AFPMB

Armed Forces Pest Management Board Technical Guide No. 36

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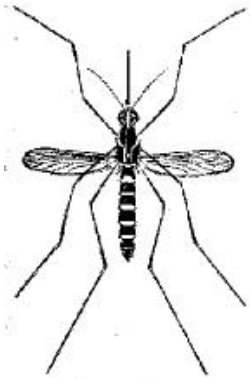
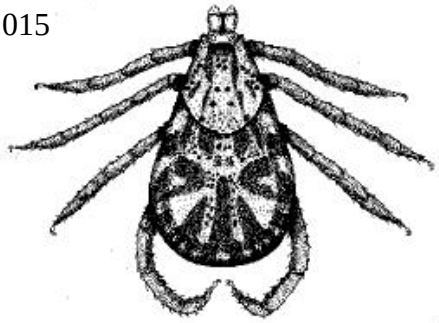
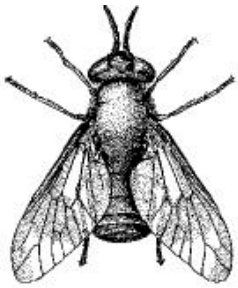
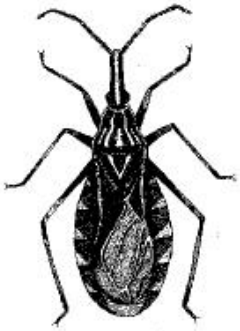
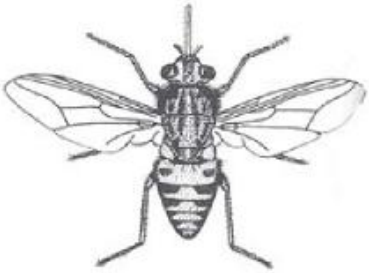




Personal Protective Measures Against Insects and Other Arthropods of Military Significance







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TECHNICAL GUIDE NO. 36
PERSONAL PROTECTIVE MEASURES AGAINST INSECTS AND OTHER ARTHROPODS OF MILITARY SIGNIFICANCE

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TECHNICAL GUIDE NO. 36

PERSONAL PROTECTIVE MEASURES AGAINST INSECTS AND OTHER ARTHROPODS OF MILITARY SIGNIFICANCE

1. INTRODUCTION

1-1. Purpose

This Technical Guide (TG) provides force health protection information and guidance to Department of Defense (DoD) personnel who have contact with arthropods (disease vectors and nuisance insects), or who are responsible for protecting the health of personnel. It describes the DoD Insect Repellent System and other techniques that provide maximum, safe protection from arthropods. These techniques include the use of protective clothing and equipment, repellents, pesticides, education, and other strategies. This Armed Forces Pest Management Board (AFPMB) TG is based on, and supersedes, US Army Environmental Hygiene Agency (USAEHA) TG No. 174, Personal Protective Techniques Against Insects and Other Arthropods of Military Significance, June 1991 version, and the Armed Forces Pest Management Board's TG No. 36, Personal Protective Techniques Against Insects and Other Arthropods of Military Significance, September 2009 version.

1-2. References

References are listed in Appendix A.

1-3. Suggested Improvements

The organization responsible for this TG is the AFPMB. Users are invited to send comments by accessing the following link: http://www.afpmb.org/contact

1-4. Background

a. Historically, in every war and military conflict, combat power has been reduced more significantly by disease and non-battle injuries than from direct combat casualties. A large number of diseases affecting the troop strength of deployed units are directly attributed to disease-carrying arthropods. Moreover, arthropods can inflict physical, psychological, and economic stresses that threaten the military mission. Not only do they transmit disease, but the bites they inflict can be painful and distracting, and can lead to secondary infections, dermatitis, or allergic reactions. Further, contamination of food and damage to other commodities can be costly.

b. History is replete with examples of how arthropod-borne diseases have significantly affected military operations[1-4].

(1) In 1812, Napoleon invaded Russia with 422,000 men. Within three months, seven out of every ten soldiers had fallen to epidemic louse-borne typhus, leaving a force of only 100,000. Cold injuries completed the devastation of the disease-weakened force and by the time Napoleon's Grande Armée retreated out of Russia only 10,000 remained. Dysentery and pneumonia further reduced the force to fewer than 3,000 living troops.

(2) In General George Washington's Continental Army, for every combat casualty, ten soldiers died from diseases. In the War of 1812, General Andrew Jackson's victory at the Battle of New Orleans in January 1815 was immediately followed by the death of most of the surviving American and British troops from malaria. During the Civil War, there was a 2:1 ratio in deaths from disease versus combat. In 1898, during the Spanish-American war, disease casualties included 90,416 cases of malaria, 1,169 cases of yellow fever, and 249 cases of dengue fever.

(3) During World War I, the ratio of deaths from disease versus combat in US troops improved to 1:1, but there were still 16,930 cases of malaria. During World War II, an estimated 24 million man-days were lost due to arthropod-borne diseases.

(4) In 1993, over 200 cases of malaria were reported among US military personnel who served in Somalia during Operation Restore Hope. In 1994, dengue virus infections occurred in military personnel stationed in Haiti as part of Operation Uphold Democracy, and throughout the 1990s cases of leishmaniasis were an outcome of military operations in Central and South America, and the Middle East.

(5) During Operation Iraqi Freedom, there were 653 cases of cutaneous and 2 cases of visceral leishmaniasis by the close of March 2004. Some estimates have placed the actual number much higher; figures ranging up to 2,500 have been cited, which would be an infection rate of 1% of US troops serving in Iraq during 2003 – 2004[5].

(6) In 2011, at least 124 US military members were diagnosed and/or reported with malaria. Nearly 75% of cases (91/124) were likely acquired in Afghanistan, 19% (24/124) in Africa, and the remaining cases from other parts of the world where service members were assigned or deployed.

(7) Tick-borne infections such as Lyme disease and tick-borne encephalitis continue to have a significant impact. Emerging infections such as human ehrlichiosis are posing further hazards. Nuisance arthropod bites and the diseases they transmit will continue to be a serious threat to troops in training and combat. In 2008, a soldier died after contracting Crimean-Congo hemorrhagic fever while training in Afghanistan.

1-5. Arthropods of Military Significance

a. Table 1 lists the major arthropod pests of military importance and the primary diseases that they transmit[6,7]. This section is intended to be an introduction to the topic. The U.S Army Public Health Command (USAPHC) has a website devoted to military entomological issues, which can be accessed at the following link: http://phc.amedd.army.mil/topics/envirohealth/epm/Pages/default.aspx

Readers are also encouraged to review the cited references for detailed information on arthropod vectors.[8-10]

(1) In most regions of the world, mosquitoes are the foremost disease vectors and nuisance pests. They transmit three of the most serious vector-borne diseases that jeopardize US forces: malaria, dengue, and viral encephalitis.

(2) Phlebotomine sand flies transmit other major diseases of military importance such as leishmaniasis and sand fly fever.

(3) Ticks vector a wide range of disease agents, including viruses, bacteria, and protozoa that can cause acute or chronic illnesses, such as Lyme disease, relapsing fever, Crimean-Congo hemorrhagic fever, human babesiosis, Rocky Mountain spotted

fever, ehrlichiosis, boutonneuse fever, tularemia, Colorado tick fever, and encephalitis. Tick-transmitted human diseases have increased significantly over the last several decades and represent a growing occupational health risk, adversely impacting military readiness and the health of military dependents.

(4) Other arthropods that transmit disease, present nuisance problems, or cause direct injury are: black flies, deer flies, horse flies, stable flies, tsetse flies, horse and deer flies, filth flies, bot flies, Tumbu flies, biting midges, fleas, mites, lice, kissing bugs, bees, wasps, ants, and scorpions.

(a) Although some arthropods, notably filth flies, do not bite and are therefore not true biological vectors of disease, they can mechanically transmit the pathogens that cause many serious illnesses, such as dysentery, cholera, salmonella, shigellosis, and typhoid fever. Additionally, they are often numerous enough in many areas to be a serious nuisance, constantly seeking moisture from sweat and from fluids of the eyes, nose, and mouth.

(b) Other arthropods that directly cause human injury, but are not true vectors of disease, are the bot flies and the Tumbu fly. Larvae (also known as maggots) of these flies burrow into human skin and develop in the tissue, causing intense pain and itching. Invasion of tissue by fly maggots is called myiasis.

Table 1. Arthropods of Military Importance and the Major Diseases they Transmit

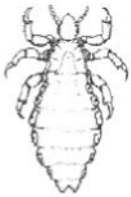
Visual ID	Common Name	Genus	Diseases
	Biting midges No-see-ums Punkies Sand Flies	*Culicoides*	- Visceral filariasis (Mansonellosis) - Oropouche fever
	Body lice	*Pediculus*	- Epidemic typhus - Relapsing fever - Trench fever
	Black flies	*Simulium*	- Onchocerciasis (river blindness)
	Bot flies	*Dermatobia*	- Myiasis
	Deer flies	*Chrysops*	- Eye worm disease (loa loa) - Tularemia

Table 1. Arthropods of Military Importance and the Major Diseases they Transmit

Visual ID	Common Name	Genus	Diseases
	Fleas	*Xenopsylla* *Pulex* *Ctenocephalides* and others	- Plague - Murine typhus
	Kissing bugs	*Rhodnius* *Triatoma* *Panstrongylus*	- Chagas' disease (American trypanosomiasis)
	Mites Chigger mites Scabies mites Mouse mites	 *Leptotrombidium* *Sarcoptes* *Liponyssoides*	 - Scrub typhus - Scabies - Rickettsialpox
	Mosquitoes	*Aedes*	- Dengue - Viral encephalitis
		Aedes *Haemagogus* *Sabethes*	- Yellow fever
		Anopheles	- Malaria
		Culex *Aedes* and others	- Viral fevers - (Rift Valley fever, Chikungunya, etc.)

Table 1. Arthropods of Military Importance and the Major Diseases they Transmit

Visual ID	Common Name	Genus	Diseases
	Sand flies	*Lutzomyia* *Phlebotomus*	- Leishmaniasis - Sand fly fever - Bartonellosis
	Hard ticks	*Dermacentor*	- Spotted fevers - Colorado tick fever
		Ixodes	- Lyme disease - Babesiosis - Viral encephalitis - Tularemia
		Amblyomma *Ixodes*	- Human ehrlichioses
		Hyalomma	- Crimean-Congo hemorrhagic fever
	Soft ticks	*Ornithodoros*	- Relapsing fever
	Tsetses	*Glossina*	- Trypanosomiasis (African sleeping sickness)
	Tumbu flies	*Cordylobia*	- Myiasis

1-6. Responsibilities

a. Personal protection is a shared responsibility between the individual and the chain of command. Military personnel must be aware of the following:

(1) Types of arthropods in an area;

(2) Their habits;

(3) The threat they present;

(4) The resources available for protection;

(5) How to use these resources effectively.

AWARENESS and COMMAND EMPHASIS ARE ESSENTIAL!

Each of the three Services in the DoD provide guidance and policy formulation that ultimately tasks commanders and medical personnel with ensuring that personal protective strategies are in place, that all appropriate protective resources are being provided, and that individuals are using these protective resources properly. US Army Regulation 40-5: Preventive Medicine; Navy P-5010-8, Navy Entomology and Pest Control Technology; Air Force Instruction 48-102, Medical Entomology Program; Department of the Army Pamphlet 40-11 (DA PAM 40-11) 2005 (revised 19 Oct 2009) require units to pre-stock specific quantities of the standard military skin and clothing repellents for each individual. It is imperative that troops be educated on the threat and have immediate access to sufficient personal protective supplies if they are to be adequately protected upon deployment or during activities that expose them to vectors and pests.

2. METHODS OF PROTECTION

Section I. Introduction

2-1. General

Arthropod-borne diseases and nuisance pests can be prevented or controlled with a number of techniques, including personal protective measures and environmental controls. In many situations, personal protective measures such as avoiding infested areas, or the use of physical barriers, chemical repellents, vaccinations, and chemoprophylaxis might be the only means of protection available. Environmental controls, while not a primary focus of this TG, are nevertheless mentioned to illustrate the total integrated pest management approach that should be employed by a unit in field situations. They include such measures as sanitation, education, mechanical and behavioral modifications, and pesticide application.

Section II. Avoidance

2-2. Field Strategies

The most effective and obvious means of preventing exposure to arthropods is to avoid their known habitats. Absolute avoidance of arthropod pests is often neither practical nor possible. However, if the tactical situation allows, choose bivouac sites that are dry, open, and as uncluttered as possible. Avoid sites with rodent burrows and proximity to local settlements, animal pens, garbage/refuse dumping locations, and other areas where arthropod infestations are likely to be concentrated.

2-3. Information Sources

a. Preventive medicine personnel should provide guidance on the presence of arthropod populations in an area based on information obtained through surveillance or via intelligence sources.

(1) The Information Services Division of the AFPMB has compiled Disease Vector Ecology Profiles (DVEPs), which are comprehensive summaries of the vector-borne diseases that occur in specific countries or other geographic areas. DVEPs focus on causative agents, vector importance, bionomics, behavior, and pesticide resistance, as well as provide basic information on the geography and customs of each country. They may be

obtained from the Information Services Division, AFPMB, DSN 295-7476, commercial 301-295-7476, or from the AFPMB web site at http://www.afpmb.org or by accessing the following link: http://www.afpmb.org/pubs/dveps/dveps.htm. Additional information can be acquired from the National Center for Medical Intelligence (NCMI), Centers for Disease Control and Prevention (CDC), and local public health offices.

(2) Up-to-date worldwide information on diseases and vectors may be obtained from the NCMI by email at Webmaster@ncmi.detrick.army.mil, by telephone at 301-619-7574, DSN 343-7574, or by accessing the following link: https://www.ncmi.detrick.army.mil/.

(3) The CDC provides current information on communicable diseases, including arthropod-borne diseases. Information can be accessed at the following link: http://www.cdc.gov/

2-4. Emergency Requisition of Repellents and Pesticides

a. Deploying and/or deployed forces often need pesticides and pest management equipment on short notice. The Defense Logistics Agency (DLA) has established an agency-wide Customer Interaction Center (CIC) to help meet these needs.

b. For emergency procurement of pesticides, including repellents and pest management equipment, pesticide application equipment, and personal protective equipment, etc., Contact the DLA CIC at 1-877-DLA-CALL (1-877-352-2255), DSN 661-7766, and verbally speak the phrase "Supply & Transportation" when prompted for assistance. For credit card orders, verbally speak the phrase "Credit Card Purchases" when prompted for assistance.

c. For technical inquiries or assistance regarding emergency procurement of pesticides, repellents, pest management material/equipment, and all chemicals, contact the Chemical/POL Office, DLA Aviation, Defense Supply Center Richmond, at DSN 695-3995 or commercial (804) 279-3995 during normal duty hours [0830-1700 hrs eastern standard time (EST)] or via government cell phone (804) 484-9449, or by fax at (804) 279-3971 anytime, 7 days a week..

Section III. Physical Barriers

2-5. Clothing

a. Field Uniform

Clothing is the first direct line of personal defense against arthropods. Proper wearing of the field uniform is essential to minimize skin exposure (Figure 2-1). If the risk of heat stress is a factor in a particular environment, common sense or advice from medical or Preventive Medicine personnel should dictate when the following recommendations are not practical.

Figure 2-1. Proper wearing of field uniform minimizes exposure to arthropod attack.

(1) Tuck pant legs into boots or into socks. This forces non-flying pests, such as ticks, chiggers, stinging ants and spiders, to climb up the outside of the pant legs, thus decreasing access to the skin and increasing the likelihood of their being seen.

(2) Roll sleeves down and close the collar to help protect the arms and neck from arthropod attack. This is especially important in malaria-endemic regions when *Anopheles* species bite from dusk until dawn.

(3) It is difficult for pests to bite through the uniform fabric unless it is pulled tightly against the skin. Therefore, the uniform should be worn loosely, with an undershirt worn underneath the coat to act as an added barrier[12,13]. The undershirt should be tucked into the pants to decrease access by crawling arthropods at the waistline. Mosquitoes can easily bite through tight-fitting material such as that used for the combat uniform.

(4) The field cap and its brim help protect the head and face. Some biting insects tend to avoid the shaded area of the face under the cap's brim.[14]

(5) Uniforms that are treated with permethrin provide protection only on the covered portion of the body. Mosquitoes will still readily feed on the hands, neck and head. It is essential to apply an approved insect repellent to exposed body surfaces. Reapplication is advised according to the label.

b. Tick Checks

Figure 2-2. Tick check.

(1) When in tick-infested habitats, check clothing routinely and use the buddy system to check areas of the body that cannot easily be seen during self-examination (Figs. 2-2 and 2-4).

(a) Ticks can be removed from clothing by hand. However, avoid crushing any ticks with your fingernails because their body fluids may contain pathogens and therefore be infectious. After removal, kill the tick. They can be destroyed by placing them in alcohol, by immobilizing them within a piece of folded tape, or by crushing them under a boot, with a rock, etc.

(b) Ordinary masking tape, cellophane tape, or a similar substitute, is useful to remove ticks from clothing. A ring of tape can be made around the hand, leaving the sticky side out and attaching the two ends. Ticks will adhere to the tape when it is dabbed against the clothing. The tape can then be folded carefully over the ticks to prevent their escape and discarded with the trash.

(c) An adhesive lint roller (available from most post/base exchanges and commissaries) is a very efficient means of quickly removing large numbers of ticks from the uniform, especially the very tiny larvae, which may be present in clusters of several hundred.

(2) Once clothing is removed, it is important to carefully check all areas of the body for evidence of ticks. Re-examine clothing, inside and out, and remove and dispose of all ticks. If a tick is found attached to the body, seek medical attention for removal. If proper medical attention is not readily available, follow the guidelines in USAPHC *Just the Facts.... Protect Yourself from Tick-Borne Diseases*. Grasp the tick with forceps at the point of attachment and pull it out with a single smooth motion (Fig 2-3). DO NOT burn, smother, or kill the tick while it is attached to you. This is likely to cause it to regurgitate pathogens.

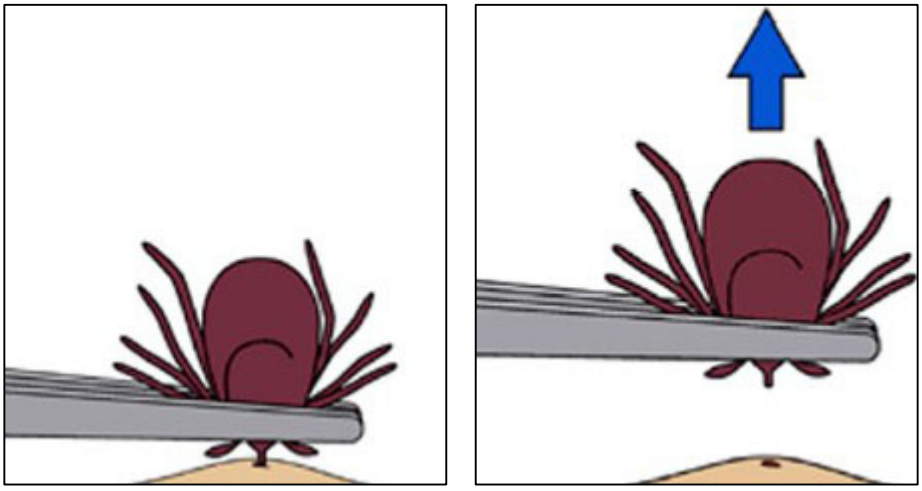


Figure 2-3. Tick removal. Photos from the US CDC.

Figure 2-4. A tick check performed while wearing the uniform.

c. Spiders, Centipedes, Scorpions, and Snakes

To reduce the chance of being bitten by spiders, centipedes, scorpions (stung), or snakes:

(1) Always wear shoes or boots with socks during waking hours (Fig. 2-5).

(2) Never walk outdoors in bare or stocking feet.

(3) Shake out boots and uniforms before putting them on.

(4) Store boots with socks pulled down over the boot tops as far as possible to prevent entry of such pests.

(5) Do not reach into areas that might harbor spiders, centipedes, scorpions, or snakes without carefully checking first.

Figure 2-5. Boots provide protection from bites and stings.

2-6. Protective Equipment

a. Introduction

Equipment items available through the military supply system can be used to augment the physical protection afforded by the clothing barrier. A current list of available personal protection items on the NSN list can be accessed by first going to the AFPMB website (www.afpmb.org) and then proceeding to "DoD Standard Pesticides and Pest Control Equipment Lists," then to "DoD Pest Management Materiel Other Than Pesticides," and finally to "Section 19 - Personal Protection Materiel." This link provides access to the DoD Standard Pesticide and Pest Control Equipment list:

http://www.afpmb.org/standardlist.htm

AFPMB TG No. 24 (accessed on the AFPMB website) is the Contingency Pest Management Guide and will identify all items on the contingency pest management list with stock numbers.

b. Insect Head Net

(1) In areas heavily infested with flying pests, a head net can be used over the cap or helmet. The insect head net (NSN 8415-00-935-3130 or NSN 8415-00-935-2914) is a finely woven mesh (300-holes/in^2), olive drab, nylon head covering that can be worn over the bare head, cap, or helmet (Figure 2-6). The cloth top piece has an elastic

headband on the inside that fits securely over the head gear. A fabric-covered metal hoop holds the net away from the head and neck.

(2) Wear the head net so that the elastic headband rests comfortably on the upper part of the forehead or grips close above the brim of the helmet. Tie the drawstring permanently so the drawstring knot is about 8 inches below the chin and the net fits snugly below the collar, both front and back. Hook the elastic loops found at the drawstring edge of the net over the breast pocket buttons.

Figure 2-6. Insect Head Net NSN 8415-00-935-3130 shown over helmet.

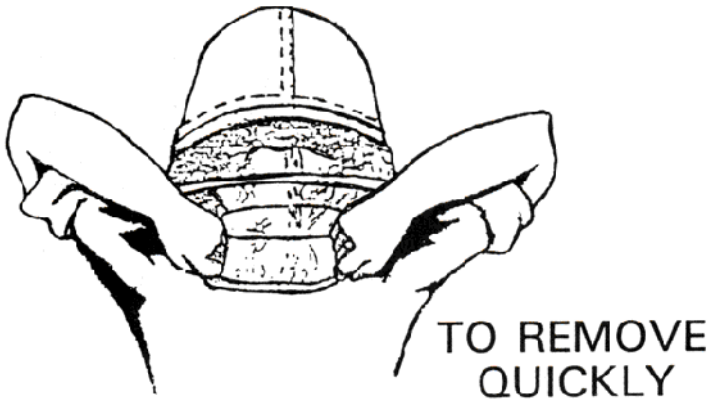


Figure 2-7. Remove insect net from the back.

(3) For quick removal of the head net, grasp the back edge where it rests over the collar and pull forward over the head (Figure 2-7).

(4) For added protection, the head net may be lightly sprayed with permethrin [see paragraph 2-11c(2)]. Allow it to dry thoroughly before wearing. The treatment should be effective for several months. In the absence of permethrin, the net may be hand-treated with one of the DoD approved repellents [see paragraphs 2-8 and 2-9] every evening by dispensing a small quantity onto the palm of one hand (3 to 4 drops of the liquid, or a small dab of the lotion), rubbing the hands together to spread the repellent, and finally rubbing the netting between the hands. Repeat the process until all the netting has been lightly and evenly covered. It is not necessary to saturate the netting. **KEEP DEET REPELLENT OFF OF THE ELASTIC AS IT IS A PLASTICIZER AND MAY DAMAGE PLASTICS, RUBBER, VINYL, OR ELASTIC ITEMS.**

(5) Due to its small mesh size, the insect head net can be very hot for the wearer and may obscure vision, making it impractical in some climates and under certain deployed conditions. It can be slept in when climate allows.

c. Insect Protective Mesh Parka and Mittens

(1) A mesh parka or over-jacket is available (small, medium, large, extra-large, extra-extra-large: NSN 3740-01-483-2988, -3002, -3004, -3007, -3008, respectively) (Fig. 2-8) that is effective without the application of permethrin or repellent, unlike the old repellent parkas. It is made from narrow-mesh polyester netting, is worn over outer clothing, and is snag resistant. The small mesh size not only protects against mosquito bites, but also prevents bites from very small flying insects, such as “no-see-ums”, sand flies, black flies, and gnats. The parka is waist-length, has a pocket, long sleeves, a

drawstring and a mesh hood that covers the face and head. **REMEMBER, THIS PARKA OFFERS PROTECTION WITHOUT BEING TREATED WITH PERMETHRIN OR REPELLENT.**

Figure 2-8. Insect Protective Mesh Parka.

(2) Insect Net Mittens (NSN 8415-01-192-2357) are also available to augment protection from biting arthropods, but these must be permethrin treated to offer full protection.

d. Insect Net Protectors

Personal protection can be greatly enhanced by using bed nets, pop-up nets, and tent screens. Unlike head nets, parkas and mittens, the mesh size of bed netting and tent screens is not fine enough to keep out all biting arthropods, especially biting midges and sand flies. Treating bed nets and tent screens with permethrin can significantly reduce the ability of these arthropods to gain entry.[15-17]

(1) There are currently two bed nets available (NOT including the "pop-up" bed nets discussed in section 2 below) in the NSN stock system (Fig 2-9). The insect net protector (Figure 2-9) (NSN 7210-00-266-9736) is a finely woven mesh (550-holes/in^2), olive drab, nylon canopy that can be used with the folding cot, hammock, steel bed, or shelter half-tent. Another nylon insect protector (NSN 7210-00-266-9740) is also available; this item has slightly smaller dimensions yet can also be used with the folding cot.

(a) The insect net protector should be erected and supported in such a way as to prevent contact of the net with the sleeping person. This will decrease the risk of mosquitoes and other blood-feeding arthropods biting the individual through the net. NSN items 7210-00-267-5641, 7210-00-300-6950, and 7210-00-359-4850 are additional pieces of equipment designed to properly erect the insect net protectors with the folding cot, although NSN 7210-00-359-4850 can be used with or without a folding cot.\

Figure 2-9. Insect Net Protector (Mosquito Bed Net), NSN 7210-00-266-9736 used with Poles, (NSN 7210-00-267-5641), on Folding Cot.

(b) Do not allow the net to contact the ground where crawling arthropods may use it to gain access to the sleeping area. Tuck the net under the mattress or sleeping bag. Bed nets should be set up before dusk, the time when many mosquitoes become active.

(c) Prior to entering the net, check for the presence of flying insects, such as mosquitoes, trapped inside the net. These insects need to be removed. If physical removal is not feasible, apply an approved insecticide space spray for flying insect control following label guidelines. Avoid breathing pesticide vapors while spraying and **DO NOT USE SPACE SPRAY ON THE SKIN OR CLOTHING.**

(d) Before climbing inside, spray the net lightly with permethrin aerosol only if the net is untreated (see paragraph 2-11c(2), and Figure 2-20), or use the compressed air sprayer method prior to setting it up (see paragraph 2-11c(3)(e) and Figure 2-24). The permethrin

will help protect against arthropods small enough to fit through the mesh of the net (e.g., sand flies). Allow the net to dry before handling. Permethrin applied with a 2-gallon sprayer (or compressed air sprayer)to the bed net should provide protection for several months to a year or more.[18,19]

Pop Up Bed Nets

(2) There are currently 4 types of pop-up bed nets in the NSN stock system:

- NSN 3740-01-516-4415: self-supporting low profile (SSLP) bed net; green camouflage WITH attachment straps for optional rain barrier; see photo and specifications at the following link:

http://afpmb.org/sites/default/files/pubs/standardlists/DOD_PEST_MANAGEMENT_MATERIAL_LIST.pdf

- NSN 3740-01-518-7310: self-supporting low profile (SSLP) bed net; coyote brown WITHOUT attachments for optional rain barrier; see photo and specifications at the following link:
http://afpmb.org/sites/default/files/pubs/standardlists/DOD_PEST_MANAGEMENT_MATERIAL_LIST.pdf

NSN 3740-01-543-5652: Improved bed net system (Figure 2-10); coyote brown WITH attachments for optional rain barrier; see photo and specifications at the following link:
http://afpmb.org/sites/default/files/pubs/standardlists/DOD_PEST_MANAGEMENT_MATERIAL_LIST.pdf

NSN 3740-01-644-4953: Pop-up high profile bed net; treated with deltamethrin and permethrin, allows user to sit up on a standard or oversized cot, provides better ventilation by using a larger mesh size; see photo and specifications in the AFPMB Pest Management Materials Other Than Pesticides List at the following link:
http://afpmb.org/sites/default/files/pubs/standardlists/DOD_PEST_MANAGEMENT_MATERIAL_LIST.pdf

Figure 2-10. Improved Bed Net System, Pop-up, self-supporting, low profile bed net, (NSN 7210-00-266-9736), on Folding Cot.

These three pop-up bed nets are identical in dimensions and all three are factory-treated with permethrin to provide long-lasting repellent protection against arthropods. They can either be used on top of a folding cot or set directly on the ground and used with or without a roll-up mat. The NSN 3740-01-518-7310 will generally be the least expensive pop-up bed net on the NSN list, but be aware that this pop-up cannot be combined with the optional rain shield (there are no attachment straps that connect to the rain shield) and therefore should only be procured for use in an exclusively dry, arid environment with little or no chance of precipitation. The following NSN items incorporate the other two pop-up bed nets into system units:

(a) NSN 3740-01-547-4426: this is the Enhanced Bed Net System (green camouflage). This combined unit comes with a pop-up bed net NSN 3740-01-516-4415, rain shield, one Easton pole, 8 stakes, and repair kit. As a full-package item, it is intended to protect the occupant from most insects and also provide protection from rain and moisture. More information on this item, including a photo, can be accessed at the following link:
http://afpmb.org/sites/default/files/pubs/standardlists/DOD_PEST_MANAGEMENT_MATERIAL_LIST.pdf

(b) NSN 3740-01-543-5647: coyote brown rain shield only. This item can be used with pop-up bed net NSN 3740-01-543-5652 if the following items are also procured:

Easton Pole, NSN 3740-01-544-4056; Stake Hold Down, NSN 3740-01-545-5646; and Fiberglass pole, NSN 3740-01-546-1136. More information on this item, including a photo, can be accessed at the following link:
http://afpmb.org/sites/default/files/pubs/standardlists/DOD_PEST_MANAGEMENT_MATERIAL_LIST.pdf

(c) NSN 3740-01-546-4354: This system is essentially the same as NSN 3740-01-547-4426 (paragraph (a) above) except the color is coyote brown. This combined unit comes with pop-up bed net NSN 3740-01-543-5652 (coyote brown with attachment straps), rain shield, one Easton pole, 8 stakes, and repair kit. As a full-package item, it is intended to protect the occupant from most insects and also provide protection from rain and moisture. More information on this item, including photo, can be accessed at the following link:

http://afpmb.org/sites/default/files/pubs/standardlists/DOD_PEST_MANAGEMENT_MATERIAL_LIST.pdf

Section IV. Repellents

2-7. Introduction

a. The concurrent use of repellents on the skin (DEET/Picaridin) and clothing (permethrin) provides maximum personal protection against arthropods[12,15,20-24]. This dual strategy is known as the DoD INSECT REPELLENT SYSTEM and is explained in more depth in Fig. 2-11 below.

Figure 2-11. DoD Insect Repellent System.

More information on all DoD topical and clothing repellents can be accessed at the following link: http://www.afpmb.org/content/department-defense-insect-repellents

(1) Mosquitoes and certain other biting flies can bite either exposed skin or through light-weight clothing, whereas black flies, sand flies, biting midges, ticks, chiggers, and fleas may crawl underneath clothing to bite in addition to biting exposed skin. Consequently, both types of treatments are necessary to provide maximum protection.

(2) Clothing treatment with permethrin alone ordinarily does not adequately protect exposed skin because there is very limited vapor action. Rather, permethrin acts as a contact toxicant.

(3) Not all arthropod species are equally repelled by a particular repellent[25]. For example, DEET is highly repellent to most mosquito and biting fly species, but there are species of biting midges and mosquitoes, including certain species of *Anopheles* mosquitoes (malaria vectors), that are only partially repelled. Therefore, one should not discontinue using repellent if some bites are received when wearing DEET, as other species that are present are still likely to be repelled. This example further illustrates the wisdom of utilizing the DoD Insect Repellent System [i.e., simultaneous use of both skin (Picaridin/DEET) and clothing (permethrin) repellents].

(4) Some insect species are active during the day while others are active only at night. For this reason, it is important to follow recommendations provided by commanders and medical personnel, who may indicate the necessity of using repellents around the clock. Remember that lack of bites during the day does not preclude the threat of bites during the night.

(5) Unfortunately, no repellent appears to be significantly effective against stinging arthropods, such as bees, wasps, fire ants, and scorpions. The best strategy against them is simple avoidance.

2-8. DEET (N,N-diethyl-m-toluamide or N,N-diethyl-3-methylbenzamide)

a. Introduction

The standard skin repellent for the US military since the mid-1950s has been the chemical N,N-diethyl-3-methylbenzamide, commonly referred to as “DEET”[26,27]. DEET is effective

against a wide variety of arthropod species, especially mosquitoes and other biting flies, and also fleas, ticks, and chigger mites. In addition, DEET has been reported to provide effective protection in areas where land leeches are a problem, primarily Southeast Asia, India, and Australia.

b. Health and Safety Considerations

(1) DEET has been used safely for over 50 years by billions of people worldwide[27]. Although it has an excellent safety record, there have been isolated reports of harmful effects associated with its use. Most of these have been related to improper use, such as swallowing, spraying into the eye, or applying to already irritated skin. While most of the complaints involve temporary minor skin or eye irritation, rare cases of toxic encephalopathy (inflammation of the brain) have been reported, but not confirmed, to be associated with DEET usage, especially in young children. There have been remarkably few reports of toxicity as a result of dermal application.

(2) Since a small population of individuals may be sensitive to any chemical, it is important for personnel to apply repellents carefully following label instructions and to be aware of possible signs of intoxication. Apply DEET lightly and evenly to exposed skin. Avoid contact with sensitive mucous membranes (e.g., eyes), the lips (accidental ingestion), and broken or irritated skin (e.g., abrasions, sunburn, poison ivy, existing insect bites).

(3) If the tactical situation permits, wash off repellent after the potential exposure to arthropods has ceased. Although DEET is not soluble in water, it quickly washes off of skin and out of clothing with soap and water.

(4) DEET is a plasticizer and must be used with care to prevent damage to plastics, rubber, vinyl, or elastics, including items such as eyeglass frames, plastic lenses and cases, contact lenses, combs, watch crystals, goggles, painted and varnished surfaces, and some synthetic fabrics (nylon is okay). The water-repellent properties of Gore-Tex® are also permanently reduced by DEET. DEET does **NOT** damage cotton or wool fabrics.

c. Formulations

There are currently several DEET-based products on the NSN list. Products containing 30-33% DEET are considered to be the extended-duration formulations.

(1) Two-Ounce Tube and Three-Ounce Bottle 3M Ultrathon™: Insect Repellent, Personal Application, 33-Percent DEET, extended-duration lotion, two-ounce tube, NSN 6840-01-284-3982 (Figure 2-12a). Sawyer Ultra 30: Insect Repellent, Personal Application, 30-Percent LipoDEET, extended-duration lotion, three-ounce bottle, NSN: 6840-01-584-8393 (Figure 2-12b)

(a) These products contain 30-33% DEET. They are applied as a lotion with a mild odor. The formulation slows the absorption and evaporation of DEET, thereby holding it on the surface of the skin, where it can continue to repel arthropods for an 'extended' period of time. Laboratory testing shows that the extended-duration DEET lotion provides at least 95% protection against a variety of mosquito species (reduction in bites) for 6 hours in a tropical environment, 10 hours in a hot, dry environment, and 12 hours in a forested/wet environment[28].

(b) The label and Material Safety Data Sheet (MSDS) for these products can be accessed at the following links:

3M Ultrathon™, Two-Ounce Tube:
Label: http://www.afpmb.org/pubs/standardlists/labels/6840-01-284-3982_label.pdf
MSDS: http://www.afpmb.org/pubs/standardlists/msds/6840-01-284-3982_msds.pdf

Sawyer Ultra 30, Three-Ounce Bottle:
Label: http://www.afpmb.org/sites/default/files/pubs/standardlists/labels/6840-01-584-8393_label.pdf
MSDS: http://www.afpmb.org/sites/default/files/pubs/standardlists/msds/6840-01-584-8393_msds.pdf

Follow label directions. Dispense the lotion into one hand, rub the hands lightly together, and apply thoroughly in a thin layer over the forearms, upper arms, face, neck, ears, and other exposed areas. **DO NOT APPLY REPELLENT TO THE EYES AND LIPS OR TO SENSITIVE OR DAMAGED SKIN** (sunburn, abrasions, and poison ivy). Do not waste DEET by applying it thickly; a light, uniform coating provides excellent repellent protection.

(c) If you begin to receive bites, reapply the repellent as described in paragraph (b), above. The value of the extended-duration formulation is that the polymer, by slowing loss of DEET from the skin surface, retains DEET at a concentration sufficient to repel arthropods for a long period of time [see paragraph (a), above]. Repellent

formulations containing higher concentrations of DEET do not necessarily provide longer, or better, repellency.

(d) The extended-duration DEET formulation does NOT adversely affect the seal of the individual protective mask over the short term[29]. However, the mask should be washed after each use to preclude damage to its surfaces by long-term exposure to residues of DEET.

(e) The extended-duration DEET formulation does NOT affect the infrared signature of the uniform[30].

(f) The extended-duration DEET formulation CAN be safely used with camouflage face paint; apply a thin layer of cream from the two-ounce tube and then follow with the face paint.

Figure 2-12a.
Standard Military Skin Repellent, 33-Percent DEET, 2-Ounce Tube Extended Duration NSN 6840-10-284-3982.

Figure 2-12b.
Sawyer Ultra 30, 30-Percent DEET, 3-Ounce Bottle Extended Duration NSN 6840-01-584-8393.

(g) Storage and disposal.

(1) Ultrathon™ is water-based and nonflammable. It is relatively heat and cold stable, although at high temperatures of over 140°F, some separation is possible and the product may begin to leak from the container. Under optimum conditions, shelf-life is five years or longer.

(2) After dispensing the contents, wrap the container in accordance with label instructions and discard in the trash. In contingency situations, follow appropriate operational guidance.

(2) Six-Ounce Bottle

Cutter Backwoods: Insect Repellent, Personal Application, 25% DEET, Pump Spray, six-ounce bottle, NSN 6840-01-584-8598 (Figure 2-13)

(a) Cutter Backwoods is applied as a pump spray. Apply the spray directly to the skin and rub lightly over exposed skin. DO NOT APPLY DIRECTLY TO EYES AND LIPS. A light, uniform coating provides excellent protection. If you begin to receive bites, reapply the repellent as described above.

(b) The label and Material Safety Data Sheet (MSDS) for this product can be accessed at the following links:

Label: http://www.afpmb.org/sites/default/files/pubs/standardlists/labels/6840-01-584-8598_label.pdf

MSDS: http://www.afpmb.org/sites/default/files/pubs/standardlists/msds/6840-01-584-8598_msds.pdf

Figure 2-13. Cutter Backwoods 25-Percent DEET pump spray (NSN: 6840-01-584-8598).

2-9. Picaridin (1-piperidinecarboxylic acid 2-(2-hydroxyethyl)-1-methylpropylester)

a. Introduction

Picaridin was introduced as a DoD approved insect repellent in 2013. Picaridin is effective against biting arthropods such as mosquitoes and ticks. It is considered equivalent to DEET-based products.

b. Health and Safety Considerations

(1) Picaridin has low acute toxicity. It is slightly toxic when consumed and considered practically nontoxic for exposure to the eyes and skin. Picaridin is not a dermal sensitizer. Picaridin does not present a health concern to the general US population. Picaridin does not act as a plasticizer like DEET.

(2) As with DEET, a small population of individuals may be sensitive to Picaridin. It is important for personnel to apply all repellents carefully following label instructions and to be aware of possible signs of intoxication. Apply Picaridin lightly and evenly to exposed skin. Avoid contact with sensitive mucous membranes (e.g., eyes), the lips (accidental ingestion), and broken skin (e.g., abrasions, sunburn, poison ivy, existing insect bites).

(3) If the tactical situation permits, wash off Picaridin after the potential exposure to arthropods has ceased. Picaridin washes off of skin and out of clothing with soap and water.

(4) Picaridin is not a significant plasticizer and should not cause any significant damage to synthetic materials or to cotton or wool fabrics.

(5) More general information on Picaridin can be obtained by accessing the following link:

http://www.epa.gov/opp00001/chem_search/reg_actions/registration/fs_PC-070705_01-May-05.pdf

c. Formulations

There are several Picaridin-based products available on the commercial market, one of which is now recommended by the AFPMB and included on the NSN list.

(1) 3.5-Ounce Bottle

Natrapel®: Insect Repellent, Personal Application, 20% Picaridin, pump spray, 3.5-ounce bottle, NSN 6840-01-619-4795 (Figure 2-14)

(a) Natrapel® is applied as a pump spray. Apply the spray directly to the skin and rub lightly over exposed skin. DO NOT APPLY DIRECTLY TO EYES AND LIPS. A light, uniform coating provides excellent protection. If you begin to receive bites, reapply the repellent as described above. Picaridin does NOT affect the infrared signature of the uniform.

(b) The label and Material Safety Data Sheet (MSDS) for this product can be accessed at the following link:

Label: http://www.afpmb.org/sites/default/files/pubs/standardlists/labels/6840-01-619-4795_label.pdf
MSDS: http://www.afpmb.org/sites/default/files/pubs/standardlists/msds/6840-01-619-4795_msds.pdf

Figure 2-14. Picaridin Based Insect Repellent pump spray (NSN: 6840-01-619-4795).

d. Storage and Disposal

(1) This product is nonflammable. It is heat and cold resistant. Under optimum conditions, the shelf-life is five years or longer.

(2) After the contents of the spray can are used up, dispose of the can in the trash or recycle following local guidance.

2-10. Insect Repellent With Sunscreen

Figure 2-15. Personal Application, NSN 6840-01-288-2188, 2-ounce tubes and NSN 6840-01-452-9582, packets.

a. Items stocked under these NSNs vary, based on the most suitable product available at the time. The product will contain both DEET and sunscreen ingredients in various concentrations (e.g., 20% DEET/Sun-Protection-Factor 15).

The current label and MSDS for the 2-ounce tube (NSN 6840-01-288-2188) can be accessed at the following links:
Label: http://www.afpmb.org/pubs/standardlists/labels/6840-01-288-2188_label.pdf
MSDS: http://www.afpmb.org/pubs/standardlists/msds/6840-01-288-2188_msds.pdf

The current label and MSDS for the packets (NSN 6840-01-452-9582) can be accessed at the following links:
Label: http://www.afpmb.org/pubs/standardlists/labels/6840-01-452-9582_label.pdf
MSDS: http://www.afpmb.org/pubs/standardlists/msds/6840-01-452-9582_msds.pdf

b. Follow the label directions for use and disposal instructions.

2-11. Permethrin [(3-phenoxyphenyl) methyl (+/-) cis/trans 3-(2,2-dichloroethenyl) 2,2-dimethyl¬cyclopropanecarboxylate].

a. Introduction

(1) Permethrin is the US military's standard repellent for application to fabric and is considered the most effective clothing impregnant available. McCain and Leach (2007)[15] provided a concise history of clothing repellents in the US military and

fabric treatment by permethrin. The following link provides information on the health and safety aspects of permethrin-impregnated clothing:
http://deploymenthealthlibrary.fhp.osd.mil/Product/RetrieveFile?prodId=242

The primary mode of action is contact toxicity, particularly against crawling arthropods, such as ticks[24,31-35] chigger mites[36], fleas[37], and lice[38,39]. Permethrin also acts as a contact repellent against mosquitoes and biting flies[22,40-42]. It is odorless, nonirritating, and resistant to reduction by washing and wear[35,43-45]. Permethrin is bound so strongly to cotton or 50% cotton/nylon mix that repellency is retained even after 50 washings. After several washings, treated uniforms will continue to provide contact repellency, even though they may no longer be toxic to insects. **PERMETHRIN WILL NOT WASH OUT OF TREATED UNIFORMS WHEN WORN IN THE RAIN OR WHEN FORDING STREAMS, ETC.**

(2) Because it does not evaporate, permethrin does not provide protection to exposed skin adjacent to treated clothing. However, the concurrent use of repellents on the skin (DEET/ Picaridin) and clothing (permethrin) should provide maximum personal protection against arthropods.

(3) It is important to realize that there is science behind the testing and evaluation of permethrin impregnation of military fabrics and uniforms. Prospective uniforms are tested for binding efficiency with permethrin and the subsequent bite protection that is conferred to the user. The following link provides a summary of the evaluation processes that permethrin-impregnated uniforms undergo:

http://www.afpmb.org/pubs/tims/tg36/treateduniformevaluation.ppt

(4) Permethrin can be used to treat military field uniforms. As of the date of this TG, there is great variability in fabric composition and weight among the various field uniforms within the services. Not all uniforms can effectively be treated with permethrin! It is imperative that the user first research whether or not a particular uniform can be treated and what treatment method is approved. The following link provides the current permethrin-treatment status of the various uniforms now in use:

http://www.afpmb.org/sites/default/files/contingency/Uniform_Permethrin_Treatment_Matrix.pdf

NOTE: In the document accessed by the above link, only those uniforms that are evaluated and approved for treatment by the specific applications are shown in the color green.

It is also recommended that the specific service's uniform authority be contacted for recommendations on permethrin guidelines. Following is contact information for the respective uniform centers of each service:

- Navy:
  Navy Uniform Matters Office
  N131U
  2 Navy Annex
  Washington, DC 20307
  (703) 614-5076/DSN 224

- Marine Corps:
  Permanent Marine Corps Uniform Board (PMCUB)
  2200 Lester St
  Quantico VA 22134
  (703) 432-4607/4754 (DSN 378), FAX: (703) 432-3262

- Air Force:
  USAF Uniform Programs and Policy
  HQ USAF/A1SO
  201 12th Street South, Suite 413
  Arlington, VA 22202
  AFA1SOU.Workflow@pentagon.af.mil
  DSN: 664-0147, commercial (703) 604-0147 (general questions)
  DSN: 986-4810, commercial (937) 656-4810 (technical questions)

- Army: Project Manager Soldier Equipment
  SFAE-SDR-SEQ 10170
  Beach Road Bldg 325
  Fort Belvoir, VA 22060-5862
  https://peosoldier.army.mil/
  AKO Website: https://www.us.army.mil/suite/page/389
  AKO Knowledge Center: https://www.us.army.mil/suite/community/190

(5) Once uniforms are treated, **DO NOT DRY-CLEAN PERMETHRIN-TREATED UNIFORMS**. The solvents used in the dry-cleaning process will remove the permethrin from the fabric, as stated on the permethrin product labels.

(6) Other cloth or fabric items, such as mosquito netting, camouflage helmet covers, ground covers, and tentage (with the exception of vinyl-coated temper tents), may also be treated in the field. Temper tents that have a vinyl-urethane finish cannot be treated with permethrin because of the water-repellent finish.

b. Health and Safety Considerations

(1) The uniform cap should not be treated with permethrin because of the potential for excessive permethrin absorption through the scalp. Treatment of the cap is not critical since, due to its construction, it is considered impenetrable to biting insects.

(2) Do NOT treat underwear, including undershirts, or physical training uniforms. Although permethrin is poorly absorbed and is rapidly inactivated in mammals[15,46], wearing untreated undergarments significantly reduces the risk of exposure to fabric impregnants[47-49].

(3) Precautionary measures should be observed when handling and mixing permethrin. Avoid permethrin contact with the face, eyes, and skin, and avoid breathing vapors or spray mist. Do not allow skin contact with treated surfaces until the chemical has dried completely. Wear protective gloves when handling wet, treated uniforms. In case of contact with the eyes, flush with plenty of water, and in case of contact with skin, wash with soap and water. Get medical attention if irritation persists. Do not allow the chemical to contact food, mess gear, or water supplies. Thoroughly wash dishes and utensils contaminated with permethrin.

(4) **THIS PESTICIDE IS EXTREMELY TOXIC TO FISH AND AQUATIC INVERTEBRATES**. Keep out of lakes, ponds, streams, or any waterways, including storm drains and irrigation ditches. Do not contaminate water by cleaning equipment or disposing of wastes using runoff resulting from treatment of uniforms.

c. Methods of Permethrin Treatment

Several different methods of permethrin treatment of fabric or material are available within the military supply system.

(1) Individual Dynamic Absorption (IDA) Kit (Insect Repellent, Clothing Application, Permethrin, NSN 6840-01-345-0237)

(a) This item is a protective treatment kit for service field uniforms or equivalents that are approved for treatment with the IDA kit. This label and Material Safety Data Sheet (MSDS) can be accessed at the AFPMB website www.afpmb.org or at:

Label: http://www.afpmb.org/pubs/standardlists/labels/6840-01-345-0237_label.pdf
MSDS: http://www.afpmb.org/pubs/standardlists/msds/6840-01-345-0237_msds_hilton.pdf

or
http://www.afpmb.org/pubs/standardlists/msds/6840-01-345-0237_msds_sawyer.pdf

The IDA kit provides excellent long-term protection (one treatment is effective for the life of the uniform). This kit is sometimes referred to by the nicknames "baggie method" or "shake and bake." The kit contains materials sufficient to treat one complete uniform (coat and trousers): two plastic vials of permethrin [40-percent emulsifiable concentrate (EC), 9-ml each], two plastic treatment bags, two pieces of twine, one pair of disposable protective gloves, and one black marking pen (one pen per four kits) (Figure 2-16).

(b) This is perhaps the safest and most environmentally friendly field method by which individuals can treat their uniforms. An ideal way to train personnel on the correct use of this kit is to provide instruction during a unit formation. The unit leadership can thus ensure that the subject personnel have at least one treated uniform and that each member knows how to treat additional uniforms. A big advantage of this method is that IDA kits are compact and can be readily transported by air. The protection conferred by this permethrin treatment method is designed to last for the life of the uniform.

(c) Wear the protective gloves when mixing to avoid accidental exposure to concentrated permethrin should spillage occur. Wear protective eye wear, such as safety glasses, an eye shield, or safety goggles; these items can be shared among users. Treat the uniform shirt and trousers separately, following the instructions printed on the back of each treatment bag (Figures 2-17 and 2-18).

Figure 2-16. Permethrin IDA Kit, NSN 6840-01-345-0237, for treating a single field uniform with permethrin.

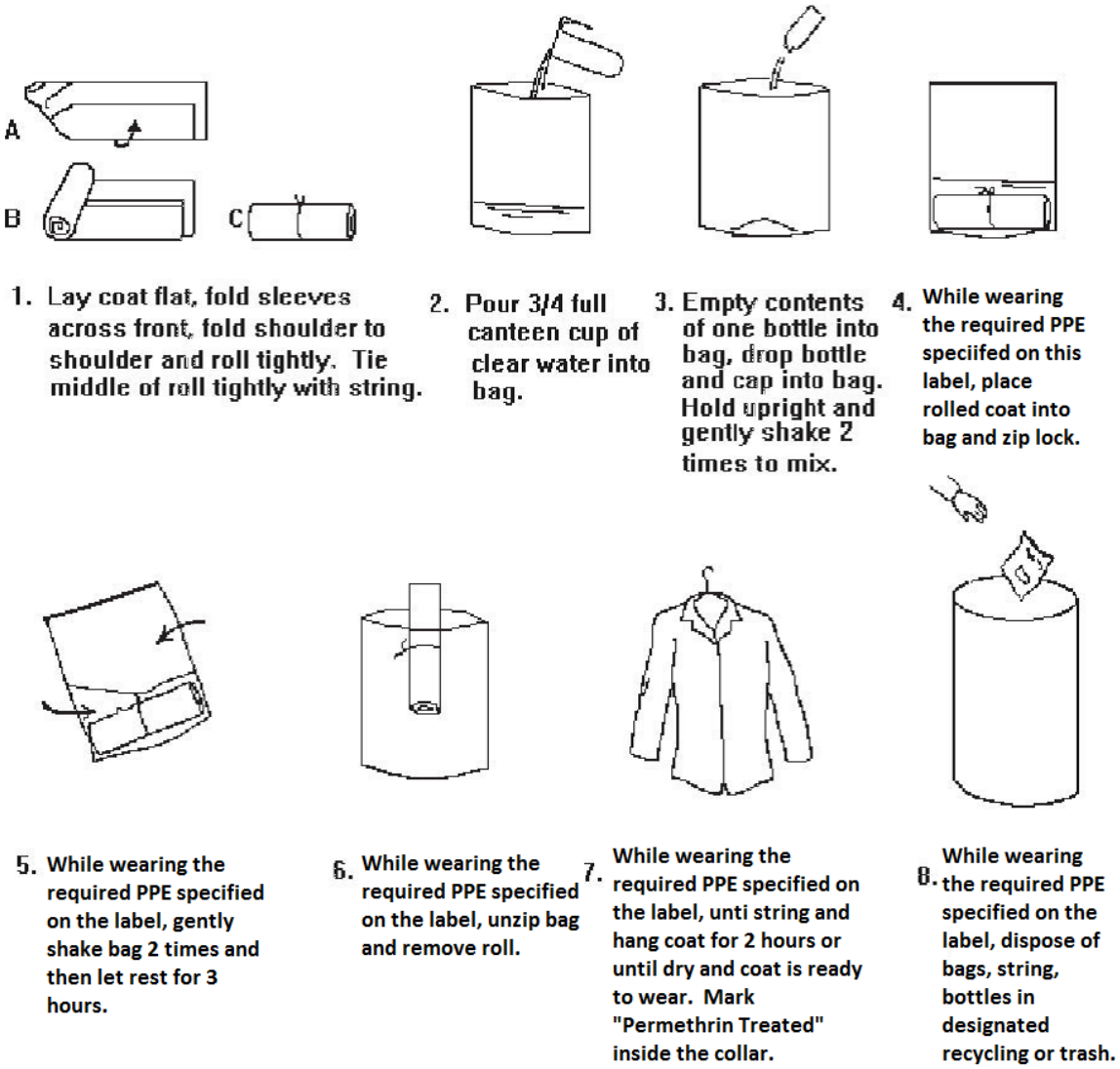


Figure 2-17. IDA Kit instructions for treating coat half of the field uniform with permethrin, as they appear on Bag A of the IDA Kit.

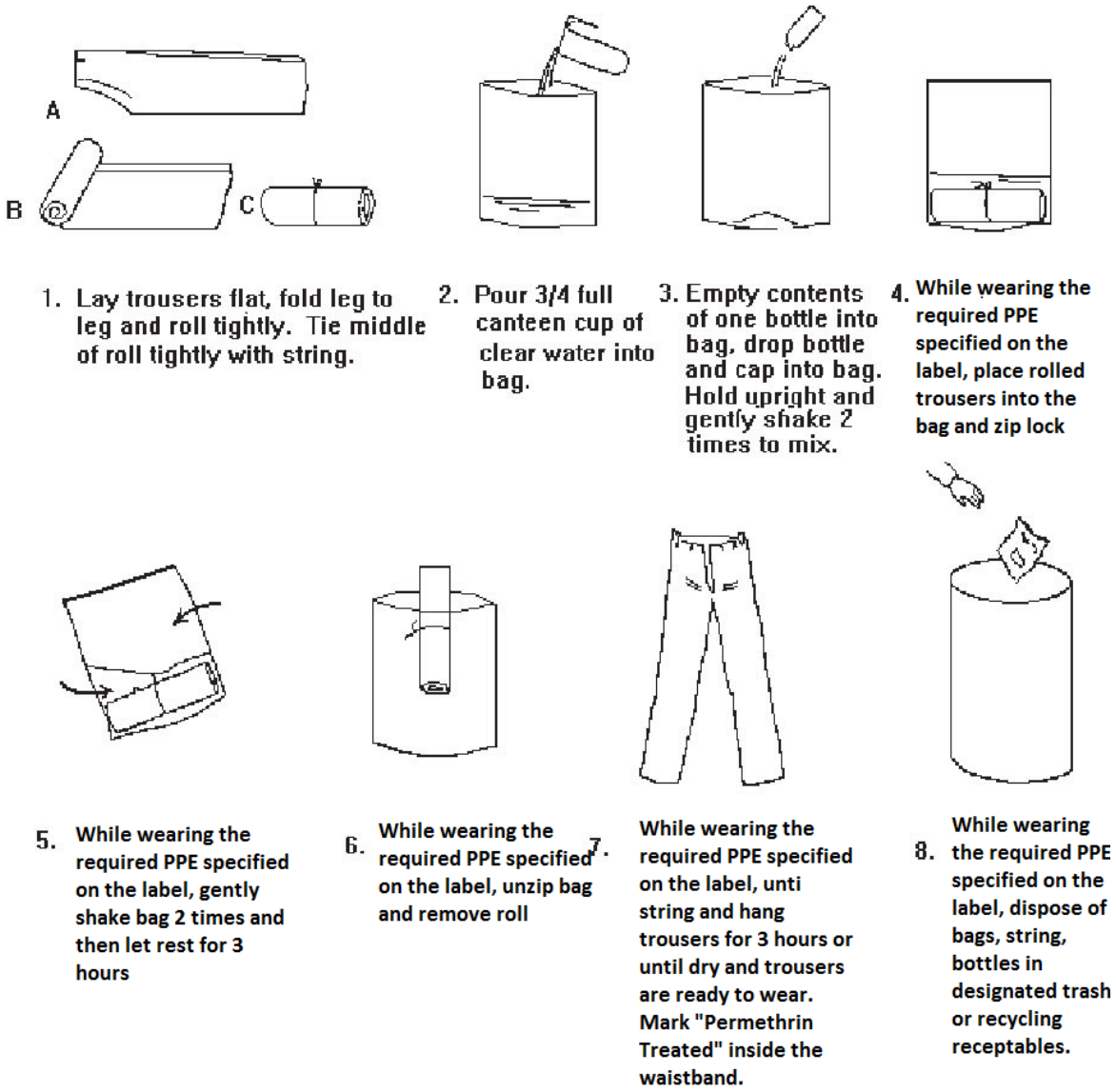


Figure 2-18. IDA Kit instructions for treating trouser half of the field uniform with permethrin, as they appear on Bag B of the IDA Kit.

(d) See Figures 2-19a-c for steps 1 through 9. Assemble all materials (Step 1). Pour 450 ml (15 ounces) of water (units will need to determine a reference for the 450 ml quantity and mark it on a readily available item, such as a disposable plastic water bottle; when canteens were a common equipment item, 450ml of water equaled 3/4 of a canteen cup) into one of the bags (Step 2), add the contents of one of the vials of permethrin to the bag (Step 3), drop in empty bottle and cap, and gently agitate to mix (Step 4).

Figure 2-19a. Steps 1-4 in using the IDA Kit, NSN 6840-01-345-0237.

(e) After rolling and tying the garment according to the instructions, place it in the bag (Step 5), re-seal the bag, agitate again (Step 6), and then allow the bag to be stationary for 3 hours (Step 7). During this time, all the liquid is absorbed by the garment. Open the bag, remove the garment, and hang until dry, which will take 2-4 hours depending upon weather conditions (Step 8). Do not reuse empty treatment bags. Place all used kit components into one treatment bag (Step 9), seal the bag, and put in the trash. In contingency situations, dispose of in accordance with operational guidance.

Figure 2-19b. Steps 5-8 in using the IDA Kit, NSN 6840-01-345-0237.

Figure 2-19c. Step 9 in using the IDA Kit, NSN 6840-01-345-0237.

(f) Once dry, permethrin has no odor and does not affect the appearance of the fabric. With the black pen, mark the inside coat collar and the inside waist band "Perm treat, mo/yr". This stands for "Permethrin treated, month/year". The uniform may now be safely handled and worn. Permethrin is bound so strongly to the fabric by this procedure that water will not remove it: **PERMETHRIN WILL NOT WASH OUT OF TREATED UNIFORMS WHEN WORN IN THE RAIN OR WHEN FORDING STREAMS, ETC.**

(g) **DO NOT RE-TREAT THE UNIFORM**: one treatment is effective in preventing mosquito bites through the fabric for the life of the uniform. **DO NOT TREAT THE UNDERWEAR OR THE CAP. REMEMBER THAT DRY-CLEANING WILL COMPLETELY REMOVE PERMETHRIN.**

(h) Starching field uniforms prior to treatment with permethrin does **NOT** adversely affect impregnation. Homogeneous absorption of permethrin is achieved in both hot- and temperate-weather uniforms whether or not they are starched prior to treatment[50].

(i) Permethrin-impregnated and untreated temperate-weather field uniforms **CANNOT** be laundered together.

(j) Store the unused kits as described in paragraph 2-7c(3)(i)(1), below. Under optimum conditions, the shelf life of this product is indefinite. If deterioration of the containers and/or leakage of the contents is detected prior to this time, turn in the product for proper disposal.

(k) This product is flammable and must be shipped in accordance with Department of Transportation (DOT) regulations.

(2) Aerosol Spray

(Insect Repellent, Clothing Application, Aerosol, Permethrin Arthropod Repellent, NSN 6840-01-278-1336)

(a) This product contains 0.5-percent permethrin in a 6-ounce can (Figure 2-20). The product label and MSDS can be accessed at the AFPMB website www.afpmb.org or by clicking on these links:

Label: http://www.afpmb.org/pubs/standardlists/labels/6840-01-278-1336_label.pdf

MSDS: http://www.afpmb.org/pubs/standardlists/msds/6840-01-278-1336_msds.pdf

Figure 2-20. Permethrin Aerosol, NSN 6840-01-278-1336, 6-Ounce Can 0.5 -Percent Permethrin.

(b) All applications should be made outdoors. Select a location protected from the wind. Shake well before using. Holding the can at a distance of 6 to 8 inches from the clothing (while not being worn), spray with a slow, sweeping motion.

(1) Spray the outer surfaces of the clothing, back and front, until the surface of the fabric appears moistened and a slight color change is noted (the original color will be restored when the uniform dries). Treat the shirt/blouse/coat and then the trousers, each for a minimum of 30 seconds on each side. Pay particular attention to the trouser cuffs and the shirt cuffs. Use approximately three-fourths of the can to treat one complete field uniform.

(2) The outer surface of the socks may also be sprayed, regardless of whether they are cotton, wool, or synthetic. The most critical areas are the top and front of the socks. This will aid in protecting against chiggers and tiny immature ticks that may

find their way through the boot eyelets. The top edge and eyelet areas of the boot itself may also be treated. Remaining spray can be used to treat mosquito netting.

(3) Allow the uniform to dry completely before being worn. This takes approximately 2 hours (or up to 4 hours under humid conditions). If possible, and if time permits, allow to dry in a shaded area because sunlight hastens degradation of permethrin. Permethrin has no odor once dry. A drawback of this method is that reapplication is needed after 6 weeks. **REMEMBER THAT DRY-CLEANING WILL COMPLETELY REMOVE PERMETHRIN AND REMOVE THE INFRARED SIGNATURE BLOCKING CHEMICALS.**

Figure 2-21. Applying permethrin aerosol to the field uniform.		**Figure 2-22.** Applying permethrin aerosol to insect head net.

(c) Storage and disposal

(1) The aerosol should be stored at temperatures between 32°F and 130°F (0°C to 54ºC). At temperatures above 130°F (54ºC), there is increased risk of the can bursting. At temperatures below 32°F (0ºC), permethrin will begin to crystallize out of solution, although upon return to temperatures of 60-80°F (16ºC to 27ºC), it re-dissolves with no apparent effect on the quality of the product[51]. Under optimum storage conditions, the shelf-life of the aerosol is indefinite. If deterioration of the can occurs, as evidenced by leakage or loss of propellant, turn in the product for proper disposal. Permethrin spray cans should be checked carefully after 5 years to ensure that they are still functional.

(2) After the contents of the can have been dispensed, replace the cap, wrap the container in several layers of newspaper, and discard in the trash per label

instructions. Alternatively, most CONUS sites can recycle the can. Do not puncture or incinerate. In contingency situations, dispose of in accordance with operational guidance.

Figure 2-23. Applying permethrin aerosol to insect net protector (Mosquito Bed Net).

(3) 5.1-Ounce (151 ml) Bottle

(Insect Repellent, Clothing Application, Permethrin, 40-Percent Liquid, air compressed Sprayer NSN 6840-01-334-2666).

(a) The product label and MSDS can be accessed at the AFPMB website www.afpmb.org or at the following links:

Label: http://www.afpmb.org/pubs/standardlists/labels/6840-01-334-2666_label.pdf
MSDS: http://www.afpmb.org/pubs/standardlists/msds/6840-01-334-2666_msds.pdf

This product contains 40% permethrin EC (Figure 2-24). In accordance with its label, **IT IS FOR USE BY CERTIFIED OR TRAINED PERSONNEL ONLY**. This restriction must be carefully considered when determining what method of permethrin treatment is to be used. Are there sufficient personnel certified and up-to-date on appropriate occupational health testing and respirator fit test to carry out this method of application? Is the equipment available?

(b) As per label instructions, this method can be applied to certain military field uniforms, netting, and tentage, as approved by the military service. Treatment by this method will invariably result in runoff of the chemical. Wear appropriate personal

protective equipment (e.g., respirator, gloves, etc.) when applying permethrin with this method. Ensure appropriate steps are taken to minimize/prevent contamination of the environment; water sources must not be contaminated.

(c) Application can be made by air compressed sprayers such as: 2-gallon sprayer (NSN 3740-00-641-4719), manually carried backpack sprayer (NSN 3740-01-496-9306), manually carried hydraulic backpack sprayer (NSN 3740-01-543-0676), manually carried compressed air backpack sprayer (NSN 3740-01-561-9663), and the gasoline/battery powered sprayer (NSN 3740-01-518-6876). For treatment of uniforms, the key requirement is that the sprayer must be calibrated to deliver 32 fluid ounces of mixture to each uniform (front and back). This delivery equals a fabric treatment level of 0.52% weight by weight of active ingredient.

(d) Several steps are essential in properly using this treatment method and product. Wear protective gloves and a respirator when mixing and applying this formulation. While a number of different air compressed sprayers can be used with this method (see above paragraph), the 2-gallon sprayer will be highlighted as the example:

Thoroughly clean a 2-gallon sprayer by triple-rinsing with water. Add one gallon of clean water to the sprayer, followed by the entire contents of the 5.1 ounce bottle; then add a second gallon of water. This procedure helps to mix the water and permethrin. Agitate and bring to the maximum pressure of 55 pounds per square inch (psi) with 40-55 full hand strokes. (The 2- gallon sprayer, NSN 3740-00-641-4719, comes equipped with a pressure gauge. When retrofitting older sprayers, use NSN 3740-01-332-8746, gauge, and NSN 4330-01-332-1639, filter/gauge.) As soon as spraying begins, the pressure will progressively drop, requiring frequent re-pressurizations.

When using any of the other approved air compressed sprayers, the sprayer must be calibrated to deliver a total of 32 fluid ounces of mixture to each uniform (front and back).

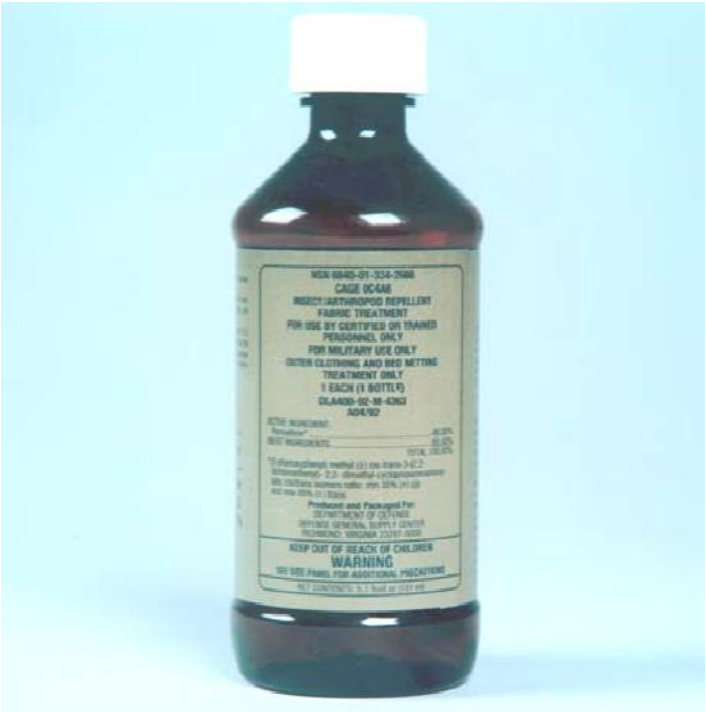


Figure 2-24. Permethrin 5.1-Ounce (151-ml) Bottle, NSN 6840-01-334-2666 Insect Repellent, Clothing Application, Permethrin, 40-Percent Liquid, 2-Gallon Sprayer.

(e) To treat clothing (Figure 2-25), place the complete uniforms on the ground. One bottle of permethrin is enough to treat eight complete uniforms. Hang the uniforms until they are dry (usually 2-4 hours, during which time the original color will be restored). Once dry, permethrin has no odor and does not affect the appearance of the fabric, and the garments may be safely handled and worn. This procedure impregnates 8 sets of uniforms with permethrin. Permethrin is bound so strongly to the fabric by this procedure that water will not remove it: **PERMETHRIN WILL NOT WASH OUT OF TREATED UNIFORMS IN THE RAIN OR WHEN FORDING STREAMS, ETC.**

(f) **DO NOT RE-TREAT THE UNIFORMS**: one treatment is effective in preventing mosquito bites through the fabric for more than the life of the uniform. **DO NOT TREAT UNDERWEAR OR CAPS. DRY-CLEANING WILL COMPLETELY REMOVE PERMETHRIN.**

Figure 2-25. Applying permethrin by 2-Gallon Sprayer to multiple field uniforms.

(g) To treat netting (Figure 2-26), spread the netting on the ground and spray on the netting for an even coverage. Spray with a slow sweeping motion to completely cover the netting fabric without runoff. Allow to dry completely before using. Re-treat after 1 year of use or six launderings. Bed nets that have been stored immediately following treatment will retain their effectiveness for many years prior to use.

(h) To treat tentage that has not been coated with a water-repellent finish (Figure 2-27), erect the tent and treat the entryways and the inside surface (ceiling, walls and floor) as this is where pests are most likely to rest. Direct the spray to the walls, ceilings, and floor (if present) with a slow sweeping motion for even coverage just to the point of runoff. Permethrin is compatible with the fire retardants and mildew inhibitors used on general purpose, temper, and Arctic tents, as well as cotton tent liners. Re-treat after 9 months of use in arctic or temperate climates and after 6 months of use in tropical climates. Tents that have been stored following treatment will retain their effectiveness for many years prior to use. **PERMETHRIN SOLUTIONS ARE INEFFECTIVE ON VINYL-COATED TEMPER TENTS**, as the water-based permethrin will simply drip off the water-repellent surface. In this case, it becomes even more important to use treated bed nets.

Figure 2-26. Applying permethrin by 2-Gallon Sprayer to insect net protector (Mosquito Bed Net).

Figure 2-27. Applying permethrin by 2-Gallon Sprayer to the external surface of a tent.

(i) Storage and disposal.

(1) Do not store products containing permethrin EC below 32°F, because the permethrin will crystallize. However, if that does occur, the integrity of the product can be restored when it is thawed, brought back to ambient temperature, and agitated until all the crystals re-dissolve. The flash point of 40% permethrin EC is 115°F due to the flammable solvent used in the formulation. Although the product shows little or no decomposition at 122°F after 30 days, storing the product in an enclosed space at or above 115°F will increase the chance of explosion due to ignition of vapors. Under optimum conditions, the shelf-life of this product is indefinite. However, if deterioration of the container occurs, such as leakage, dispose of properly with guidance from an environmental/waste management authority.

(2) When empty, the pesticide container should be recapped, placed in a plastic bag, and discarded in the trash per label instructions. In contingency situations, dispose of in accordance with operational guidance.

(3) This product is flammable and must be shipped in accordance with DOT regulations.

(4) Factory Treatment of Military Uniforms

(a) In this method, military uniforms are factory-treated with permethrin prior to distribution. Factory-treated uniforms bear a unique label with a statement indicating that the fabric has been treated. Click on the following link for more information on factory permethrin treatment of military uniforms, including the treatment of fire-retardant uniforms:

http://phc.amedd.army.mil/PHC%20Resource%20Library/PermethrinFactory-TreatedACU.pdf

(b) **DO NOT TREAT FACTORY-IMPREGNATED UNIFORMS WITH ADDITIONAL PERMETHRIN. REMEMBER THAT DRY-CLEANING WILL COMPLETELY REMOVE PERMETHRIN.**

d. Summary on the Permethrin Treatment of Uniforms

The following steps should be taken when initiating the permethrin treatment of any military uniform:

STEP 1: Can the specific uniform be treated with permethrin?

Check the following link:

http://www.afpmb.org/sites/default/files/contingency/Uniform_Permethrin_Treatment_Matrix.pdf

What if a uniform is not on the matrix? Contact the contingency liaison officer at the AFPMB.

STEP 2: If it can be treated, what application method has been evaluated and approved?

In addition to the link provided in STEP 1, consult with the uniform authority for the respective service (contact information is listed under 2-11.a(4))

STEP 3: Of the approved application methods, which one should be used?

Be careful when choosing a method because there are many factors to consider. For instance, perhaps you need to treat a large quantity of uniforms and have a 2- or 3-month window prior to deployment. The best option in this case may be to send the uniforms to a designated contractor for factory impregnation. If the 5.1-ounce bottle method with air compressed sprayer is selected, will there be a sufficient number of trained and fully certified personnel to conduct the spraying? Is there a proper application area available? Will there be sufficient drying time? Another factor to consider is expected time in the field. Is the deployment to last more than 6 weeks? If so, the spray can method may not be feasible as re-application is needed after 6 weeks or 6 launderings. If the spray operation has to take place in theatre, will there be available cargo for either the spray cans or 5.1-ounce bottles. If IDA kits are used, will there be sufficient time for drying the garments? The above are just some of the questions that must be asked when choosing a method; each situation will be different and must be decided on a case-by-case basis.

2-12. Miscellaneous Repellent

CHIGG-AWAY® (Insect Repellent, Personal Application, NSN 6840-01-137-8456) Fig. 2-28 is a yellow lotion with a sulfurous odor, available in a 188-ml plastic squeeze bottle. The label and Material Safety Data Sheet (MSDS) for this product can be accessed at www.afpmb.org or by clicking on these links:

Label: http://www.afpmb.org/pubs/standardlists/labels/6840-01-137-8456_label.pdf
MSDS: http://www.afpmb.org/pubs/standardlists/msds/6840-01-137-8456_msds.pdf

Figure 2-28. CHIGG-AWAY.

DEET, picaridin, and permethrin-treated uniforms repel chiggers. Chiggers are annoying pests in the USA but transmit scrub typhus, a potentially deadly disease, in Asia and the Pacific. This product has NOT been tested for efficacy against the vectors of scrub typhus.

This product is labeled for use only against chiggers and as such is not recommended for use in most situations where other nuisance and/or vector arthropods may be active.

a. CHIGG-AWAY® contains 5-percent benzocaine to relieve itching caused by chigger and other insect bites. If you are using it to relieve itching bites, then it is not a repellent and is not protecting against arthropod-borne disease. It will, however, give temporary relief from chigger and insect bites.

b. Do not apply this product to the eyes or other mucous membranes. The product is NOT intended for prolonged use.

c. Storage and Disposal

(1) The shelf life of CHIGG-AWAY® is approximately 4 years. An expiration date is stamped on the container. It should be stored at room temperature, not above 100°F, and should be kept from freezing. This product contains no hazardous ingredients. It is non-flammable and non-reactive.

(2) The empty bottle should be rinsed with tap water and discarded in the trash. In contingency situations, the container can be disposed of in the same manner as other non-hazardous trash.

2-13. DoD Insect Repellent System

The **BEST STRATEGY** for defense against insects and other disease-bearing arthropods is the **DoD INSECT REPELLENT SYSTEM** (Figure 2-11), summarized in the following link:

http://phc.amedd.army.mil/topics/envirohealth/epm/Pages/DoDInsectRepellentSystem.aspx

This system includes the application of extended-duration Picaridin or DEET to exposed skin, coupled with the application of permethrin to the field uniform. When used with a properly worn uniform, the DoD insect repellent system will provide nearly complete protection from arthropod-borne diseases. This system should always be augmented with tick/insect checks on clothing and exposed skin.

2-14. Area Repellents

a. The AFPMB does NOT recommend the use of any area repellent as an effective means for repelling arthropods, especially in a field environment. Currently, there are no area repellents in the NSN list. It is recommended that only the pest management items in the NSN list (http://www.afpmb.org/standardlist.htm) be procured for use in any and all military operations.

Protected areas can decrease to virtually zero on the upwind side of these area repellent devices. Thus, area repellents may give a false sense of security to persons in the vicinity, resulting in their not using skin and clothing repellents. Area repellents include products that prevent bites over a large area rather than just on a person or their clothing. Some products claim to prevent bites by emitting sounds or electromagnetic waves. These include smart phone apps that claim to produce repellent sounds. Other products use various methods of dispersing chemical compounds into the air. Products include candles, burning coils, heat dispersed chemicals (from electric elements, butane combustion, or a candle), and vermiculite impregnated with various chemicals. Efficacy under ideal conditions varies from nearly complete prevention of bites to no protection at all. For devices that emit chemical compounds, protective effects are greatly affected by wind, and product claims for a given area of protection are based on windless conditions.

2.15 Repellent Devices Worn on the Body

Do not use these devices. Wrist bands, broaches, etc., that contain repellent compounds and that claim to prevent insects from biting the wearer are also of little use. Field and laboratory data show that these offer no protection and in some cases actually increase the risk of being bitten. Wrist bands have their effect only in the immediate vicinity of the band itself (i.e., the wrist or forearm of a person wearing one). Broaches and pins containing repellents are likewise limited. Additionally, simply walking around creates sufficient breeze across a person’s body to reduce the effectiveness of these devices.

Soldiers, airmen, sailors, and marines have used animal flea and tick collars around their wrists, ankles, arms, or belt lines. These collars are **NOT INTENDED FOR HUMAN USE** so their safety has never been tested on humans. Such products contain many different kinds of pesticides that may have adverse dermal and/or systemic effects on people. Severe skin reactions have been reported from using these products (Figure 2-29). In addition, some pesticides contained in these collars could trigger chemical agent detectors.

Figure 2-29. Skin lesions caused by use of flea and tick collars.

Section V. Ineffective and Hazardous Practices

2-16. Introduction

A number of commercial products that are either not marketed for personal protection, or are not very effective repellents are nevertheless being widely used by troops for this purpose. Such products are less effective than those containing DEET and they may be hazardous or fatal when used in a manner not approved by the label. Products with concentrations in the range of about 20% to 40% DEET provide an appropriate mix of effectiveness and duration of protection. Within this range of concentration, percent active ingredient generally translates to duration of protection. Products with less than 20% DEET provide protection for too short a period of time to be useful in military scenarios. Above 40% DEET, the gain in duration of protection is generally not great enough to warrant using the higher concentration products. Medical personnel should instruct troops on the correct use of appropriate personal protective measures and should strictly prohibit the use of unauthorized products.

2-17. Commercial Products

a. Non-DEET/Picaridin Products

Many new repellent products that do not contain DEET may use active ingredients that are not proven repellents or have very little repellency (e.g., bath oils, dryer sheets, and some so-called natural products), may contain repellent ingredients at such low concentration

they are ineffective (e.g., citronella), or may actually be hazardous to use on humans (e.g., flea/tick collars and cattle ear tags). Many of these products may provide some protection over a short period of time under low pest biting pressure (e.g., backyard barbecues), but they are not sufficient to protect personnel in the field against arthropod vectors that may carry disease.

b. Ingested Products

Some products or publications make claims that ingesting certain materials will protect you from insect bites. There is no scientific evidence that any material that is ingested (e.g., match heads, vitamin B1, garlic, peanut butter, chewing tobacco, lemon grass, etc.) has any repellent effect on insects or other biting arthropods.

c. Recommendation

We stress again that only products listed on the DoD Standard Pesticides and Pest Control Equipment Lists (http://www.afpmb.org/standardlist.htm) be used for personal protection, as these have been through extensive and exhaustive evaluations and found to be safe and efficacious.

Section VI. Pesticide Reduction through Physical/Mechanical Modifications and Sanitation

2-18. DoD and Integrated Pest Management (IPM)

a. Current DoD environmental policy stresses a concerted effort to reduce pesticide use within military programs. As a part of this overall effort, use of the DoD INSECT REPELLENT SYSTEM will help to reduce the need for pesticide applications during contingency operations, as well as during routine activities. The link between repellent use and reduced need for pesticide dispersal is nothing new, but has become increasingly more important in this era of enlightened environmental stewardship. Pesticide treatment may be necessary when troops are to remain for a prolonged period of time in an area that is heavily infested with arthropods. Pesticide applications must only be performed by trained or certified individuals and only after Preventive Medicine personnel determine that other protective and preventive measures are, or will not be, fully successful. Aerial applications can be used for large areas and should be conducted prior to deployment into the site. They must be conducted according to all applicable environmental laws and regulations.

b. The DoD is committed to the concept of IPM, an effective and environmentally sensitive approach to pest management that relies on a combination of common-sense practices. Physical/mechanical modifications such as clearing away leaf litter and underbrush that provide potential habitat for arthropods and/or for animal hosts may reduce nuisance and vector arthropods without the need for pesticides. Raking is simple and efficient. Keep grass and weeds mowed back where possible, especially around buildings and in housing, cantonment, and recreational areas. For large areas, controlled burning of the understory may be necessary, although this should only be attempted by trained personnel when other methods fail or are impractical and after authorization has been obtained through appropriate environmental and medical channels. Mosquito breeding sites should be eliminated or reduced by draining standing water and by preventing water accumulation in containers, depressions in the ground, or other receptacles. Although not primarily a personal protective measure, it is the responsibility of each individual to participate in the overall unit sanitation effort. Once a bivouac site is established, sanitation is critical. Garbage and other odiferous decaying matter will attract arthropods and other animal pests and should not be allowed to accumulate. These types of materials should be maintained in tightly closed containers or should be buried, burned, or removed.

Section IX. Conclusion

2-19. Summary

Conscientious use of the **DoD INSECT REPELLENT SYSTEM** and the other protective measures described in this TG will provide maximum, safe protection from arthropod attack.

2-20. Training Package

A number of short training videos on personal protective measures are available at the following USAPHC website:

http://phc.amedd.army.mil/topics/envirohealth/epm/Pages/default.aspx

APPENDIX A – REFERENCES

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