor.....	400 to 700 ohms
Radation.....	WITHOUT resistor- off both ends of antenna. WITH resistor- off resistor end only.

RADIATION WITHOUT RESISTOR

RADIATION WITH RESISTOR



GROUND PLANE ANTENNA

Used with FM radios when the RC-292 Antenna is not available.

Length.....	Antenna Element.....2 meters Ground Plane Elements...2 ½ meters.
Range.....	Under most conditions will increase the range of set.
Height.....	Not to exceed 13 meters.

Figure 6-1. Antenna dimensions

Orientation

Orienting an azimuth is important and often difficult because of the requirement to compute large declination angles in northern latitudes. Directional antennas are often required to compensate for other conditions causing range degradation.

WIRE AND CABLE SYSTEMS

Laying wire over long distances in deep snow is greatly facilitated by the use of oversnow vehicles. These vehicles can also be the worst enemy of wire systems. Their skis and tracks damage surface-laid wire and cable that they pass over, dragging away large sections and cutting critical circuits. Standard wire-laying techniques, ties, and tagging apply in cold regions as well as in temperate zones. Aerial laying is advised when tactically feasible. Burial is desirable, but often difficult or impossible. Retrieving wire in cold regions is tedious and usually results in excessive salvage work due to ice and traffic damage. Stringing wire overhead is preferred because the wire will not freeze to the ground.

Wire insulation is often brittle, and impedance is increased in snow or damp conditions. Splices performed in the cold are often done improperly, and fewer can be allowed for continued use of serviced wire. A slack factor of 30 percent is recommended for wire-laying teams instead of the 20 percent suggested in the TM. This allows for cold weather shrinkage.

The TA-1/PT voice-powered telephone tends to perform poorly in extreme cold on wire of lengths extending beyond squad or platoon boundaries. The TA-312/PT, when powered by alkaline batteries (such as the BA-3030/U), provides reliable communications and is the preferred instrument for wire troubleshooting teams.

Reeling wire and cable should be done carefully; reeled wire freezes into a coiled shape and should be warmed up before unreeling. The use of bigger coils also reduces the chances of pinches or breaks.

The newer type WD-1/TT field communications wire performs nearly as well in the cold as the old type of spiral wire. It is less durable and more susceptible to damage by vehicle traffic, however, and should be used in less traveled areas. The WD-36/TT assault wire is lighter and easier to handle, man-pack, dispense, and splice than WD-1/TT in the cold, but it is much less durable.

POWER SOURCES

Generators should be thoroughly inspected and winterized, since experience has shown that they develop a higher failure rate at sub-zero temperatures. This is attributable to outdated LOs, exposed batteries, and other elements. Follow these procedures for best results:

- Winterize the item using the correct cold weather lubricants.
- Move the air filter's intake shutter to WINTER when temperatures drop below freezing, so that warm manifold air keeps the carburetor from freezing up.
- Find a way to keep the battery warm, and prevent ice and snow from plugging battery cap vent holes. Keep one battery fully charged.
- Preheat using other heat sources when possible.
- Use the correct fuel icing inhibitor: technical methanol for gasoline; fuel system icing inhibitor for diesel fuel.
- Provide shelter so that the item provides its own heat. If a shelter is not available, use pallets or trailers to keep the generator off snow, ice, or frozen ground.
- Use correct idling and running speeds.

- Follow correct shutdown maintenance procedures.
- Use clean fuel and additives. A common problem is leaving expended fuel cans with caps off, allowing accumulation of snow and moisture in the can. This mistake eventually leads to icing in the fuel lines. Keep fuel tanks as full as possible to reduce condensation.
- Check, drain, and clean filters at least daily and at shutdown to prevent icing. Change oil more often in cold weather.
- Proper grounding of generators is important, but is seldom done satisfactorily. Perform expedient grounding by using an ice auger to cut through frozen surfaces, then submerge conductors in the water. TC 11-6, *Grounding Techniques*, is an excellent guide. If an area is used in summer and winter, bury a three-foot-square metal plate below the moisture line before the ground freezes. If its location is marked, it can be used when the earth is frozen. An existing ground, like an underground metal pipe, can be used as long as it is not for gas or flammable liquid. A cluster of short rods connected in parallel, or a long rod buried horizontally, can serve as a ground, as long as it reaches below the frostline. Ground rods work best if driven near a heat source, with a salt solution poured around it--about a pound of salt in a gallon of water.

COMPUTERS

Most computers are not designed to operate at extremely low temperatures and may become unreliable or unavailable for use (0° F for larger work stations, -30° F for small handheld devices). Liquid crystal displays (LCD), especially, may be affected by extreme cold. Frozen knobs, dials, and switches should not be forced.

LCD displays can freeze or break below 32° F. When initially turned on, an LCD display in cold weather is faint and hard to read. If it is left on it will improve over time due to self warming.

NICAD computer batteries do not last as long in below 32° F weather. Charge rate for cold-soaked batteries is slower.

Appendix A
Antifreeze Materials, Fuels, Hydraulic Fluids, and Lubricants for Use in Cold Weather to -65°

This appendix contains a listing of antifreeze materials, fuels, hydraulic fluids, and lubricants for use in cold weather. Ensure LOs are checked before using or adding any materials.

ITEM	NSN	CONTAINER SIZE
Additive, Antifreeze Extender, Liquid Cooling System MIL-A-53009)	6850-01-160-3868	1-gal can 1-gal plastic 55-gal drum
Alcohol, Denatured, Grade III 0-E-760	6810-00-543-7415 6810-00-201-0907 6810-00-201-0904	1-gal can 5-gal can 55-gal drum
Antifreeze, Ethylene Glycol, Inhibited, Heavy Duty, Single Package MIL-A-46153)	6850-00-181-7929 6850-00-181-7933 6850-00-181-7940	1-gal can 5-gal can 55-gal drum
Brake Fluid, Silicone, Automotive, All-Weather, Operational and Preservative (BFS) (MIL-B-46176)	9150-01-059-2586 9150-00-102-9455 9150-01-072-8379	1-gal can 1-gal plastic 55-gal drum
Cleaner, Rifle Bore (CRC) MIL-C-372	6850-00-224-6656 6850-00-224-6657	2-oz can 8-oz can
Cleaner, Lubricant and Preservation (CLP)	9150-01-053-6688 9150-01-054-6453 9150-01-079-6123 9150-01-079-6124 9150-01-079-6125 9150-01-079-6126	1-gal liquid 1-pt liquid w/trigger/sprayer 1-oz liquid 4-oz liquid 16-oz aerosol 3-oz aerosol

Compound, Cleaning With Conditioner and Inhibitor for Engine Cooling Systems (MIL-C-10597)	6850-00-598-7328	package

Dry-Cleaning Solvent: P-D-680

Type I	6850-00-264-9037	55-gal drum, 16
Type I	6850-00-285-8012	55-gal drum, 18
Type II	6850-00-281-1986	55-gal drum, 16
Type II	6850-00-285-8011	55-gal drum, 18
Fuel System Icing Inhibitor, Diesel Fuel: (Ethylene Glycol Monomethyl Ether) MIL-I-27686	6850-00-753-5061	5-gal drum
	6850-00-060-5312	55-gal drum
(Diethylene Glycol Monomethyl Ether) MIL-I-85470AS	6850-XX-XX-XXX	
Fuel Oil, Diesel: Regular Grade (DF-2) VV-F-800C	9140-00-286-5284	55-gal drum
	9140-00-286-5283	bulk
Arctic Grade (DF-A) VV-F-800C	9140-00-286-5284	55-gal drum
	9140-00-286-5283	bulk
Turbine Fuel, Aviation, Kerosene Type, Grade JP-8 MIL-T-83133	9130-01-031-5816	bulk
Gasoline, Automotive, Combat Type II	9130-00-160-1830	bulk
	9130-00-160-1831	5-gal can
	9130-00-221-0685	55-gal drum, 16 gal
	9130-00-240-8201	55-gal drum, 18 gal

Lubricating Oil, Gear, Multipurpose, Arctic (GO-75W) MIL-L-2105	9150-00-257-5440	5-gal can
Lubricating Oil, General Purpose, Light (LO) VV-L-2105	9150-00-252-6173	4-oz can
Lubricating Oil, General Purpose, Low Temperature (GP) MIL-L-7870	9150-00-542-1430 9150-00-263-3490	4-oz can 1-qt can
Lubricating Oil, General Purpose, Preservative (PL-S) VV-L-800	9150-00-231-6689 9150-00-273-2389 9150-00-281-2060	1-qt can 4-oz can 55-gal drum, 18-gal
Lubricating Oil, Instrument (OAI) MIL-L-6085	9150-00-257-5449 9150-00-223-4129 9150-00-664-6518	4-oz can 1-qt can 1 1/2-oz can
Lubricating Oil, Internal-Combustion Engine, Tactical (OE/HDO-10) MIL-L-2104	9150-00-186-6668 9150-00-189-6728	5-gal can 55-gal drum
Lubricating Oil Internal-Combustion (OE/15W40) MIL-L-2104D	9150-01-152-4117 9150-01-152-4118 9150-01-152-4119	1-qt can 5-gal can 55-gal drum
Lubricating Oil, Internal Combustion Engine, Arctic (OEA) MIL-L-46167	9150-00-402-4478 9150-00-402-2372 9150-00-491-7197	1-qt can 5-gal can 55-gal drum

Lubricating Oil, Internal Combustion Engines, Preservation and Break-In (EO-10) MIL-L-21260	9150-00-111-3199 9150-00-111-3200	5-gal can 55-gal can
Lubricating Oil, Weapons (LAW) MIL-L-14107	9150-00-664-0038 9150-00-292-9689 9150-00-292-9687	4-oz can 1-qt can 1-gal can
Lubricating Oil, Semi-fluid (LSA) MIL-L-46000	9150-00-889-3522 9150-00-687-4241	4-oz bottle 1-qt can
Methanol, Technical (MOGAS Fuel Additive)	6810-00-275-6010	5-gal drum

Gasoline, Automotive Leaded or Unleaded, Volatility Class E:

Limited, Unleaded (VV-G-1690)	9130-00-148-7102	Bulk
Limited, Leaded (VV-G-1690)	9130-01-135-2507	Bulk
Regular, Unleaded (VV-G-1690)	9130-00-148-7102	Bulk
Regular, Unleaded (VV-G-1690)	9130-01-135-2507	Bulk
Premium, Unleaded (VV-G-1690)	9130-00-148-7102	Bulk

Grease, Aircraft and Instrument (GIA) MIL-G-23827	9150-00-985-7245	8-oz tube
	9150-00-985-7246	1-qt can
	9150-00-985-7247	1-gal can
	9150-00-935-4017	4 1/2-oz cartridge
	9150-00-985-7248	35-lb pail
Grease, Automotive and Artillery (GAA) MIL-G-10924	9150-00-190-0907	35-lb pail
	9150-00-190-0904	1-qt can
	9150-00-190-0905	1-gal can
	9150-00-935-1017	14 1/2-oz cartridge
	9150-00-065-0029	2 1/4-oz tube
Grease, Molybdenum Disulfide (GMD) MIL-G-21164	9150-00-935-4018	14 1/2-oz cartridge
	9150-00-754-2595	1-qt can
	9150-00-223-4004	1-gal can
	9150-00-065-2003	35-lb pail
Hydraulic Fluid, Petroleum Base for Preservation and Operation (OHT) MIL-H-6083	9150-00-935-9807	1-qt can
	9150-00-935-9808	1-gal can
	9150-00-935-9809	5-gal pail
	9150-00-935-9810	55-gal drum

NOTE: OHT should be used wherever previous documents have specified OHC.

Hydraulic Fluid, Fire-Resistant, Synthetic Hydrocarbon Base (FRH)	9150-00-111-6254	1-gal can
	9150-00-111-6255	5-gal pail
	9150-00-111-6256	1-qt can

NOTE: OHT should be used for temperatures below -25° F.

Lubricant, Cleaner and Preservative for Weapons Systems (CLP) MIL-L-63460	9150-01-053-6688	1-gal can
	9150-01-054-6453	1-pt plastic
	9150-01-079-6124	4-oz plastic bottle
	9150-01-102-1473	1/2-oz plastic bottle

Lubricating Oil, Exposed Gears and Wire Ropes (CW IIA) VV-L-751	9150-00-261-7891	35-lb pail

NOTE: CO-75W should be used for temperatures below -25° F.

Lubricating Oil, Gear (GO-75W) MIL-L-2105C	9150-01-035-5390 9150-01-048-4593 9150-01-035-5391	1-qt can 1-gal can 5-gal can

Appendix B
Special Materials for Use in Cold Weather (0°F To -65°F)

This appendix contains a listing of special materials available for use in cold weather. Check appropriate publications before ordering any item.

NSN	ITEM
5950-01-134-3770	Adaptor, Battery Terminal, Finned (Positive)
5950-01-134-3771	Adaptor, Battery Terminal, Finned (Negative)
5935-00-322-8959	Adaptor Connector (NATO Slave Cables)
(See CTA 50-970)	Anticontact gloves
6135-00-930-0030	Battery, Dry, BA-3030/U
6135-00-926-3503	Battery, Dry, BA-398/U
6135-01-034-2239	Battery, Primary, Lithium, BA-5598/U
7240-00-132-6431	Bushing (Gasket), Synthetic Rubber, for 5-gal Can

Cable, Battery Booster, Consisting of:

- **6145-00-705-6674** No. 1 AWG Wire (Length Needed Per Foot)
- **5940-00-047-4610** Clamp,BlacK
- **5940-00-047-4613** Clamp,Red

2590-00-148-7961	Cable Kit, Special Purpose (NATO Slave Cables)
7240-01-318-5222	Can, Cradle (5-gal Fuel Can)
7240-00-132-6433	Cap and Screen Assembly, Flexible Spout, for 5-gal Fuel Can
7240-00-125-9061	Case, Military Water Can, 5-gal
2530-01-369-9994	Cleat, Ice for T158 Track (M1 Series Tank)
5310-01-102-2711	Nut, Self-Locking for Ice Cleat

2530-00-859-7335	Evaporator, Alcohol (Vehicular Air Compressor)
4940-00-475-1574	Heating Torch, Gas (Blowtorch)
4720-00-542-3304	Hose, Natural Rubber, Yukon Stove (Fuel)
4720-00-913-5222	Additional Stock Number for Same Type of Hose
5965-00-876-2375	Loudspeaker, LS-454/U (PRC-77)
8465-00-753-6335	Maintenance Kit, Rubber Patch, VB Boot
6530-00-786-4635	Pad, Heating, Chemical
8340-00-823-7451	Pin, Tent, Stell, 12-inch
6850-00-177-5094	Silicone Compound, 2-oz Tube
6850-00-880-7616	Silicone Compound, 8-oz
6850-00-295-7685	Silicone Compound, 10-gal
5970-00-240-0620	Tape, Insulation, Electrical, Low Temp, TL-600
6630-00-105-1418	Tester, Antifreeze/Battery
6850-00-001-4194	Water-Indicating Paste
5330-01-271-7621	Gasket, Synthetic Rubber, For 5-gal Can, -60°F
3030-00-224-8357	Belting Variable Link Adjustable, 3/8-inch
3030-00-224-8358	Belting Variable Link Adjustable, 1/2-inch
3030-00-233-9126	Belting Variable Link Adjustable, 3/4-inch
5935-00-224-8368	Connector Tool for Adjustable Belt
5820-01-263-1760	Grounding Kit, Surface Wire, MK-2551A/U

Appendix C
Environmental Protection Concerns

In spite of the difficulties cold weather may present to unit operations and maintenance, leaders must remember that units are still required to comply with federal, state, local, and HN environmental regulations.

Many cold weather areas contain fragile environmental ecosystems that could be damaged significantly by spills or improper hazardous waste and materials disposal. Increased fuel consumption coupled with the use of special oils, lubricants, batteries, and the failure of equipment from low temperatures increases the possibility of environmental damage.

In light of the increased risk, it is important that leaders conduct unit environmental self-assessments prior to deploying to a cold weather area. They must ensure that the resulting risks are made part

of the unit environmental awareness training program.

An example of a unit environmental self-assessment is contained in Appendix C, TC 5-400, *Unit Leaders' Handbook for Environmental Stewardship*. The self-assessment looks at the following: management, waste-oil storage, hazardous material/ hazardous wastes, solid-waste management, spill prevention, recycle program, washracks, and land management. It is the primary tool for conducting a unit environmental assessment and should be supplemented by local regulations. A copy of *Environmental Products, Chemical Alternatives, Recyclers, Aircraft Cleaners and More*, published by the DLA, should be used to choose environmentally preferred substitutes for the fluids, fuels, lubricants, and materials listed in Appendix A.

Appendix D
Sample Cold Weather Supplement to Unit Maintenance SOP

This SOP is provided as an example only. It should be modified to accommodate specific unit equipment and local procedures.

1. REFERENCES. FM 9-207, appropriate TMs, LOs, and local SOPs.

2. PURPOSE. Establish additional procedures for the operation and maintenance of unit equipment in cold conditions.

3. RESPONSIBILITIES

a. Commander

(1) Sets unit cold weather maintenance policy.

(2) Ensures that personnel comply with the provisions of the cold weather SOP and the above references.

(3) Ensures that super-visors, operators, and mechanics receive proper training in cold weather operations and maintenance.

(4) Ensures environmental compliance and that soldiers receive proper training in environmental awareness.

b. Maintenance Officer

(1) Plans, coordinates, and supervises cold weather maintenance and recovery efforts.

(2) Ensures that adequate cold weather maintenance support is provided to the unit.

c. Motor Sergeant. Supervises maintenance personnel in the proper performance of cold weather maintenance and services.

d. Mechanics. Perform cold weather maintenance and troubleshooting IAW appropriate TMs, LOs, and SOPs.

e. Equipment Operators. Operate vehicles and equipment IAW the cold weather sections of appropriate TMs and special instructions given by maintenance personnel.

4. GENERAL. Cold weather effects on unit maintenance can be placed into two major categories: personnel and material.

a. Personnel. Major problems encountered by maintenance personnel include:

(1) Increased time to perform maintenance tasks due to bulky clothing and adverse conditions.

(2) The requirement for maintenance personnel to spend a large portion of time on self-preservation.

(3) The need to train maintenance personnel on improvising and using expedient maintenance and recovery procedures to combat cold weather.

b. Materiel. Cold weather adversely affects almost all materiels. The lower the temperature, the more adverse the effect. Specific effects include:

(1) Vehicles/equipment re-quire extra warmup time for metal parts to reach operating temperatures.

(2) Vehicles/equipment may require warming from an outside heat source before starting.

(3) Caution must be taken when loading vehicles to prevent undue stress on brittle metal parts.

(4) Rubber becomes very stiff and brittle in extreme cold and also when exposed to moderate cold for long periods. Several hours of operation or preheating may be required to soften rubber.

(5) Wiring, cable, and rubber hoses may become brittle and crack. Handle these items with care to avoid damage.

(6) Plastics contract and become brittle. Plastic windows crack easily. Use care in handling.

(7) Windows may crack if defrosted too rapidly. Never use hot water to thaw windows in extreme cold.

(8) Glass can crack when ice scrapers are used with hard or violent jabs. Use scrapers with caution.

(9) Tarps made of heavy canvas appear to shrink. It may be difficult to fold or smooth wrinkles in the canvas. Plastic tarps become brittle and cracked. Store and unfold the tarps in heated shelters whenever possible.

5. OPERATING PROCEDURES. All unit vehicle operators and maintenance personnel will comply with operational checks outlined in vehicle TMs, as well as the following procedures:

a. Before Operations

(1) Check to ensure that brakes are not frozen and can be released. The use of portable heating equipment may be required.

(2) Check springs for cracking due to metal brittleness.

(3) Ensure tracks/wheels are not frozen to the ground. Park vehicles on wooden blocks, planks, or other materials to reduce freezing to the surface. When operating tracks in snow-covered and icy terrain, it may be necessary to remove track pads, install ice cleats, or

reverse track center guides to improve traction. Also, it may be necessary to spread sand, dirt, salt, or a combination of these materials over the traveled surface to aid traction.

(4) Remove built-up dirt and ice from the suspension system.

(5) Ensure track tension has been adjusted for cold operations by increasing the amount of slack.

(6) Check vehicle oper-ators manual for inflation pressure. Ensure tires are inflated properly for operation. Deflate tires to normal pressure if pressure was increased to compensate for extended parking. Do not over-inflate tires.

(7) Ensure all carbon dioxide fire extinguishers have been winterized IAW appropriate fire extinguisher TB.

(8) When adding lubri-cants to an engine, prevent snow or ice from entering crankcase.

(9) Ensure cooling sys-tems are protected with the correct antifreeze compound.

(10) Ensure vehicle is fueled with the proper grade arctic fuel or with JP-8, as specified by the TM or appropriate TB.

(11) If engine is difficult to start, check spark plugs for ice coating due to condensation. For diesel engines check battery for proper charge to insure glow plug operation.

(12) Ensure starter drive mechanisms are clean and properly lubricated to avoid freezing.

(13) Check batteries to ensure that they are fully charged by measuring the specific gravity of the electrolyte.

b. During Operations

(1) At temperatures of -20°F to -60°F, start vehicles periodically to maintain readiness. This practice should be avoided if any other means of keeping engines operable, such as power plant heaters or external heaters, are available.

(2) Avoid idling engines if at all possible. This practice tends to waste fuel and adds to engine maintenance cost.

(3) Ensure power plant heaters are used properly and maintained IAW the appropriate TM.

(4) Operate vehicles not equipped with power plant heaters at prescribed intervals. Also ensure that portable duct-type heaters are available for engine compartment preheating.

(5) Avoid starting a vehicle by towing if at all possible. If internal parts are frozen, applying external power will not solve the problem.

(6) Check chassis and body components for ice, mud, and snow buildup. Remove buildup at every opportunity to ensure proper ground clearance and to prevent interference with moving components.

(7) Check vehicle chains to ensure they are serviceable and properly fit the tires. As chains

become loose, retighten them to prevent damaged vehicle parts.

(8) Ensure engine oil pressure is maintained for safe engine operation. Also, check vehicle oil for the accumulation of sludge which can severely damage the engine.

(9) Maintain normal engine operating temperature through the adjustment of engine compartment inlet shutters or radiator covers.

c. After Operations

(1) At the end of each operating period, and for five minutes prior to shutdown, run the vehicle engine to normalize its operation and retain oil on cylinder walls.

(2) Do not park vehicles with the brakes set since they may freeze and not release. Use chock blocks to hold vehicles in place.

(3) Never park overnight where snow has melted that day; tracks and wheels will freeze to the ground.

(4) Park with tracks and wheels on brush, cardboard, or any similar material to prevent direct contact with the ground.

(5) Protect radiators from wind, snow, and ice buildup.

(6) Ensure the fuel tank is topped off to prevent condensation buildup.

(7) Drain air tanks.

Appendix E
NBC Defense in Cold Conditions

GENERAL EFFECTS

Many effects of nuclear, biological, and chemical (NBC) agents change in the cold weather environment. All NBC protective equipment and supplies must be kept from freezing. FM 3-4, *NBC Protection*, covers NBC defense.

Severely Degraded NBC Equipment Effectiveness

Materials of protective equipment become brittle, crack, and tear easily in extreme cold. Frozen detection and decontamination solutions clog and damage equipment. Because most decontamination solutions require water, heat must be supplied when conducting decontamination operations. Agent detection reactions are slow in the cold. Great care must be taken in donning and removing protective clothing to avoid contamination. Logistics requirements increase during NBC defensive operations in extreme cold. For example, quantities of fresh, potable water and heated protective shelters may be required.

Psychological Stress

Extreme cold and high altitudes produce psychological problems that numb the intellect and degrade personal and unit security. Current knowledge prevents precise assessment of the added impact on military operations. However, casualty rates will probably increase if psychological stress slows or stops normal reaction of individuals or units to NBC attacks.

Mountainous Areas

Breathing is more difficult at higher altitudes. There is little data concerning the effectiveness of NBC equipment in the extreme cold of high altitudes. At the lower barometric pressure of high altitudes, chemical agents evaporate or sublime much more rapidly. The increased elevation may, by localized surface heating, speed the vaporization of chemical agents. Contamination may be spread quicker by greater windspeeds at higher altitudes. Contamination may collect in depressions and small valleys.

EFFECTS ON NUCLEAR WEAPONS

Cold conditions can impact the effects of nuclear weapons. Leaders must understand these effects to properly plan for the protection of their soldiers.

Blast

Below -25° F, the effective radius of a nuclear blast may increase up to 20 percent. Icepack or hardened snowpack extends the distance of static overpressure, i.e., the crushing effect of the blast. Conversely, the distances of dynamic pressure may decrease due to the soft, absorbent characteristics of drifts and other snow cover. Tundra and ice formations can break up pressure waves. The cratering effects in ice and

frozen ground may be reduced to those in solid rock.

Primary and reflected blast waves and ground shock from even small yield nuclear weapons may create earthquake-like fissures, crevasses, avalanches, and rock slides as far as 30 kilometers from ground zero. Secondary effects include snowstorms, avalanches, quick thaws, and ice breakup on lakes and rivers, which can interfere with troop movement. Blast will increase damage to equipment already inflexible from cold-soaking. In heavily forested areas, blown down trees can make large areas virtually impassable to vehicles and personnel. During winter months, trees freeze and become brittle; in a nuclear blast, they can be converted into many splinter-like projectiles. Personnel in heavy, layered clothing are less susceptible to injury from flying debris.

Thermal

Cold can significantly alter the effects of a thermal blast. Due to the high reflectivity of snow and ice and the increased density of cold air, minimum safe distances may need to be increased by as much as 50 percent. Cold conditions can produce other effects, to include the following:

- Cold temperatures, cloud cover or frost, ice, and snow may reduce thermal effects on combustibles.
- When ice and snow pack melt, flash flooding may occur in low lying areas. Thawing can greatly impede troop movement.
- Snow, ice, and cold temperatures may limit destruction from post-blast fires.
- The average reflecting surfaces of muskeg, tundra, and wet conditions are characteristic of a cold region that may reduce thermal radiation.
- Ice, fog, and snow cloud cover may lessen thermal radiation from airburst detonations.
- The snow’s highly reflective surface intensifies thermal radiation.
- The dilating of pupils in winter darkness increases the chance of permanent or temporary light blindness.
- Reflective, over-white camouflage clothing and netting may reduce injurious heat absorption by personnel and equipment.

Radiation

Weather significantly influences radioactive fallout patterns. Snow can mask radiological hot spots from detection. Snow deposition is erratic due to rapidly changing winds. High winds extend radiation fallout patterns, but at the same time, may reduce radiation dose rates due to the scattering of contamination. At extremely low temperatures, the increased density of the atmosphere may reduce the distances of initial radioactive fallout by as much as 25 percent.

Contaminated snow may spread the fallout. Amounts of induced radioactivity in the soil are reduced and even prevented by deep snow. Poorly drained areas, such as meadows, limit natural flushing and may act as collecting points for radioactive contaminants. Most of the arctic is poorly drained. New snow may lessen fallout contamination of areas, permitting safe crossing by personnel and equipment.

The need for detailed radiological surveying increases in cold weather. Levels of local radiation can change quickly in windy conditions, causing *hot spots* far removed from ground zero and very low-intensity areas nearer ground zero.

The extended cold weather clothing system (ECWCS) clothing provides excellent protection from fallout. Radioactive particles may be removed by vigorous shaking and brushing of outer garments. Snow caves and below-ground shelters provide excellent shielding against radiation.

Electromagnetic Pulse

Effects are expected to be the same as in temperate zones. Electromagnetic pulse (EMP) hampers or negates radio and tactical-satellite communication for extended periods. EMP mitigating practices, such as burying and recovering cables and wire links, may be difficult or impossible because of frozen ground.

EFFECTS ON BIOLOGICAL AGENTS

Biological attacks must be anticipated. Up-to-date immunizations, acclimatized personnel, and strictly enforced personal hygiene (often considerably more difficult in the cold) are the best ways to avoid secondary spread of any infection. Vectorborne agents are rare since the vectors rarely survive. Toxins are less susceptible to the cold, and the possibility of their use by covert means must be anticipated. The survival chances of most microorganisms decrease significantly below 32°F. Layers of snow and reduced sunlight lengthen the hazard period for biological agents. Organisms may remain alive but dormant. They become active when exposed to warmer temperatures. The most effective means of biological warfare in cold weather is to covertly deliver live organisms. After a known biological attack, precautions to prevent the spread of its effects must be taken just as they would in a temperate climate.

Temperature inversions frequently found over snow fields and bodies of water tend to prolong the lives of biological agent clouds. Aerosolizing live biological agents is more difficult at extremely cold temperatures. Only some spores form bacteria, and certain viruses survive.

Tents and other areas where temperatures are higher than outside are likely areas of biological contamination spread. Once established in one person, a biological agent is likely to spread rapidly in crowded living conditions. Troops suffering from lack of nourishment or rest, or from dehydration, are more vulnerable to the effects of biological attack.

EFFECTS ON CHEMICAL AGENTS

Chemical agents are especially effective in the cold (Figure E-1). Exposure to *any* chemical agent requires masking. Conditions for aerosol dispersal are excellent. Most agents freeze at -50° F. Chemical agents, either thickened or frozen on clothing or equipment, produce deadly *off-gas* concentrations once taken into heated areas.

Blood and Choking Agents

Blood and choking agents are extremely hazardous and nonpersistent throughout low temperatures. These agents may be spread as liquids, solids, or aerosols. Masks are required whenever they are used. Hazard times may be longer. The blood agent AC is extremely hazardous, even as low as -65° F.

Blister Agents

Blister agents freeze below 0° F. They can be brushed from clothing and equipment. However, some mixtures, such as HL, remain liquid hazards at fairly low temperatures. The standard winter blister agent is a mixture of mustard and lewisite. In areas that lack water, frozen or otherwise, this blister agent persists in liquid form for up to six months. If water is present, the agent decomposes to form a pure

mustard that freezes at 58°: F.

Nerve Agents

Nerve agents freeze in severe cold. However, they present a very serious vapor hazard when brought into warm areas. When used to contaminate key facilities, nerve agents become long-term hazards. These hazards may require tremendous decontamination efforts, or even waiting for a change in seasons, to reduce contamination below lethal levels. Persistency is controlled by three factors: temperature, terrain surface, and windspeed. Nerve agents, particularly VX, are effective when absorbed through the skin or eyes, but the low volatility of VX makes the vapor hazard negligible below 32&3176; F. The physical behavior of persistent nerve agents is only slightly affected by decreasing temperature. As the temperature nears 32° F, persistent nerve agents dissolve in water, have reduced vapor hazard, and increase in persistency. Nonpersistent nerve agents (i.e., GB) tend to become semipersistent, lasting from two to ten days.

NUCLEAR, BIOLOGICAL, AND CHEMICAL DEFENSE

To effectively defend against the effects of NBC weapons, four fundamentals must be applied: detection, contamination avoidance, protection, and decontamination. In a mountainous cold weather environment, the first three fundamentals become extremely important, and decontamination, always difficult and time-consuming, becomes a logistical nightmare.

AGENT	DEGREE OF CONTAMINATION	TEMPERATURE °F	TEMPERATURE °C	PERSISTENCY (HOURS)
HD (BLISTER)	MOD	>90	>34	1-3
		75-90	24-34	2-6
		60-75	16-24	6-24
		32-60	0-16	12-36
		<32	<0	48-140
	HVY	>90	>34	4-8
		75-90	24-34	12-24
		60-75	16-24	24-48
		32-60	0-16	72-168
		<32	<0	168-4032
GD (NERVE)	MOD	>90	>34	08.5
		75-90	24-34	1.8
		60-75	16-24	.5-1.06-24
		32-60	0-16	2-4
		<32	<0	4-12

		>90	>34	.5-1
		75-90	24-34	1-3
	HVY	60-75	16-24	2-3
		32-60	0-16	4-12
		<32	<0	12-36
		>90	>34	4-12
		75-90	24-34	12-24
	MOD	60-75	16-24	24-72
		32-60	0-16	46-144
		<32	<0	168-336
VX(NERVE)				
		>90	>34	12-36
		75-90	24-34	48-96
	HVY	60-75	16-24	96-240
		32-60	0-16	168-504
		<32	<0	720-1440

Figure E-1. Persistency table

Detection

Automatic detectors must be heated. Detection is vital to identifying a hazard. The vapor hazard of chemical agents may be limited, making the M-256 chemical agent detector kit unreliable. Persistent agents can freeze into solids that may not be identifiable. This creates a potential hazard that does not materialize until temperatures rise. Reagents in the M-256 chemical agent detector kit freeze and provide inaccurate readings in temperatures below -25° F. These kits must be kept close to the body to prevent freezing. Cold slows the response of M-8 chemical detector paper. Extra time must be allowed for the paper to work. M-9 paper is of little value because all the substances that react to it are affected by the cold. Extreme cold, or the physical state of a chemical agent, may make the M-8 alarm system ineffective. Every 50 to 100 feet, detection teams should melt snow, heat it to 70° F, and test it with M-8 paper or CAM. If an agent is suspected, water is taken into a heated shelter and heated until a vapor is given off above 70° F. It is then tested with the M-256A1 kit; data is recorded, reported, and plotted according to unit SOP. Contaminated areas are marked with the standard NATO contamination signs.

Contamination Avoidance

Avoidance measures prevent offering the enemy a vulnerable target and prevent accidental contact with existing contamination. To enhance unit survival, employ the following measures:

- Harden positions by improving overhead cover.
- Disperse personnel, supplies, and equipment.
- Conceal positions.
- Provide early warning.
- Develop NBC environmental discipline.
- Remain mobile.

- Keep supplies and equipment covered.

Protection

Take active measures to protect units from contamination. Specifically, employ the following measures--

- Find and destroy enemy munitions and delivery systems.
- Use NBC reconnaissance teams to monitor contamination of specific areas.
- Use the standard warning and reporting system to warn others of hazards, or to pass the alarm locally.
- Prioritize the covering of mission essential equipment.
- Build collective protection shelters to provide contamination-free work environments.

Decontamination

Decontamination (decon) is the process of making any person, object, or area safe by absorbing, destroying, neutralizing, making harmless, or removing radioactive material clinging to or around it. Deliberate decon requires extensive time and logistical support. Temperatures below 32° F limit the effectiveness of decontamination operations. Current chemical decontamination procedures that require water rinses are impossible in freezing weather. Non-water decontamination procedures have not yet been developed. Decontamination must often be done in heated facilities. To decontaminate, soldiers must--

- Perform hasty decon.
- Continue to fight after hasty decon.
- Understand the effects of chemical agents.

SHELTER CONTROL

In cold weather operations, decon and some aspects of detection must be accomplished in heated shelters. One of the most challenging problems is preventing contamination from entering warm areas. For example, frozen agents on clothing are hard to detect because low temperatures slow the effects of the agents. If the temperature rises, or if contaminated individuals enter heated areas, the frozen agents will revaporize and become hazardous. It may be necessary to set up a thawing station for each warm shelter where agents can be isolated before individuals enter the main shelters and unmask.

INDIVIDUAL PROTECTION EQUIPMENT

Use of individual chemical protective equipment presents added challenges in cold weather. Failure to take specific precautions can result in equipment failure and possible contamination.

Field Chemical-Biological Masks

Wearing the M-17 or M-40 Series masks in cold weather requires special attention to ice formation and frostbite. Masks should be carried beneath outer garments, and care should be taken to wipe dry the inside of each mask after wear. After wear, soldiers should inspect for ice buildup in the inlet and outlet valve areas. To prevent frostbite, place small pieces of tape over the exposed metal rivets of the facepiece. During periods between repeated use, take the mask out of the carrier and shake or flex the facepiece to remove ice and snow. Warm the mask when you can, but do not warm close to a heater or

open flame as the rubber parts of the facepiece could melt. Dry facepiece with cheesecloth in a warm indoor area.

M-4 winterization kit. The M-4 winterization kit consists of an ice particle prefilter fitted over inlet valves to prevent frost from accumulating on the inlet caps. It also includes two inlet valves and two nose cup valves made of a relatively soft rubber that does not become hard or brittle in the cold.

Mask carriers. The mask carrier should be adjusted to be worn in a side carry beneath the cold weather parka. Body heat helps keep the mask warm and flexible, but masking is slow and difficult. Soldiers must be aware of this requirement when donning their cold weather clothing. They must ensure that the ECWCS parka is large enough to accommodate insulating layers and the gas mask with its carrier.

Outserts. Two outserts are provided with the mask to prevent fogging of the eye lenses. Green- and amber-tinted outserts can be used for bright light and fogging. Avoid wiping eyepieces with gloves when firing because they will smear.

Donning Protective Masks

Hold your breath. Remove the mask from under your parka, lower the parka hood, and don the mask. Adjust the head harness only tight enough to create a good seal. Raise the parka hood and fasten the outer garment.

NOTE: Do not clear the mask by exhaling a large amount of air because the lens will frost. Exhale slowly and steadily. The outlet valve may stick to the seal. If this occurs, lift the outlet valve cover and rotate the disk with a finger while exhaling only. After freeing the valve, reset the valve cover. Check the mask for leaks by pulling down the cheek flaps on the ice particle prefilter while covering the inlet valves with hands. Fasten the cheek flaps and resume normal breathing.

Removing Protective Masks

Remove gloves or mittens before removing the mask. Loosen the outer garment and lower the hood. Brush snow or ice particles from the mask. Remove the mask and immediately dry your face and the inside of the mask. Raise your parka hood and fasten outer garment. Wipe the mask thoroughly before storing to prevent ice formation. Store the mask in the carrier. Put on gloves or mittens. When possible, further dry the mask by placing it in a warm area, but not in direct heat.

Wearing the Chemical Protective Overgarment

Contamination avoidance measures may fail. The enemy may find and attack with NBC weapons. Soldiers may be downwind of an NBC attack, or the mission may require them to cross contaminated areas. Protection options must be available to survive and continue the mission.

Wearing the chemical protective overgarment presents a particularly difficult operational/logistics decision that com-manders must make before entering the operational theater. The impact of mission oriented protective posture (MOPP) conditions on operations must be considered. If the ECWCS parka is not needed because of the added warmth provided by the chemical protective overgarment, store and seal it in a plastic bag. If the ECWCS is worn outside the chemical protective overgarment, it permits the layering required for added warmth. However, it requires that the contaminated clothing worn over the chemical protective overgarment be removed before entering a heated shelter where the agents can

revaporize. Upon decon, the external layers of the overgarment have to be discarded. Also, once the ECWCS is donned, it is not possible to adjust the overgarment. Replacement issues of cold weather clothing are needed. Stocks of ECWCS are not adequate to support this requirement. A method of decontamination of this cold weather clothing is necessary. The chemical protective overgarment produces internal moisture and condensation and dehydration problems that can lead to hypothermia. In full MOPP gear, speed is reduced by at least 50 percent (probably greater due to buildup of condensation and the potential danger of hypothermia).

Chemical Protective Glove Set

Vapor barriers (i.e., medical examination gloves, the wool insert, and the leather shell covered by the butyl-rubber glove) make up the chemical protective glove set. This set allows the insulator (the wool insert) to remain dry and warm. If either outer glove is punctured or torn, the glove set must be replaced.

VB Boots

Vapor barrier (VB) boots are an effective and adequate replacement for the normal overboots. However, the natural rubber composing the VB boot can be penetrated by chemical agents that contain mustard gas. After 50 hours exposure, they must be replaced and turned in for decontamination or discarding.

Decon Kits

The M-258A1 decon kit is good to 32°F. It must be kept next to the body to prevent freezing. Because it assumes surrounding air temperature, the solution should be used quickly once it is opened to avoid possible frostbite. The M-13 consists of a bag of Fuller’s earth for equipment decon. It is not affected by the cold. Neither are the components of the M291 skin decontamination kit (SDK) or M295 individual equipment decontamination kit (IEDK).

NAAK M-K1

The NAAK M-K1 should be protected from freezing. At temperatures below -40° F, remove from the mask carrier and store in a parka pocket.

UNIT PROTECTION

Units must be self-sufficient in NBC defense. Cold weather conditions impose many special considerations on defense planning. For example, adjacent units may not be able to provide mutual support, logistical support may be drastically reduced, and rapid movement may become more difficult.

Bivouac Location

Because of terrain and weather restrictions, bivouac location for effective NBC defense requires considerable planning. Gullies, ravines, ditches, natural depressions, fallen trees, and caves can reduce the effects of nuclear weapons, but low-lying areas are places where toxic clouds can settle. If feasible, positions should be constructed upwind of possible threats. The heat, light, and initial radiation of nuclear blasts are absorbed by hills, while the rest is deflected up by the slope. Likely targets such as MSRs and mountain passes should be avoided. Wooded areas present a mixed blessing. Biological agents persist longer as forests retain moisture and keep out sunlight. Coniferous forests of Europe and the northwestern US reduce the possibility of liquid contamination from chemical weapons. However, the chemical vapor hazard increases.

Special Concerns for Nuclear Protection

The primary concern for nuclear protection is shielding from gamma and neutron radiation. Gamma protection requires thick layers of dense, heavy shielding such as lead, iron, or earth. Light hydrogen-based materials such as water, snow, paraffin, or oil offer good neutron protection. However, the absorption of neutrons produces additional gamma radiation. Dark, rough materials, such as wool or canvas, should be used to cover potential reflecting surfaces. These may burn or char but do not present the hazard a melted poncho would. Avoid direct contact with these materials. View ports should be covered with metal window screening material that can block thermal radiation by up to 50 percent. Smaller openings reduce the amount of initial and residual radiation that enters.

Work Rate

Dehydration injuries are likely when soldiers must perform difficult physical tasks. Soldiers become more prone to suffering subsequent cold weather injuries. Freezing air inside protective clothing, or perspiration that cannot evaporate, leads to chilling or hypothermia. Generally, soldiers in MOPP-4 conditions at 20° F need twice the time required at higher temperatures to accomplish tasks. Added supervision of work loads is necessary to prevent cold weather injuries.

MOPP Gear Exchange

If a unit becomes contaminated, decon will be done by MOPP gear exchange (gloves and overgarment only). Two complete sets of MOPP gear and waterproof bags to seal contaminated clothing per person should be available. Care must be taken with packaging the overgarment. Tears and exposure to air will degrade protective qualities. Extra suits must be provided when crossing water obstacles or conducting amphibious operations. Any contaminated cold weather clothing item must be replaced.

DECON OF EQUIPMENT

Cold temperatures can be expected to adversely affect liquid solutions, pumps, sponges, swabs, brushes, etc.

Water, the most common ingredient in decon operations, is useless if frozen. It should not be used when temperatures are so low that it freezes on contact with equipment. In these temperatures, use undiluted DS2 but remember that DS2 corrodes equipment quickly. Equipment must be replaced quickly. Because of their low freezing points, solvents such as JP4, diesel fuel, or kerosene may be used to physically remove contamination. With present technology, equipment decon problems are hard to overcome in an arctic environment.

Commanders must consider fighting dirty in cold weather areas. Fresh units can be rotated into the contaminated areas so that dirty units can move to decon stations. DS2 and STB freeze at approximately -15° F. In temperatures less than -15° F, JP4 could be used to remove contamination. This removes but does not deactivate the chemicals. The ground and equipment used to remove contaminates must be destroyed or removed properly. JP4 is also highly flammable. The large amount of static electricity in cold dry climates can ignite the fuel. There is a definite risk of frostbite when fuel contacts exposed flesh. Rinse water must be heated, or antifreeze added to the rinse solution, to prevent freezing on contact with a cold vehicle. If the vehicle cannot be rinsed, the DS2 will quickly corrode the vehicle.

Use of the chemical agent monitor is limited by the cold’s shortening of battery life. Two nitrogen

cylinders may be required to expend the contents of the M-11 decon apparatus at temperatures below 32° F.

Difficulties develop in dispensing DS2 as temperatures near 0° F. To overcome this

problem, the decon apparatus portable (DAP) must be warm enough for the DS2 to pump through the brush assembly. Commanders should consider positioning a contingency supply of the M-13 inside heated vehicles and develop a plan to rotate the other DAPs into heated shelters as needed.

The M-17 sanator decon apparatus has problems in cold temperatures because the system relies on a water-based decon method. Normal engine cold-soaking problems have been observed along with internal pumps, lines, etc., cracking from the expanding freezing water. This system must be used within a heated shelter.

Decon stations should be sited in built-up areas, near road junctions, at intersections of forest lanes, or where they may be approached from several directions.

Snow can be used to cover contaminated areas. However, when the snow blows away or when vehicles or personnel break through this surface, the contamination will reappear. Snow cover provides some protection if left undisturbed, but this protection is unreliable.

Unfrozen earth may not be available to make STB dry mix. Use snow in place of dirt (same proportion) in shuffle pits and for other decon purposes. Burying contaminated materials in frozen ground is difficult. Mark burned or abandoned material with standard contamination signs.

GLOSSARY

ASOAP	Army Oil Analysis Program
BFS	brake fluid, silicone
BMO	battalion motor officer
CASCOM	Combined Arms Support Command
CLP	leaner lubricant and preservative
CONUS	continental United States
CTIS	central tire inflation system
CSS	combat service support
DA	Department of the Army
DAP	decon apparatus portable
decon	decontamination
DFA	diesel fuel, arctic
DLA	Defense Logistics Agency
DOD	Department of Defense
DS	direct support
ECWCS	extended cold weather clothing system
EMP	electromagnetic pulse
EOQ	economic order quantities
F	Fahrenheit
FASCAM	family of scatterable mines
FM	field manual, frequency modulation
FMTV	family of medium tactical vehicles
FRH	hydraulic fluid, rust inhibited, fire resistant, synthetic hydrocarbon base
FSC	Federal Supply Catalog
GAA	grease, automotive and artillery

GMD	grease, molybdenum disulfide
GPS	gunner's primary sight
GS	general support
HET	heavy equipment transporter
HF	high frequency
HHLRF	handheld laser range finder high mobility multi-purpose wheeled vehicle
HMMWV	high mobility multi-purpose wheeled vehicla
HN	host nation
IAW	in accordance with
IEDK	individual equipment decontamination kit
LAW	lubricating oil, weapons
LCD	liquid crystal displays
LO	lubrication order
LSA	lubricant
MG	machine gun
MGS	missile guidance set
MIL-STD	military standard
MOPP	mission oriented protective posture
MPU	main power unit
MSR	main supply route
NATO	North Atlantic Treaty Organization
NBC	nuclear, biological, chemical
NICAD	nickel-cadmium
NSN	national stock number
OEA	oil, engine, arctic
OHT	hydraulic fluid, petroleum base for preservation and operation
PLS	palletized load system
PMCS	preventive maintenance, checks and services
POL	petroleum, oils, and lubricants
PSI	pounds per square inch

QE	quadrant elevation
RPM	revolutions per minute
RSR	required supply rate(s)
SB	supply bulletin
SDK	skin decontamination kit
SFL	solid film lubricant
SINCGARS	single-channel ground-air radio system
SOP	standard operating procedures
SUSV	small unit support vehicle
SWGS	surface wire ground system
TB	technical bulletin
TM	technical manual
TOW	tube launched, optically tracked,wire guided
TRADOC	Training and Doctrine Command
US	United States
UXO	unexploded ordnance
vb	vapor barrier
WTR	wide temperature range

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DOCUMENTS NEEDED

These documents must be available to the intended users of this publication.

Operator's manual for the specific piece of equipment, vehicle, or weapon system to be operated.

READINGS RECOMMENDED

These publications contain relevant supplemental information.

FM 90-11. *Cold Weather Operations*. (when published)

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