CHAPTER 9

CHEMICAL AND BIOLOGICAL WARFARE DEFENSE

Learning Objectives: Recall the elements required for chemical warfare (CW) and biological warfare (BW) defense and countermeasures.

Nuclear weapons are primarily designed to destroy material by blast and shock. Biological and chemical substances for military use are primarily antipersonnel agents; they are intended to produce casualties without the destruction of buildings, ships, or equipment. This chapter provides an overview of shipboard chemical warfare (CW) and biological warfare (BW) defense and countermeasures. Detailed information on these subjects is available in the *Naval Ships' Technical Manual (NSTM),* chapter 470, "Shipboard BW/CW Defense and Countermeasures."

Chemical biological (CB) warfare defense is not a function that a ship performs in isolation from other tasks. A ship is expected to operate in hazardous environments including a variety of toxic environments. A chemical or biological environment should be viewed as a potential overlay on any warfare task. The employment of defensive measure may impair the ability of a ship to perform its assigned mission.

CB WARFARE DEFENSE PROTECTIVE EQUIPMENT

Learning Objective: Recall the function and use of protective equipment designed for CB warfare defense.

The employment of most CB countermeasures and protective equipment makes normal activities and operational evolutions more difficult. The use or even the threat of use of chemical or biological weapons may force the ship into a protective posture that degrades its operational capabilities. In some situations, the risk of chemical or biological casualties must be accepted to permit accomplishment of a high priority mission, but this risk should always be minimized. Risk management is basically making informed tradeoffs. It is important to understand not only the capabilities of chemical and biological agents and weapons but their limitations as well. This knowledge provides the ability to make informed decisions about the level of protection required. Protective measures can then be limited to those that are necessary and their use can be suspended as soon as possible. In this way, the negative impact on operational capability by the use of CB protective equipment can be minimized.

MCU-2/P SERIES PROTECTIVE MASK

A primary means of defense against CB agents is the protective mask. The MCU-2/P series mask (fig. 9-1) is designed to protect the face, eyes, and the respiratory tract of the user from tactical concentrations of chemical and biological agents, toxins, and radioactive fallout particles. It has a single filter and two voicemitters, one on front of the mask for speaking directly into a telephone or radio handset and one at the side to allow personnel nearby to hear. A nosecup with two inlet valves fits over the nose and mouth. It directs incoming air across the inside of the lens to reduce fogging. The mask has a drinking tube that connects to a canteen with an M1 cap. Since the MCU-2/P protective mask is available in three sizes, it is important to determine which size will provide the best fit and the maximum protection to an individual. To simplify mask size selection and initial sizing, use a caliper to measure face length (tip of chin to nasal root depression) according to instructions contained in the MCU-2/P manual.

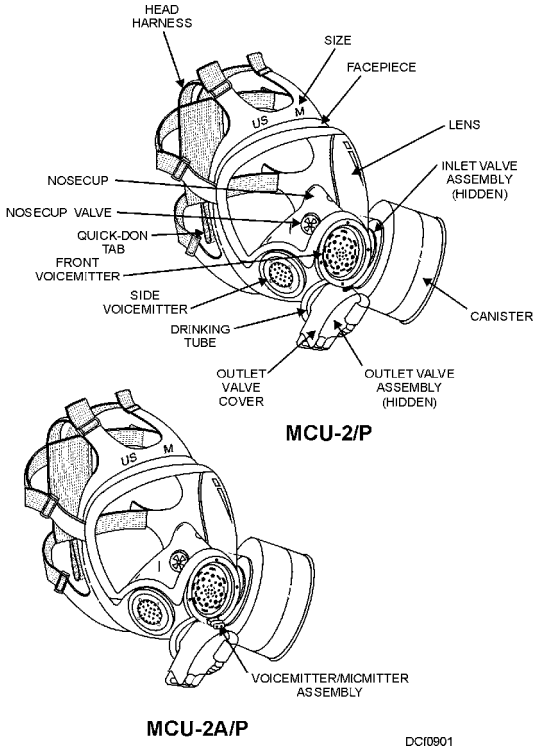


Figure 9-1. MCU-2/P and MCU-2A/P protective masks.

Checking and Testing the Protective Mask

When a protective mask is donned, a visual check should be made to ensure the mask fits properly. Things to check for are as follows:

- The facepiece should come well up on the forehead, but not extend over the hairline.
- The straps should not cut into the ears.
- The bottom part of facepiece should not cut into the throat.
- The nose cup should not interfere with vision or press painfully on the nose.
- For persons wearing combat spectacles, there should be no interference between the nose cup and the bridge of the spectacles.

After ensuring a good fit, perform a negative pressure check by covering the canister air inlet opening with the palm of your hand and inhaling lightly to deflect the facepiece and lens slightly inward. Then hold your breath for 5 to 10 seconds to determine if the facepiece and lens remain in the deflected position. If the lens does not deflect, this may be due to leaks around the edge of the mask caused by poor adjustment or incorrect size. It is important to determine the cause of the leak and correct it immediately.

Donning Procedures

Before donning a mask, you should replace unapproved eyeglasses and contact lenses with authorized combat spectacles. Once done, the donning procedure described here can begin. The steps of this procedure are as follows:

1. Stop breathing.
2. Close eyes tightly.
3. Remove headgear.
4. Open mask carrier.

CAUTION

Do not remove the mask from the carrier by pulling on the outlet valve.

5. Grasp the mask by the front portion of the facepiece in the area of the voicemitter and outlet valve assembly.
6. Withdraw the mask from the carrier.
7. Hold the outlet valve assembly in the palm of one hand. Using your free hand, push forehead hair aside.
8. Place the mask on your face forcing the chin cup very tightly against your chin.
9. Pull the head harness over your head using the quick-don tab.
10. Grasp a neck strap in each hand and tighten with small, jerking motions.
11. EXHALE.
12. Open your eyes and remove the outsert if required by command policy and place it in the carrier.

CAUTION

If inhalation is too forceful while checking for leaks, the facepiece will collapse against the face and the outlet valve may become dislodged.

13. Press the palm of one hand over the canister opening. Inhale to determine if an airtight seal of the mask against your face has been obtained.

CAUTION

If the mask collapses slightly while inhaling and remains collapsed while holding your breath, it is leak-tight. If the mask does not collapse, check for hair or other material between the mask seal and your face. Tighten straps if necessary and recheck.

14. After a proper seal is obtained, open your eyes and RESUME NORMAL BREATHING.
15. Close the carrier.

Doffing Procedures

Following proper procedures for doffing a mask is very important for your safety. The following procedures apply to masks that have not been exposed to contamination or, if they have been exposed, have been decontaminated.

1. Loosen the mask neck straps by rotating the buckles forward.

2. Grasp the mask by the outlet valve body and remove it by pulling down, outward and up.
3. Install the outsert, if necessary.
4. Reverse the head harness over the mask facepiece and remove moisture from inside the mask.
5. Clean and dry the mask according to current PMS requirements.
6. Stow the mask in the mask carrier.

Outserts

Clear plastic outserts that fit over the mask lens can serve two purposes. They protect the lens from scratches when they are stored in the carrier and they protect the lens from chemical agent droplets, oil, and other petroleum products when the mask is worn. Outserts shall be used on masks when they are stowed in carriers.

NOTE

Use of outserts when masks are worn is subject to command policy.

C2 Canister

The MCU-2/P series protective mask uses a single filter canister, designated C2.

This canister has a NATO standard thread and screws into the inlet valve body. In the initial configuration, the canister is on the left side of the mask; however, it can be moved to the right side by switching the locations of the inlet valve body and the side voicemitter.

Two canisters are issued with the mask and the ship issues a third. Two shallremain sealed in their packaging and reserved for wartime use. The third is attached to the mask for training and acclimation. Sixty days after a canister is removed from its packaging, it is marked as a training canister.

The C2 canister has an operational service life, based on a worst-case environment (hot climate and high humidity) as follows:

In the absence of a CB agent, shipboard personnel can retain canisters for operational use for 60 days after the seal is removed from the packaging. Canisters open for more than 60 days shall be retained for training only or discarded. A white stripe is painted around the rim of each to identify training canisters.

Canisters are good for one attack of blood agent, after which they shall be replaced. Canisters are good for 30 days following exposure to other chemical threat agents, as long as the 60-day limit after removal of the packaging seal is not exceeded.

Canisters should be replaced when certain conditions exist. These conditions include the following:

1. The charcoal is wet.
2. The canister has been damaged.
3. The canister is clogged and causes excessive breathing resistance.
4. The charcoal dust is left on your face after use.
5. The replacement is directed by the commanding officer.

NOTE

The guidance in this paragraph does not apply to canister replacement on masks issued for use in response to radiological casualties associated with the Naval Nuclear Propulsion Program.

Combat Spectacles

Combat spectacles are available in two sizes for use with the MCU-2/P series mask. The medical department is responsible for ordering and issuing combat spectacles.

WARNING

Combat spectacles are the only eyeglasses approved for use with the MCU-2/P series mask. Contact lenses will NOT be worn.

Canteen

A 1-quart canteen is used when aboard ship. The drinking tube of the MCU-2/P series mask attaches to the M1 cap on the canteen. The cap contains a pin that depresses a diaphragm on the end of the drinking tube, allowing the wearer to replenish fluids while wearing the mask. Covers and belts for carrying the canteens may be ordered separately.

MCU-2A/P PROTECTIVE MASK

The latest variant in the MCU-2/P mask series is the MCU-2A/P mask (fig. 9-1). It contains the same features as the MCU-2/P mask and, with modifications, may be integrated into the ship's Interior Voice Communications System (IVCS) and the Flight Deck Communications System. The priority for issue of MCU-2A/P masks is as follows:

1. Flight deck supervisory personnel
2. Personnel at general quarters (GQ) stations outside collective protection system (CPS) Total Protection (TP) zones who require access to IVCS
3. Remaining flight deck personnel
4. Personnel at GQ stations inside of CPS TP zones who require access to IVCS

CHEMICAL PROTECTIVE OVERGARMENT

The chemical protective overgarment (CPO) is made of material that is permeable to water vapor; that is, it allows the escape of moisture from perspiration. This design reduces heat stress on the wearer but will not prevent it entirely in a hot climate.

The function of the CPO is to protect the wearer from threat levels of chemical agents in liquid form and from the associated vapor. The inner antigas layer contains activated charcoal to entrap chemical agent vapors. The outer layer that is made of modacrylic nylon repels an unthickened chemical agent or spreads the agent over a wider surface area. This spreading process is called wicking. It enhances the evaporation of the liquid agent so less of it is absorbed and reaches the inner antigas layer. Thickened agent will not spread very much, so it must be wiped off.

The chemical protective overgarment (CPO) consists of two pieces—a smock with an attached hood and trousers. The smock and trousers are generously cut to fit over the general duty uniform. The smock has a back gusset to allow freedom of movement. There is a large front flap pocket for storing Atropine Auto Injectors, Pralidoxime Chloride Auto Injectors (2 PAM-CL), Nerve Agent Pretreatment Pyridostigmine (NAPP), and the M291 Skin Decontamination Kit. The smock also has a sleeve patch for securing detector paper. The smock can be adjusted with hook and pile fasteners at the wrist and waist. The trousers have a front gusset for ease of fit and suspenders which cross the shoulders and tie in the front. Hook and pile fasteners are located at the waist and at the bottom of each leg for adjustment. The CPO comes in four sizes—small, medium, large, and extra-large. The wear time in a contaminated environment is 6 hours. In an uncontaminated environment, the CPO has a total cumulative wear time of 100 hours within 30 days after opening the protective packages in which it is issued.

The chemical protective ensemble (CPE), as shown in figure 9-2, consists of the CPO plus a protective mask, and a pair of boots and gloves.

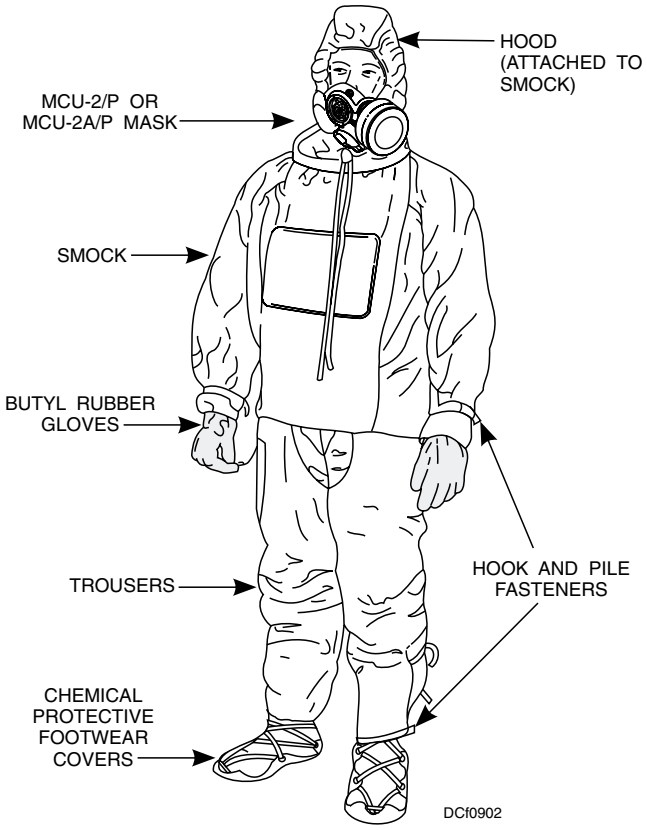


Figure 9-2. Chemical protective ensemble (CPE).

Advanced Chemical Protective Garment

The advanced chemical protective garment (ACPG) is an overgarment that is worn over the duty uniform or underwear. It is made of material that allows water vapor to escape. This design allows perspiration to pass through which reduces heat stress but does not eliminate it entirely in warm weather. The ACPG provides protection against chemical agents in liquid, vapor, and aerosol form. Details of the ACPG are covered in *NSTM,* chapter 470.

NOTE

The advanced chemical protective garment (ACPG) will be phased in to replace the CPO over several years. Issue and use of the CPO will continue until stocks are exhausted and shelf life has expired.

REVIEW QUESTIONS

Q1. The MCU-2/P protective mask comes in a total of how many sizes?

1. One
2. Two
3. Three
4. Four

Q2. What is the minimum number of C2 canisters issued with a MCU2/P protective mask?

1. One
2. Two
3. Three
4. Four

Q3. What is the maximum life expectancy of a C2 canister when opened in a noncontaminated area?

1. 30 days
2. 60 days
3. 90 days
4. 120 days

Q4. What is the maximum life expectancy of a C2 canister in a contaminated environment?

1. 30 days
2. 60 days
3. 90 days
4. 120 days

CHEMICAL OPERATIONS

Learning Objective: Recall the methods used for dissemination of chemical agents, the characteristics of the various agents and their effect on personnel, the devices used for detection of chemical agents, and the capability of each device.

In chemical operations, toxic chemical agents produce death, injury, or irritating effects. Although chemical agents are frequently referred to as gases, they may actually be found as solid particles, liquids, or gases. Chemical agents are used chiefly for their effects on personnel. Some agents have corrosive effects on certain materials, and incendiary agents will burn most materials. Chemical agents produce harmful physiological reactions when applied to the body externally, inhaled, or swallowed. Most military chemical agents cause disorganization of the functioning of the body.

Chemical agents can be disseminated by aircraft spray, chemical projectiles, chemical bombs, chemical grenades, smoke pots, smoke candles, chemical land mines, and missiles. These principal factors determine the method by which a chemical agent is spread, the quantity of the agent required to accomplish specific objectives, the nature of the agent being used, the distance to the place of attack, and the speed with which the agent must be used.

CHARACTERISTICS AND EFFECTS OF CHEMICAL AGENTS

The characteristics and some of the general physiological effects of the more common chemical agents are discussed in this section. This knowledge is very important in allowing personnel to react quickly and accurately should a chemical attack occur.

The rate of action of a chemical agent is the rate at which a body reacts to or is affected by that agent. There is a wide variation in the rate of reaction to the toxic chemical agents, even to those of similar tactical or physiological classifications. For example, distilled mustard (HD) produces no immediate sensation, and 4 to 6 hours may pass before the skin reddens. Lewisite (L), on the other hand, causes immediate pain, and the skin begins to redden within 30 minutes.

Blister agents must be decontaminated within 1 to 2 minutes after exposure if serious effects are to be prevented. Nerve agents and blood agents act quickly. If death is to be averted, you should administer antidotes or start other first-aid measures within 30 seconds after the symptoms appear. Vomiting and tear agents also take effect within a short time after being inhaled.

Some agents are effective when absorbed through the skin or eyes, but others must be inhaled. Tear agent (CN) primarily affects the eyes; tear agent (CS) affects both the eyes and the upper respiratory tract. Blister agents affect the internal as well as the external body surfaces. Vomiting agent adamsite (DM) and choking agent phosgene (CG) must enter the lungs to produce their effects.

The rate of detoxification is the rate at which the body counteracts the effects of a chemical agent. It is an important factor in determining the hazards of repeated exposure to sublethal doses of toxic chemical agents. Some agents are detoxified quite rapidly. Other agents are detoxified very slowly, and their effects are cumulative. The blood agents cyanogen chloride (CK) and hydrogen cyanide (AC) are detoxified rapidly, thus requiring high concentration for maximum casualties. The nerve agent sarin (GB) is detoxified slowly and is cumulative to a large degree. If 50 percent of a lethal dose is received, only minor symptoms appear. However, another 50 percent received within the next few hours may cause death if no treatment is received. The blister agent distilled mustard (HD) and the choking agent phosgene (CG) also are cumulative. A 10-minute exposure to either followed a few hours later by a similar exposure has the same effect as one 20-minute exposure. Additionally, repeated exposure to sublethal doses of HD can result in sensitivity to low concentrations of the agent.

Nerve Agents

Nerve agents are not quickly and easily detected. Small quantities can cause casualties and deaths quickly. They may be colorless gases with little or no odor or colorless to light brown liquids. These agents radically disturb the chemical processes of the nervous system, which impairs or stops other bodily functions.

Nerve agents can enter the body by inhalation, ingestion, and absorption through the skin and eyes. Entry through the skin is extremely effective. This means that the protective mask alone is not adequate protection because the agent can enter through any exposed skin.

There are now two series or groups of nerve agents—G series and V series.

The G series agents include the following:

- Tabun (GA)
- Sarin (GB)
- Soman (GD)

The V series is composed of agent VX.

The physical properties of the G agents are similar and are as follows:

- The GA is a colorless to brownish liquid, which gives off a colorless vapor.
- GB and GD are both colorless to light brown liquids that give off colorless vapors.
- All three G agents normally are nonpersistent; however, GA and GD are longer lived than GB.

G agent poisoning displays approximately the same sequence of symptoms whether the agent enters the body by inhalation, absorption, or ingestion. These symptoms, in usual order of appearance, are as follows:

1. Runny nose
2. Tightness of chest
3. Dimness of vision and pinpointing of the eye pupils; difficulty in breathing
4. Drooling
5. Excessive sweating
6. Nausea
7. Vomiting
8. Cramps
9. Involuntary defecation and urination
10. Twitching, jerking, and staggering
11. Headache and confusion
12. Drowsiness
13. Coma
14. Convulsion

All of the above symptoms can take place in 30 seconds if the dose is sufficiently heavy. These symptoms are followed by cessation of breathing, then death. Symptoms appear much more slowly from skin dosage than from respiratory dosage. Although skin absorption great enough to cause death may occur in 1 to 2 minutes, death may be delayed for 1 to 2 hours. Respiratory lethal dosages kill in 1 to 10 minutes, and liquid in the eyes kills almost as rapidly. The number and severity of symptoms that appear depend on the quantity and rate of entry of the nerve agent into the body.

Most of the detailed information about agent VX is classified and cannot be covered in this text. In general, V agents are colorless and odorless liquids that do not evaporate rapidly or freeze at very low temperatures. Because of their low volatility, their vapor effect is limited; thus, the duration of their effectiveness is increased. In liquid or aerosol form, V agents affect the body in a manner similar to that of the G agents. The V agents usually are disseminated as liquid droplets. When inhaled, these agents are inherently about five times as toxic as the older nerve agents (G series). When absorbed through the skin, the V series agents are several hundred times more toxic than the G agents, because there is no breakdown of the V agent (as there is in GB) as it passes through the fatty layer of the skin.

Blister Agents

The blister agents, used for casualty effect, may restrict the use of ground personnel, slow troop movements, and hamper the use of material or installations. These agents affect the eyes and lungs and blister the skin, producing long-term incapacitation or death. Blister agents are odorless and vary in duration of effectiveness. Most blister agents are insidious in action; there is little or no pain at the time of exposure (except to lewisite (L) and phosgene oxime (CX), which cause immediate pain on contact). The development of casualties is somewhat delayed; the effects of distilled mustard (HD) may appear in 4 to 6 hours after exposure. The first effect is eye irritation. Next, the more sensitive body parts are affected. A series of symptoms follow, ranging from slight redness to blistering and the forming of ulcers. Wet skin absorbs more mustard than dry skin. For this reason, lower concentrations of mustard HD are needed in hot, humid weather because the body is then moist with perspiration. This fact is important in the tropics. Protection from blister agents is extremely difficult, because they attack any part of the body that comes in contact with the liquid or vapor agent.

The primary blister agents, HD and HN, are most effective for general use. However, they are far less effective than the nerve agents for casualties that result in quick death from inhalation are, because a high dosage of mustard vapor is required to produce death. Mustard is effective by absorption of both vapor and liquid through the skin. The physiological action is localized to the area of the skin that is contaminated, but it does not produce a systemic effect.

In the pure state, mustard is a yellowish, oily liquid. Because of its high boiling point, liquid mustard evaporates slowly at normal temperatures; consequently, it remains effective for a considerable length of time after application. In fact, in winter months, HD may produce casualties for several weeks after dissemination. On the other hand, the warm temperatures of summer, assisted by wind and rain, may reduce its capability to days. Almost every shipboard surface or material, except bright metal and glass, absorbs some mustard and retains it more or less persistently. Regardless of weather and wind, no shipboard surface contaminated with mustard should be considered completely free of this agent unless a negative test is obtained with a detector kit.

Because HD can be dissolved by fats, it may be dissolved in foodstuffs and make them poisonous. Mustard can be dissolved easily in such commercial solvents as benzene and cleaning fluid, and in motor oils, but it is only slightly soluble in water. On prolonged standing, it reacts with water to produce harmless substances. The action of HD on metal is very slight.

The newer blister agents include the nitrogen mustards HN-1, HN-2, HN-3 and the mixed blister agent HL. These mixtures do not produce more severe injuries than do other agents alone, but they have a lower freezing point than pure HD.

Blood Agents

Blood agents enter the body through the respiratory tract. They affect bodily functions through action on the enzyme cytochrome oxidase, thus preventing the normal transfer of oxygen from blood to body tissue. Most blood agents act rapidly and are normally nonpersistent. In general, a victim who does not die quickly will recover within a few hours.

The most common blood agents are as follows:

- Hydrogen cyanide (AC)
- Cyanogen chloride (CK)

Although AC is one of the most deadly poisons known, it is one of the least effective chemical agents because it evaporates rapidly. The vapors are less dense than air. They do not provide a blanket of the agent, and the poisoning effects do not accumulate as exposure continues. CK deteriorates the chemical canisters in protective masks within a short period of time.

Choking Agents

Choking agents, sometimes called lung irritants, primarily injure the respiratory tract which includes the nose, the throat, and particularly the lungs where it causes pulmonary edema. In extreme cases, membranes swell, lungs become filled with liquid, and death results from lack of oxygen; thus, these agents choke an unprotected man. Fatalities of this type are known as "dry-land drownings."

The two most common choking agents are as follows:

- Phosgene (CG)
- Diphosgene (DP)

Use of these agents is rather limited because they react rapidly with water to yield nontoxic hydrolysis products. Their concentrations in air are reduced fairly rapidly by water condensates (rain and fog) and by dense vegetation. Other classes of agents are much more efficient. Unlike the nerve and blister agents, choking agents have no poisonous effect upon foods; they are too readily destroyed.

Vomiting Agents

The most important vomiting agents are as follows:

- Diphenylchlorarsine (DA)
- Diphenylchanoarsine (DC)
- Adamsite (DM)

These agents are dispersed as aerosols and produce their effects by inhalation. These agents produce minor eye irritation and a feeling of pain and sense of fullness in the nose and sinuses. This is accompanied by a severe headache, intense burning in the throat, tightness and pain in the chest, and irritation of the eyes, producing excessive tear formation. Coughing is uncontrollable and sneezing is violent and persistent. Nausea and vomiting are prominent. Mild symptoms, caused by exposure to very low concentrations, resemble those of a severe cold. The onset of symptoms may be delayed for several minutes after initial exposure, especially with DM. Therefore, effective exposure may occur before the presence of the smoke is suspected. If the protective mask is then put on, symptoms will increase for several minutes, despite adequate protection. As a consequence, the victim may believe the mask to be ineffective, and by removing it cause further exposure. On leaving the scene of the attack, the victim's symptoms subside rather rapidly, and the severe discomfort vanishes after about one-half hour. At high concentrations, effects may last for several hours. Because of their arsenical properties, these agents make foods poisonous.

Tear Agents

Tear agents (also known as riot-control agents) are essentially local irritants, which, in very low concentrations, act primarily on the eyes, causing intense pain and a considerable flow of tears; stinging of warm, moist skin; and irritation of the nose. High concentrations produce irritation of the upper respiratory tract and lungs and cause nausea and vomiting. The agents may be either solids or liquids and may be dispersed in the air as vapors or smokes.

Tear agents include the following:

- CN
- CNC
- CNB
- BBC
- CS

Of these agents, CS is the newest and most effective. It produces immediate effects even in extremely low concentrations. An individual is incapacitated about 20 to 60 seconds after exposure. Effects last 5 to 10 minutes after the affected individual is removed to fresh air. During this time, affected individuals are incapable of effective concerted action. This agent is highly successful in quelling riots.

The physiological effects of tear agents include the following:

- Extreme burning of the eyes accompanied by a heavy flow of tears
- Coughing, difficulty in breathing, and chest tightness
- Involuntary closing of the eyes
- Stinging sensation of moist skin

WARNING

Although personnel exposed to CS may shower as necessary, when CS dust or particles are on the skin, showering should be delayed for 6 hours to prevent stinging and reddening of the skin.

Incapacitating Agents

Incapacitating agents were developed through intensive study and research. They are used to wage and win a war without resorting to the massive killing, enormous destruction of property, and immense monetary cost, as in past wars, which undeniably will characterize any future conflict in which nuclear weapons are used. Incapacitating agents are the latest discovery. Many are still in the research, development, and testing stage; and much remains to be learned about them.

The effects of incapacitating agents are not predictable and may even change from dose to dose and person to person. During a single exposure, a person's feelings may range from impatience, restlessness, and anxiety to an exuberant sense of happiness. The person may suffer from delusions of persecution or grandeur. Some people may reach a catatonic state where they cannot move voluntarily and will hold any position in which placed. In this state, a person may suffer from hallucinations, panic, and make violent outbursts.

An agent of this type is BZ, a slow-acting aerosol. It enters the body by inhalation and interferes with mental processes that control bodily functions.

Although there are many unanswered questions concerning the physiological action of these incapacitating compounds and much research remains to be accomplished, they offer many advantages. Some of these advantages are as follows:

- They are flexible. The effects can be tailored to meet a commander's needs—ranging from drowsiness or mild hallucinations and confusion and lack of physical coordination to hysteria, irresponsibility, or complete withdrawal.
- They are economical. They are far less expensive to produce, pound for pound, than fissionable materials or even some of the more advanced conventional weapons.
- They are not destructive. An enemy nation subdued by the use of incapacitating agents against its armed forces and against its support services will not pose to the victors the mammoth problems of reconstruction and rehabilitation. Factories will remain standing; cities will still be alive.
- They are less injurious. Properly employed, these agents are likely to cause far less loss of life, less maiming or crippling, and less permanent aftereffects than has been true of high explosives used in past conflicts.
- They are simpler weapons system. Agents of this type are easily stored, loaded into munitions, and delivered on target. They may be projected from generators upwind of the enemy as an aerosol; they may be introduced clandestinely into his food and water supplies; or they may be injected by one well-placed agent into the ventilating systems of large headquarters.
- They are difficult to detect. Most agents of this type are colorless, odorless, tasteless, and produce no immediate recognizable physiological symptoms. Sprays can be made to resemble obscuring smoke; artillery shells can be designed that display the same burst characteristics as HE rounds.

Effective personal protective measures can be adopted with incapacitating agents as with other chemicals—the protective mask, protective clothing, highly sensitive alarms, or detectors.

Toxins

Toxins are poisonous products of animal or vegetable cells. When injected into animals or people, they cause the formation of antibodies called antitoxins. The most important toxins are those produced by bacteria, the most potent of which is botulin. Botulin is hundreds of times more poisonous than phosgene, mustard gas, or cyanide, and it is several times more toxic than rattlesnake or cobra venom. Toxins can be used in two ways—they can be produced outside the body and introduced into food, water, or wounds, or the organisms producing them can be used as agents. In peacetime, control is exercised over diseases of this group by strict sanitary measures and thorough medical inspection of all foods prescribed by the Food and Drug Administration.

Incendiaries

Incendiary weapons, unlike other chemical agents, are concerned primarily with material damage, rather than with inflicting casualties. Incendiaries have been used against personnel. However, their greatest application is in the destruction of industrial installations, housing, ammunition, fuel dumps, and so on. Modern military incendiaries may be divided into three categories—oil, metal, and a combination of oil and metal. They may also be divided into spontaneously flammable materials, such as

Table 9-1. Chemical Agent Detection Capabilities

IDENTIFIER SYMBOLS	TYPE AGENTS	CHEMICAL AGENT NAME	*M8 PAPER	*M9 PAPER	M256	** M18A2	CWDD	CAPD
GA	Nerve	Tabun		X	X	X	X	X
GB	Nerve	Sarin	X	X	X	X	X	X
GD	Nerve	Soman	X	X	X	X	X	X
VX	Nerve	Unknown	X	X	X	X	X	X
AC	Blood	Hydrogen cyanide		X	X	X		
CK	Blood	Cyanogen chloride			X	X		
CX	Blister	Phosgene oxime		X	X	X		
ED	Blister	Ethyldichloroarsine		X	X			
HD	Blister	Distilled mustard	X	X	X			
HL	Blister	Mustard-lewisite mixture	X	X	X			
HN1	Blister	Nitrogen mustard	X	X	X			
HN2	Blister	Nitrogen mustard	X	X	X			
HN3	Blister	Nitrogen mustard	X	X	X			
HT	Blister	Mustard Mixture	X	X	X			
L	Blister	Lewisite	X	X				
MD	Blister	Methyldichloroarsine		X	X			
PD	Blister	Phenyldichloroarsine		X	X			
T2	Nerve							
HT-2	Blood/Blister	Trichothescenes			X			
CG	Choking	Phosgene			X	X		

*Will detect all agents in liquid form only.
**For EOD—May be aboard ship.

phosphorous, and those agents requiring ignition, such as magnesium.

DETECTION OF CHEMICAL AGENTS

Various devices are available to detect and identify chemical agents. Table 9-1 provides a list of chemical agents and identifies which chemical detection device can detect each of the agents. Most of the devices indicate the presence of chemical agents by color changes that are chemically produced.

Some of the detection devices used by the Navy are as follows:

- M-8 Chemical Agent Detection Paper
- M-9 Chemical Agent Detection Paper
- M256A1 Chemical Agent Detector Kit
- Chemical Warfare Directional Detector (CWDD) AN/KAS-1
- Chemical Agent Point Detector System (CAPDS)

M-8 Paper

The M-8 chemical agent detection paper (fig. 9-3) is issued in a book of 25 split sheets (50 separate responses). It is chemically treated, dye impregnated, and perforated for easy removal. This paper detects the presence of liquid V agents, G agents (nerve), and H agents (blister/mustard). When the M-8 paper is brought in contact with the suspected chemical agent, the chemicals in the paper react with the agent to produce specific color changes. The sheet of paper is then matched to the color comparison chart printed on the inside front cover of the M-8 book. Liquid droplets as small as 125-200 microns will produce a color change that is detectable by the naked eye. Response time is approximately 20 seconds.

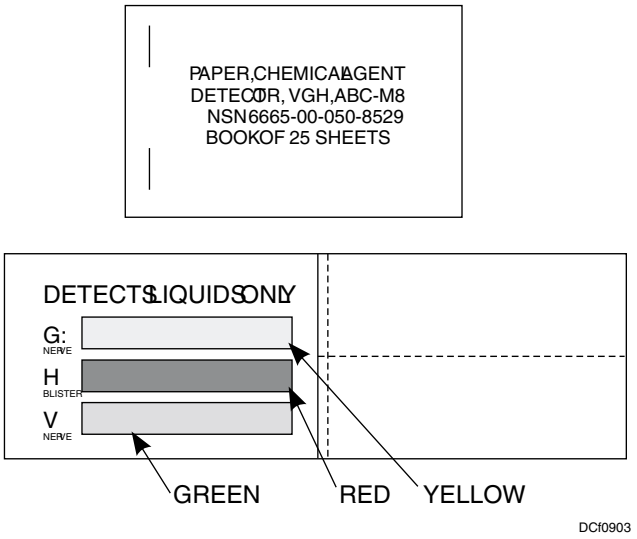


Figure 9-3. M-8 detector paper.

NOTE

Certain agents give a red-brown color response, which is inter- mediate between the typical H and the typical G colors.

The steps of the procedure for using M-8 paper is as follows:

1. Detach a sheet of detector paper from the book and attach it to your clothing, or place it on a surface so that it can be exposed to drops or liquid splash of chemical agents. Use masking tape or any other available means to secure the paper in place.

2. If colored spots appear, put on your protective mask. Be prepared to take proper medical action if symptoms appear.

3. Compare the colored spots with the colors on the inside cover of the detector paper book to determine what type of agent is present.

4. The paper may also be used to detect liquid contamination by placing the paper in contact with the suspect surface. A color change similar to that shown on the inside cover indicates the presence of chemical agents. This paper will NOT detect gases or vapors.

M-9 Paper

The new M-9 (fig. 9-4) detector paper detects nerve agents (G and V) and blister agents (H and L) in the liquid state. The paper is sensitive to droplets as small as 100 microns and responds in approximately 10 seconds or less. The response time increases at temperatures below freezing. High temperatures of 160°F or above may cause a red color to appear, thus producing a false reading. The use of the M-9 detector paper is limited to agents in the liquid state; it will not detect chemical agent vapors. The M-9 detector paper has no agent specificity; the red color appears for all detectable agents.

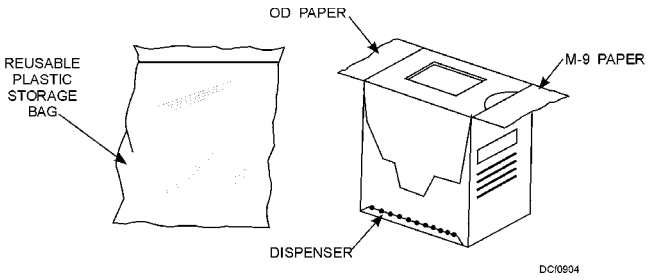


Figure 9-4. M-9 detector paper and storage bag.

The M-9 liquid-agent detector paper is issued by the roll and is 30 feet long and 2 inches wide. It has a Mylar film backing that has adhesive and release paper on the reverse side. The roll comes in a cardboard dispenser that has a serrated metal edge for cutting. A moistureproof, resealable bag is provided for storing the dispenser after it is removed from its original shipping package.

When you open the shipping package, remove the dispenser and the plastic storage bag. Save the plastic storage bag and discard the shipping package. Immediately write or stamp the current date on the

dispenser. This date will be the base line to determine the useful life of the M-9 detector paper. Remove the cutter edge protector and throw the protector away.

The steps of the procedure for removing M-9 detector paper from the dispenser are as follows:

1. Start the olive drab (OD) paper strip through the slot by applying a little finger pressure with the thumb or finger.

2. Hold the detector paper strip between the forefinger and thumb of one hand and the OD paper strip between the forefinger and thumb of the other hand. Pull enough of the detector paper out through the slots for the intended use. Be sure to pull the detector paper strip and the OD paper strip at the same time.

3. After you pull both of the paper strips through the slots, cut the detector paper half way by pulling the strip down on the cutting edge.

4. Lift the detector paper strip up off the cutting edge, and then pull both of the strips out a little further, about 1 inch.

5. Tear through the remaining half of the detector paper strip.

6. Tear off the OD paper strip, but leave enough paper sticking out to be ready for your next use.

Attach detector paper to equipment and bulkheads at locations where it can be seen easily. Wrap the detector paper around some part of the equipment where it will not get stepped on. To help make it easier to remove the detector paper, fold 1 inch of the paper back over (adhesive side to adhesive side) to form a tab. Remember to keep the paper away from hot surfaces and direct sunlight. Heat may cause the detector paper to turn red and cause false readings.

To attach the detector paper to flat surfaces, you first place the paper on the surface. Then, cover the detector paper with the OD paper strip and press the detector paper into date. Be sure to make a tab, as mentioned above, to help make it easy to remove the detector paper when required.

To check the surface of an area for liquid chemical agent contamination, take a piece of the detector paper and blot the surface around the suspected contaminated area. Do not rub or scrape the detector paper across rough surfaces. Scuff marks will cause false readings. If spots on the paper appear pink, red, red-brown, red-purple, or any shade of red, take protective actions and assume that you have been exposed to a liquid chemical agent.

Do not check the detector paper under a red light because you will not be able to see the red spots of the liquid chemical agent. Personnel who are color-blind should not check the detector paper for red spots. Blue, yellow, green, gray, or black spots are caused by humidity, not by liquid chemical agents.

Detector paper strips that show false positive readings need to be replaced with a fresh strip. False positive readings can be caused by the following factors:

- Temperatures above 125°F
- Scuffs
- Cleaning compounds
- DS-2 decontaminating agent
- Gasoline
- Grease
- Hydraulic fluid and brake fluid
- Insect repellent/spray
- Lubricating oil
- Ethylene glycol (pure antifreeze)

The M-9 detector paper will work in rain, snow, and sleet. However, the reaction to agents is slower when the detector paper is soaked. When the surfaces are wet, attach the detector paper tighter than usual to prevent it from slipping. Also, temperatures around 32°F reduce the speed in which the paper will turn red and it may take the paper several minutes to show a color change.

When the dispenser is not in use, place it in the plastic storage bag to prevent contamination of the detector paper. Squeeze out the air before sealing the plastic storage bag. If the discard date or the useful life date has passed, replace the detector paper with a new, unopened roll.

M256A1 Chemical Agent Detector Kit

The M256A1 chemical agent detector (fig. 9-5) is a portable, expendable item that consists of a carrying case with straps, 12 sampler-detectors, one book of M-8 paper, and a set of operational instruction cards. You will use the sampler-detectors to test for chemical agents in the vapor form. The M-8 paper is used to check for chemical agents in the liquid form.

The 12 sampler-detectors are individually wrapped. Each sampler-detector consists of eight glass ampoules (each filled with chemical reagent),

three test spots, a chemical heater, protective strips, and tabs. Each sampler-detector has instructions for its use printed on the outside of its protective bag. Formed channels in the plastic sheets direct the flow of the reagents from the finger-crushable ampoules to wet the test spots at the time of testing. SAFE/DANGER observations are printed on each sampler-detector. They show the approximate color that each spot develops if the agent is present and if it is absent.

The square test spot is used with the blister reagent ampoules and the chemical heater to detect mustards (H and HD) and phosgene oxime (CX). The lewisite detecting tablet and the lewisite tablet-rubbing tab are used to detect lewisite (L). A pull-tab covers the lewisite detecting tablet.

The circular test spot is used with the blood reagent ampoules to detect hydrogen cyanide (AC) and cyanogen chloride (CK).

The star-shaped test spot is used with the nerve reagent ampoules to detect nerve agents (V and G).

The hinged protective strip, used in the closed position, protects the blood and nerve agent test spots. The colored beads in the ampoules have no operational function. They are installed during manufacture of the sampler-detector as an aid in identifying the sampler ampoules.

One book of M-8 chemical agent detector paper is also included in the M256A1 kit. Use the M-8 paper as discussed earlier in the chemical agent detection paper section of this chapter. One set of operational instruction cards is attached to the case by a lanyard. These cards contain instructions on the use of the M256A1kit.

The M256A1 kit is a portable means for CBR monitoring teams to detect concentrations of nerve, blister, or blood agents to differentiate between classes

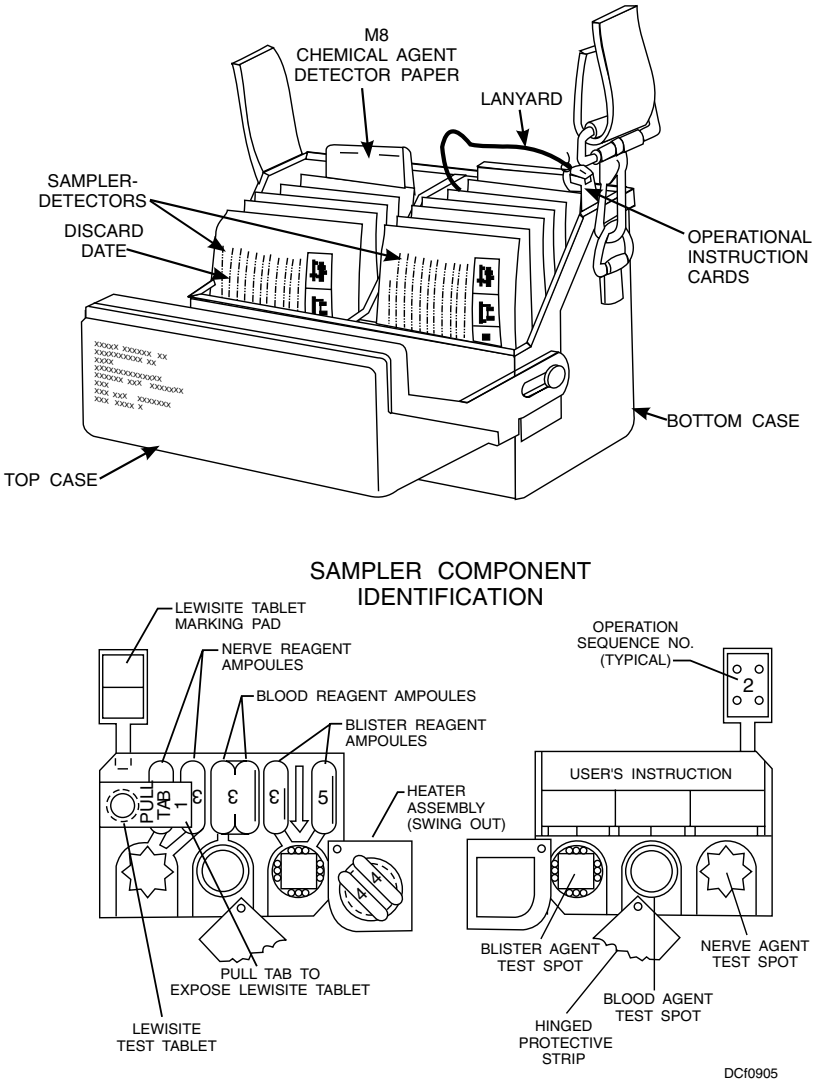


Figure 9-5. M256A1 chemical agent detector kit.

of agents and to help determine when it is safe to remove CBR protective masks and clothing.

When using the M256A1 kit to detect vapors in the air, you should use the following procedures:

1. Remove the three operational instruction cards from the kit. Read these instructions before proceeding.

2. Remove a sampler-detector from the kit. Check to ensure that it has not exceeded its discard expiration date. Do not use an outdated sampler-detector because it will not give you a reliable test indication.

3. Read the instructions on both sides of the protective bag before proceeding.

4. Open the sampler-detector bag by tearing the bag along the tear line that is marked with arrows. Hold the sampler-detector on the windward side from you to keep from picking up vapors from your protective equipment. Do not allow excessive moisture, such as rain and dew, to come in contact with the sampler-detector.

5. Carefully remove the sampler-detector from its protective bag. Save the protective bag to refer to the instructions that are printed on it. Do not touch the sampler-detector agent test spots because incorrect test results may be produced.

6. Handle the sampler-detector carefully. Hold it by the hinged protective strip in the closed position. Keep the protective strip in the closed position to protect the test spots.

7. Swing the hinged heater assembly away from the test spot and discard the two loose protective strips under the hinged heater assembly.

8. Pull off and discard the pull tab (marked 1) to expose the lewisite detecting tablet.

9. Rub the top half of the white paper side of the lewisite tablet-rubbing tab (marked 2) on the lewisite detecting tablet. Repeat the rubbing until a mark is visible.

10. Hold the sampler-detector in the vertical position so that the ampoules are down.

11. Crush the four reagent ampoules in the three center pockets (marked 3) with your finger.

12. Rotate the sampler-detector until the test spots are in a down position. Force the liquid from the four ampoules through the formed channels to the test spots to ensure wetting.

13. Check to ensure that the hinged protective strip is over the test spots. Hold the sampler-detector horizontal with the left thumb over the center test spot.

14. Make sure that the hinged heater assembly is away from the test spot. The heater produces hot vapors and is hot to the touch. Keep the sampler-detector away from your face and bare skin once the ampoules have been broken.

15. Crush one of the two green ampoules (marked 4) with your finger. Immediately swing the hinged heater assembly over the test spot. Vent the vapor away from your body. Leave the hinged heater assembly in place for 2 minutes.

16. Swing the hinged heater assembly and the hinged protective strip away from the test spot after the 2 minutes have passed.

17. Hold the sampler-detector by the hinged protective strip.

18. Expose the test spots to the air for 10 minutes while shielding the sampler-detector from direct sunlight.

19. Crush the second green ampoule (marked 4) with your finger. Swing the hinged heater assembly over the test spot, and vent the vapor away from you. Leave the hinged heater assembly in place for 1 minute.

20. Swing the hinged heater assembly away from the test spot after 1 minute has passed.

21. Hold the sampler-detector vertically with the test spots down.

22. Crush the remaining ampoules (marked 5) with your finger. Force the liquid from the two ampoules through the formed channels to the test spots to ensure wetting.

23. Rerub the lewisite-detecting tablet with the lewisite tablet rubbing tab. Make sure that the second rub mark is next to the first rub mark.

24. Immediately turn the sampler-detector over to determine whether safe or danger conditions exist. Observe the lewisite tablet rubbing tab for a difference in color between the two rub marks. Also, you can use the operational instruction cards to make a color comparison.

You can compare the blood agent and the lewisite tests immediately after the prescribed exposure time. The blister agents (H and CX) develop color immediately after all of the ampoules are broken. The nerve agent test requires a waiting period of 2 minutes.

Disregard the small blue areas under the plastic rim of the nerve agent spot. The blue coloring is caused by the humidity. The nerve spot may become difficult to wet with the solutions as the kit ages. You have to work the solutions to the spot carefully. At low concentrations, a change in the lewisite tablet rub mark may be very slight. Compare the first rub mark with the second rub mark before making a judgment. Yellow and orange colors sometimes occur on the blood test spot when no agent is present. A pink or blue color must be present for the test to be positive.

If the suspected surface contamination is in the form of a liquid, use the M-8 paper as discussed earlier. Keep the M256A1 kit stored in a cool, dry area when not in use. Be sure that the case is kept closed. Inspect the M256A1 kit completely before using to make sure you have all of the equipment needed. If any of the components are missing or the blood agent test spot is pinkish, do not use the sampler-detector.

AN/KAS-1 Chemical Warfare Directional Detector (CWDD)

The AN/KAS-1 chemical warfare directional detector (CWDD) system (fig. 9-6) is a passive, infrared imaging sensor. Its primary function is to provide U.S. Navy ships with the capability to detect and identify a chemical warfare (CW) agent attack. The AN/KAS-1 can be used to detect and identify nerve agent attacks against sister ships in a task force, against waves of amphibious assault ships and boats proceeding ashore, or against assault forces in the vicinity of the landing area. Chemical warfare agent cloud detection and identification can be accomplished against a sky background for all conditions under which CW attacks may be expected to occur. Detection of CW activity against a land background can be accomplished also, but less effectively.

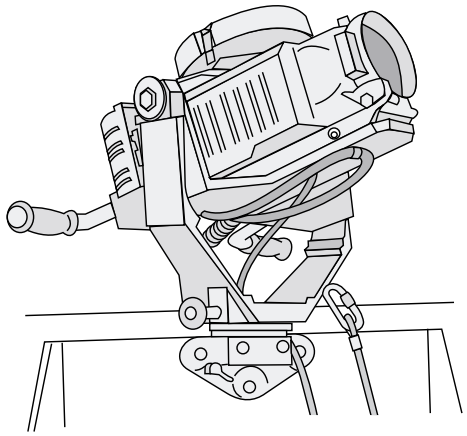


Figure 9-6. Chemical warfare directional detector (CWDD), AN/KAS-1.

The AN/KAS-1 infrared sensor gives the equipment a secondary function of low-visibility/night pilotage and area surveillance. The operator of the AN/KAS-1 can detect and provide relative bearing to prominent land features, such as lighthouses and water towers. In the future, the AN/KAS-1 may be approved for the detection of buoys and personnel on the surface of the water. The AN/KAS-1 is a shipboard mounted, portable unit. It consists of a sensor unit, a pivot mount, a power conversion unit (PCU), a carrying and stowage case, a maintenance kit, an overboard lanyard, and a foul weather cover.

The sensor unit is equipped with the following controls:

- A narrow field of view (NFOV).
- A range/focus knob.
- A brightness knob.
- A contrast knob.

A filter wheel switch. This switch allows you to rotate a wheel positioned in the optical chain of the unit through the following positions: filter 1, filter 2, filter 3, and filter out. This is referred to as interrogating. These filters are used to identify CW nerve agent clouds.

The pivot mount provides the mechanical interface between the sensor unit and the standard bracket and lock assembly. Handlebars are provided to assist you in positioning the sensor unit. The interconnecting cable provides electrical connection and power transfer from the PCU to the sensor unit through a coiled, double-shielded cable.

The power conversion unit provides operating energy to the sensor unit from the ship's 115-volt alternating current (vac) 60-Hertz (HZ) power supply. Press-to-test switches and lights are included to verify input and output voltages. The unit consists of an electronics tray contained in a watertight, protective housing.

The carrying and stowage case is provided for transportation and stowage of the AN/KAS-1 system. Space is also provided in this case for the stowage of the sensor unit, pivot mount, interconnecting cable, overboard lanyard, maintenance kit, and foul weather cover. The maintenance kit (stowed inside the carrying and stowage case) is provided with each system. The maintenance kit contains the following:

- Expendable nitrogen gas cartridges (six) to purge the sensor unit of moisture (30-day requirement)
- A purge kit regulator and connector assembly
- Lens wipers (cleaning pads)
- A lens cleaning solution
- Spare bulbs and lenses

The overboard lanyard is a vinyl-covered, stainless steel cable. It is used to secure the sensor and pivot mount unit to an eyelet on the PCU unit mounting plate before installation and/or removal. The overboard lanyard and associated safety procedures prevent accidental over-the-side loss or severe damage to the equipment, due to a fall to a lower deck, during installation or removal of the sensor unit.

The foul weather cover, or waterproof canvas, is used to protect the sensor and pivot mount when they are not in use. (Do not cover the sensor unit with the foul weather cover while the unit is in operation. The confined heat that is generated by the sensor unit cooler will harm the sensor unit.)

Use the following procedures to place the AN/KAS-1 in position for use.

1. Have two people carry the AN/KAS-1 stowage case to the mount site to be used.

2. Remove the free end of the overboard lanyard from the case and secure it to the eyelet in the PCU mount.

3. Have the people carefully remove the sensor unit from the case by grasping it by the yoke, and then lift and turn the pivot mount to line up with the locater pins in the bracket and lock assembly mount. Move the unit into place on the mount.

4. Secure the sensor unit to the mount by securing the lock mechanism on the bracket and lock assembly. Try to lift the sensor from the mount to ensure that it is locked in place.

5. Position the left and right handles by placing one hand on the sensor assembly for support. Pull out each handle, one at a time, and rotate each one into a horizontal position.

6. Notify the support maintenance signalman to purge the sensor unit according to the applicable MRC from the PMS.

7. Free the lens cover by releasing the two side latches. Remove the lens cover and secure it to the lens cover stowage mount on top of the sensor unit with the two side latches.

8. Verify that the PCU CB1 switch is off, and then connect the sensor unit power cable to the PCU connector.

After the AN/KAS-1 is set up, perform the AN/KAS-1 operator check procedure. Now the AN/KAS-1 system is ready to be aligned.

The steps of the procedure to set up the AN/KAS-1 for operation are as follows:

1. Remove the canvas foul weather cover.

2. Push the button flap on the cover into the cover. Roll the cover up and secure it with the drawstring. Ensure that the cover is secured by its strap to the mount eyebolt. This will prevent the equipment cover from being blown overboard.

3. Remove the lens guard cushion by releasing the two latches, one on each side. Secure the lens guard cushion to the top of the sensor unit using the same two latches.

4. Rotate the mount control handles 180° into the operational position.

5. Release the elevation stow pin and azimuth locks. Adjust the azimuth friction lock to the desired level of control.

6. Perform the AN/KAS-1 operator check procedure.

7. Check the sensor unit alignment with the alignment bench mark data engraved on the data plate. If necessary, perform the alignment procedure.

The AN/KAS-1 is now ready for operation.

To conduct the AN/KAS-1 operator check, turn on the PCU CB1 switch. The sensor unit cooler will operate. After about 3 minutes, the sensor will reach cool down and an IR scene should be visible in the eyepiece. If the IR scene is not visible or clear, the steps of the procedure to troubleshoot the problem are as follows:

1. Place the PCU S1 switch in the TEST position. If all lights come on but there is no IR scene visible in the eyepiece within 5 minutes, replace the sensor unit. If the DS3 fails to light up, the ship's power to the PCU is OFF. Check the ship's power. If the DS3 lights up but there is no image and either the DS1 or the DS2 fails to light up, replace the PCU. If some of the lights are out but the IR

scene is visible in the eyepiece, replace the defective lamp.

2. Adjust the BRT (brightness) and the CTRS (contrast) controls to obtain a good image. Remember this image, because on foggy or hazy days the image will not focus sharply. If you are in a low-visibility or heavy fog condition, use the narrow field of view and focus on a hot object within 50 feet of the sensor. If you are unable to obtain a good image, replace the sensor unit.

3. Using the narrow field of view, observe the hot object at 50 feet or more and adjust the image. Switch to the wide field of view and verify the focus. Always focus the AN/KAS-1 in the narrow field of view; this will focus the wide field of view also. If you are unable to focus the image, replace the sensor unit.

The steps of the procedure for identifying clouds with the AN/KAS-1 are as follows:

1. Use only the wide field of view so that the entire cloud can be seen.

2. Aim the sensor unit at the cloud and begin your interrogating (moving through the filters) immediately by depressing the filter switch.

3. Go through the interrogation several times, watching the changes as the cloud forms. If the cloud is a chemical nerve agent cloud, the changes will become even more apparent as you watch it through the filters.

4. Continue the interrogation for at least six cycles until confirmation can be established.

5. If the cloud dims and grows smaller when using filter No. 1 and grows larger when using the No. 2 and No. 3 filters, take immediate action to notify the bridge. Even if the suspected cloud is not a chemical agent, keep interrogating other suspicious looking clouds.

When conducting maintenance on the AN/KAS-1, follow the procedures listed in the manufacturer's technical manual and the PMS system.

Chemical Agent Point Detector System (CAPDS)

The chemical agent point detector system (CAPDS), shown in figure 9-7, is a local sampling detection device. It is used to detect the presence of chemical agents in the air. The system has an alarm that provides rapid warning. The CAPDS is capable of detecting nerve agents GB, CD, and VX in time to allow personnel to take protective countermeasures. The system provides a means of continuously sampling the outside air. It will automatically sound an alarm at the remote control unit and remote status unit. The CAPDS consists of a detector, two through-the-bulkhead units (TBU), a remote control unit, and a remote status unit. The detector consists of the alarm module and the power supply. The alarm

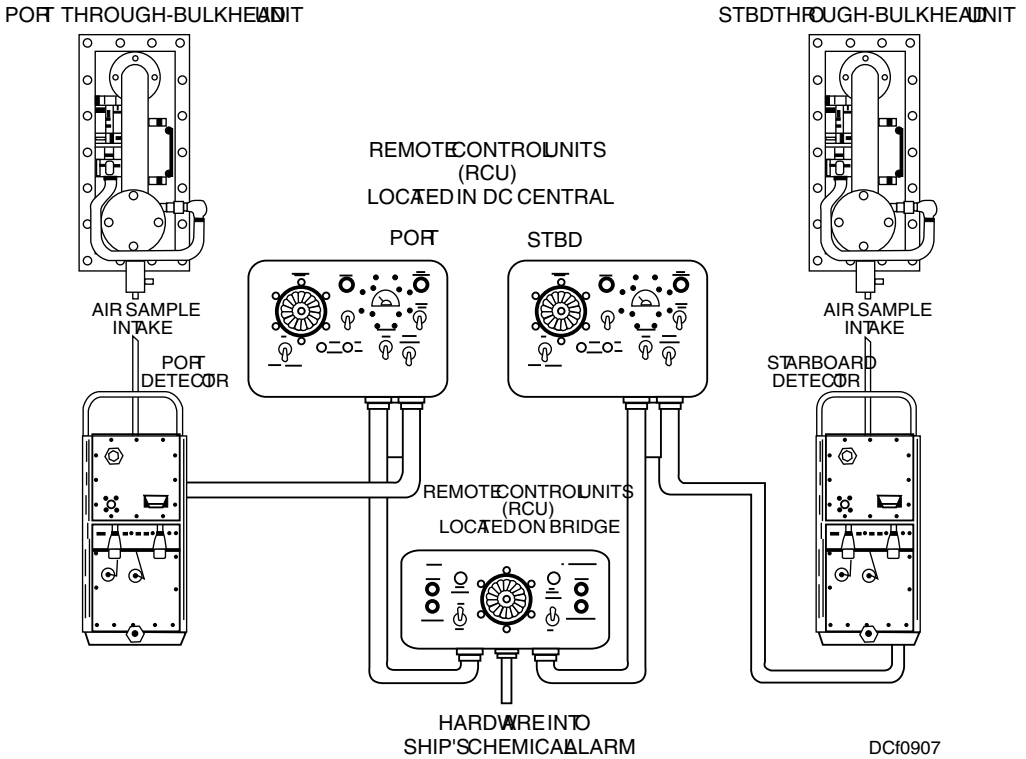


Figure 9-7. Chemical Agent Point Detector System (CAPDS).

module contains a pneumatic system, an ionization and detection system, and an alarm electrical system, which is necessary to perform the agent sampling operations. The pneumatic system is used to supply air samples from the TBU to the alarm module for chemical analysis. It will then remove the air sample once the sample has been analyzed as exhaust.

The ionization and detection system draws air samples into a heater block where it is heated to a temperature of approximately 140°F. The sample moves into a sensor cell for ionization. A sample containing chemical agents will increase the output of the sensor cell and trigger the alarm. The alarm electrical system provides the power to maintain airflow, heater temperature, and the other electrical systems involved.

The power supply provides the input power from the ship's electrical system. If the input power is lost, the power supply provides the power from an internal battery.

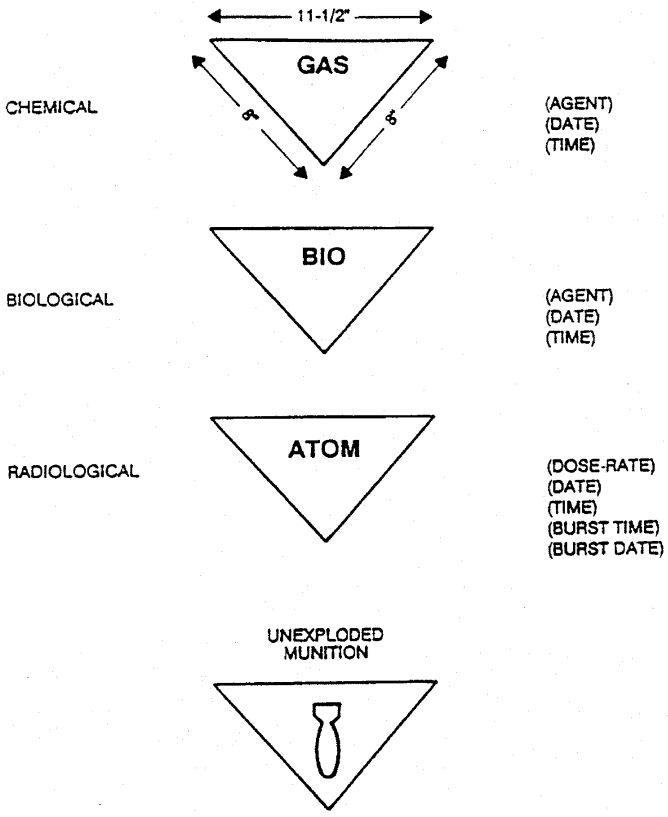
The through-the-bulkhead unit consists of an electronics and fan assembly. This assembly provides continuous air samples for the alarm module.

The remote control unit connects the remote status unit with the appropriate detector and the power supply. The remote status unit is mounted on the ship's bridge but has no control over the system. It merely reports the status of the system. However, it does have a manual override of the ship's alarm system.

Since the system is automatic, it requires no operation procedures once it is installed. To perform maintenance on the system, follow the guidelines listed in the planned maintenance system.

MONITORING OF CHEMICAL AGENT CONTAMINATION

In general, the purpose of chemical surveys is to detect, locate, and identify chemical agents in either liquid or vapor form. The contamination marking kit



Danger	Primary Color	Secondary Color	
		Markings	Inscriptions
Radiological Area	White	ATOM	Black
Biological Area	Blue	BIO	Red
Chemical Area	Yellow	GAS	Red
Unexploded Munitions	Red	White (bomb)	None

Table 9-2. Colors Used for Contamination Markings

provides markers that makes it easy to identify contaminated areas as well as isolating those areas. The markers are triangular in shape and their colors are listed in table 9-2.

The most important information required from chemical surveys makes it possible to determine the following:

- Was the ship exposed to blood agent? If so, the mask filter canisters on all protective masks must be changed.
- Is off-gassing from a persistent agent on the ship's weather surfaces occurring? If so, a higher protective posture may be required inside the ship.
- Has the ship departed a vapor hazard area and reached an uncontaminated atmosphere? If there is no secondary vapor hazard, purging can begin at this point according to the ship's CBR Bill.
- Have decontamination and purging efforts been successful?
- The correlation of survey results, ventilation status, and tactical information.

REVIEW QUESTIONS

Q5. There are a total of how many sheets of M-8 detector paper in an unopened booklet?

1. 15
2. 20
3. 25
4. 30

Q6. What color does M-9 paper turn when a nerve or blister agent is detected?

1. Gold
2. Green
3. Red
4. Blue

Q7. The M256A1 detector kit is used to test for what form of chemical agent?

1. Liquid
2. Vapor
3. Solid
4. Mist

Q8. What is the primary function of the AN/KAS-1?

1. To provide U.S. Navy ships with the capability to detect and identify a chemical warfare (CW) agent attack
2. To provide U.S. Navy ships with the capability to detect and identify a biological warfare (BW) agent attack
3. To provide U.S. Navy ships with the capability to detect and identify radiological contamination
4. To provide U.S. Navy ships with the capability to detect and identify toxin contamination

BIOLOGICAL OPERATIONS

Learning Objective: Recall the requirements for biological warfare (BW) defense and countermeasures.

Biological operations are the use of living agents, such as bacteria, viruses, and other pathogenic microorganisms, to produce disease or death of humans, animals, or plants.

Biological agents are a threat that must be recognized and prepared for by all personnel. A large part of the defense against biological agents depends upon self-protection against the agents.

TYPES OF BIOLOGICAL WARFARE (BW) AGENTS

Military biology is only concerned with organisms that will adversely affect man, animals, or plants. The organisms used as BW agents are classified into two groups, pathogens and toxins.

Pathogens

Pathogens are living microorganisms that include bacteria, viruses, rickettsiae, fungi, and protozoa. In addition to being spread as aerosols or by weapons, the methods used to spread pathogens are vectors and ptests. Vectors include insects, ticks and mites (also known as arachnids), and animals. Pest include animals and plants.

MICROORANISMS.—Microorganisms are minute living organisms, which can usually be seen only with the aid of a microscope. Each organism is composed of a single cell or a group of associated cells

capable of carrying on all functions of life, including growth and reproduction. Microorganisms do not have a digestive tract, organs of sight, or a heat-regulating system. Many of them resemble plant life and are regarded as being in the vegetable kingdom. Some microorganisms, such as the protozoa, have characteristics that place them in the animal kingdom.

Microorganisms are universally distributed in the air, water, and soil. Every cubic foot of topsoil provides a natural home for billions of soil organisms. The skin, hair, nose, mouth, and digestive tract of humans and other animals harbor a considerable variety of microbes in large numbers.

Microorganisms capable of producing disease are known as pathogens. Most of these pathogens are parasites and live on or within another living organism, called a host, which provides shelter and nourishment. Other microorganisms thrive on decaying or dead organic material and are known as saprophytes. Most microorganisms are nonpathogenic; that is, they do not cause disease. In fact, many of them are beneficial to both man and plant life. Certain microorganisms are responsible for producing many antibiotics, such as penicillin and streptomycin. Others are important in the production of alcoholic beverages, manufacture of vinegar, leather making, and curing cheese and tobacco, as well as in the preparation of industrial solvents.

On the basis of structural and behavioral characteristics, microorganisms are divided into five distinct classifications of biological warfare agents as follows:

1. Bacteria
2. Rickettsiae
3. Viruses
4. Fungi
5. Protozoa

A brief discussion of the characteristics of each of these microorganisms and their potential threat to personnel follows.

1. Bacteria are very small single-cell organisms. However, they are large enough to be visible through an ordinary microscope. Bacteria may be spherical, rod-shaped, or spiral in form. They are present everywhere in nature, in air, soil, water, and animal and plant bodies, both living and dead.

Many types of bacteria can cause infection, and the powerful toxins produced by some can be used as biological warfare agents. Examples of diseases caused by bacteria are typhoid fever, meningitis, and tuberculosis.

2. Rickettsiae are usually smaller than bacteria, but they are still visible through an ordinary microscope. They grow only within living cells, and they are potent disease producers in man and animals. Many of them are transmitted by insect bites. Examples of diseases caused by rickettsiae are Rocky Mountain spotted fever and typhus.

3. Viruses are even smaller than rickettsiae and are not visible with the ordinary microscope. Some have been photographed through the electron microscope. Like the rickettsiae, they will grow only within the living cell. Viruses and rickettsiae are probably less well distributed than bacteria because they are more particular in their growth environments. However, it is known that both can survive for short periods of time in the air. Examples of virus diseases are mumps, smallpox, psittacosis (parrot fever), and influenza.

4. Fungi include such plants as yeasts, molds, and mildews. These organisms are known for their ability to spoil foods and fabrics.

Generally speaking, diseases caused by fungi in humans are less severe than those produced by other microorganisms. They usually produce low-grade, mild, and often chronic diseases. A few fungi are capable of producing serious diseases, such as blastomycosis (a chronic infection affecting the skin or the lungs, bones, liver, spleen, and kidneys). Several diseases of plants are caused by fungi. Examples are potato blight, cotton root rot, corn smut, and wheat rust. If an attack is made on food crops, the agents used might be in this class.

5. Protozoa are single-celled, animal-like forms that occur in a variety of shapes and often have complicated life cycles. Some protozoa cause diseases in both man and animals. Problems of production and transmission limit their application in biological warfare, but it must not be assumed that these problems could not be solved. Examples of protozoa infections of man are amoebic dysentery and malaria.

VECTORS OF DISEASE.—Disease vectors are animal carriers that transfer infective agents from one host to another. They usually are arthropods (insects, arachnids, and crustaceans) but may be other animals. Disease vectors are classified into two types as follows:

1. Biological vectors. These are animals in whose bodies the infecting organism develops or multiplies before it can infect the recipient animal.

2. Mechanical vectors. These are animals that transmit infective organisms from one host to another but, in themselves, are not essential to the life cycle of the parasite.

Mosquitoes that transmit malaria and yellow fever are biological vectors. The black horsefly, which transmits anthrax, and many insects that transmit plant diseases are mechanical vectors. Higher animals, and man himself, sometimes act as vectors. Swine are host to trichine, which produces trichinosis in man when he eats inadequately cooked, infected pork. Dogs, cats, skunks, foxes, and some other animals transmit rabies.

PESTS.—The meaning of the term *pest* as used here is restricted to certain animals (excluding microorganisms) that interfere with the health of other organisms. These pests live on or within the animals, or they are associated with them in other injurious ways. Pests are known as parasites when they obtain their food from living host cells. The presence of a large number of parasites on the surface of the body of the host, producing only mechanical effects, is known as *infestation*. Invasion of the tissues of the body of the host by parasites, producing injury followed by host reaction, is known as *infection*. Living organisms that consume or destroy food, clothing, and forest products also are characterized as pests.

Although many insects are beneficial to agriculture, great losses are caused by plant-feeding insects and by insect-borne plant diseases. Other serious losses result from the destruction of stored food, clothing, and forest products by such pests as rats and moths. Some pests affecting the animal kingdom are mites, ticks, spiders, scorpions, chiggers, lice, bedbugs, and flies. Some pests affecting plants are the Japanese beetle, snails, corn earworm, boll weevil, and the elm leaf beetle. Other pests that take a toll on man's products and have potential value as BW agents are rats, mice, groundhogs, starlings, and crows.

Toxins

Toxins are poisonous products of living organisms that when inhaled or swallowed or injected into a man or animal will cause illness or death. Some toxins used as BW agents are produced synthetically. Because they have similar characateristics, toxins are disseminated in the same manner as chemical agents.

NOTE

For detail information on pathogens and toxins, you should refer to *NSTM*, chapter 470. "Shipboard BW/CW Defense and Countermeasures."

EFFECTS OF BW AGENTS

BW agents may be selected to produce various strategic or tactical goals. These goals range from brief but crippling diseases to widespread serious illnesses with many deaths. The effects of biological agents vary widely, depending upon the agent or agents selected.

The mere presence of a disease-producing organism on or in the body of a host does not guarantee infection or illness. In fact, pathogenic organisms are frequently present and cause no harm in the human body for long periods of time. The factors that determine whether infection will result from contact between a pathogen and a host are not completely understood; however, some important factors are as follows:

- The general state of health of the individual
- The immunity of the particular individual to the particular organism
- The number of organisms to which the individual is exposed
- The ability of the organisms to cause disease

Remember that the effects of pathogens are always delayed. There is always an incubation period between the time organisms enter the body and the time that symptoms of disease are observed. This period may vary from several hours to several weeks.

To some extent, the effects of pathogens are determined by the route that the infecting organisms use to enter the body. Many organisms require a specific portal of entry to produce infection or disease. Other organisms can cause disease when they enter by any route. The usual ways in which pathogenic organisms enter the body are by inhalation, by swallowing, by direct contact, and by injection. Injection includes insect and animal bites.

DISSEMINATION OF BW AGENTS

BW agents may be spread in various ways. They may be used as fillings in bombs, shells, or aerial or surface spray tanks. Biological agents may be released from munitions such as aerosols. The aerosols are cloudlike formations of solid or liquid particles in which the biological agents are held suspended.

DETECTION OF BW AGENTS

There are no simple and rapid methods to detect BW agents such as those used to detect chemical agents and nuclear radiation. The positive detection and identification of a pathogen can be obtained only by taking samples of the organisms, growing a culture of the organisms under laboratory conditions, and then subjecting the culture to a variety of biochemical and biological tests.

Establishing definitively that a biological attack has occurred is difficult. It is normal for a small percentage of the crew to be ill due to the effects of naturally occurring pathogens. Occasionally, there are outbreaks of illness that affect a larger percentage; however, this could also be due to natural causes. Some developments that could indicate that a biological warfare agent is responsible are as follows:

- The number of casualties reaches epidemic proportions within hours to 3 days, most within a 24-hour period.
- The infection rate or death rate is higher than normally expected for the disease.
- An outbreak of a disease occurs that is not normally encountered in the area of the world in which the ship is operating.
- Personnel working in a protected environment do not contract the disease.
- Outbreak of multiple diseases occurs. To confirm that a biological attack was responsible, samples collected by a biological detection system, environmental samples collected by repair parties, or biomedical samples collected by medical personnel are crucial.

REVIEW QUESTIONS

Q9. Which of the following life forms is an example of a disease vector?

1. Bacteria
2. Fungi
3. Virus
4. Arachnid

Q10. There is always an incubation period between the time an organism enters a body and the first signs of the symptoms of an illness.

1. True
2. False

Q11. An indication of biological warfare is when the number of casualties reaches epidemic proportions within days, with most occurring within the first 24 hours.

1. True
2. False

COUNTERMEASURES AT SEA

Learning Objective: Recall chemical and biological (CB) warfare countermeasures employed when a ship is at sea to include closure, washdown, weathering, and decontamination of personnel.

The basic purpose of CB countermeasures at sea is to deny entry or neutralize contamination so the mission of the ship can be carried out without endangering the life or health of assigned personnel. The three kinds of ship protective action used when at sea are closure, washdown, and weathering.

CLOSURE SYSTEM

The closure system protects the interior of the ship against the entry of aerosols and gases. Quick action on closure is essential. It is not possible to predict the results if the ship is closed after exposure because personnel below decks may be in even greater danger from agents trapped inside as a result of closure.

COUNTERMEASURES WASHDOWN (CMWD) SYSTEM

The CMWD system is a dry-pipe sprinkler system that provides a moving screen of seawater over the weather surfaces of the ship. The flowing water carries away most of the liquid and solid contaminants that fall on the decks or bulkheads.

Use of the CMWD system is a form of active decontamination by physical removal. It is the best active decontamination option in the three respects. They are as follows:

1. It requires the least expenditure of manpower to operate.

2. It can be activated easily and quickly and it covers all, or nearly all, of the ship's weather surfaces at once, allowing liquid agent the least time to sorb into paint or nonskid.

3. It is highly effective in physical removal of contamination. It is most effective when used for prewetting before the arrival of the agent and then left on during and after agent deposition. However, it is still an effective decontamination system, even when it is not activated until after the agent has been deposited.

Periodic testing and inspection according to the planned maintenance system is necessary to ensure that the countermeasures washdown system is ready for use if needed.

WEATHERING

Weathering is the gradual reduction of a persistent hazard due to the effects of the environment. It is passive decontamination, requiring no expenditure of manpower or material. Evaporation is the primary mechanism for natural decay of a chemical hazard. It may occur as the liquid chemical agent is lying on a surface or as it desorbs from some material into which it was previously sorbed. Desorption proceeds quickly at first, then the rate slows considerably. It is important to remember that the agent vapor that results from weathering is harmful if its concentration is high enough.

Weathering is normally a part of any decontamination operation because active methods cannot reach all the agents that are deposited on the ship. The longer a liquid chemical agent is allowed to soak into alkyd paint or nonskid deck coating, the less effective are physical removal and chemical neutralization. However, as coatings age, the less they tend to absorb agents. This factor extends the time during which active decontamination measures can be effective. It may also increase the speed of weathering.

WARNING

If weathering is the decon- tamination option chosen, topside evolutions must be delayed until the hazard has decayed to a safe level or all personnel going topside must wear individual protective equipment.

In any active decontamination operation, personnel working in proximity should wear protective clothing and masks until the damage control assistant has declared the area safe.

Physical removal methods involving the use of water without oxidizers may dilute the concentration of agent but do not change their toxic properties. Therefore, care must be taken to ensure that spray, runoff, and disposal methods do not simply move contamination to other parts of the ship.

DECONTAMINATION OF PERSONNEL

Personnel decontamination procedures are designed to minimize the hazards to contaminated individuals and to prevent the spread of contaminants inside the ship. Decontamination procedures include individual and group efforts.

M291 Skin Decontamination Kit (SDK)

The M291 Skin Decontamination Kit (SDK), shown in figure fig. 9-8, provides each individual with a process for decontamination. The M291 is used to decontaminate liquid chemical agents from exposed skin areas by physical removal, absorption, and neutralization. Each kit consists of a wallet-like carrying pouch containing six sealed foil packets, enough for three complete skin applications. Each packet contains a folded applicator pad with a handle on one side. The pad is filled with the black decontaminating powder, a reactive and absorbent resin that is not toxic but may be slightly irritating to the skin or eyes. The M291 is small and rugged enough for the individual to carry in a pocket on the chemical protective overgarment (CPO) or the advanced chemical protective overgarment (ACPG) or in the carrier for the MCU-2/P series mask.

Contamination Control Area (CCA)

All personnel exposed to the weather during or after a chemical attack shall be considered contaminated and shall reenter the ship through a decontamination station or contamination control area (CCA). The basic procedures are generally the same for all ships. Variations are due to differences in the design and location of the decontamination stations. The basic decontamination process for personnel reentering the ship in a chemical hazard environment consists of five stages that are common to all ships. These stages are as follows:

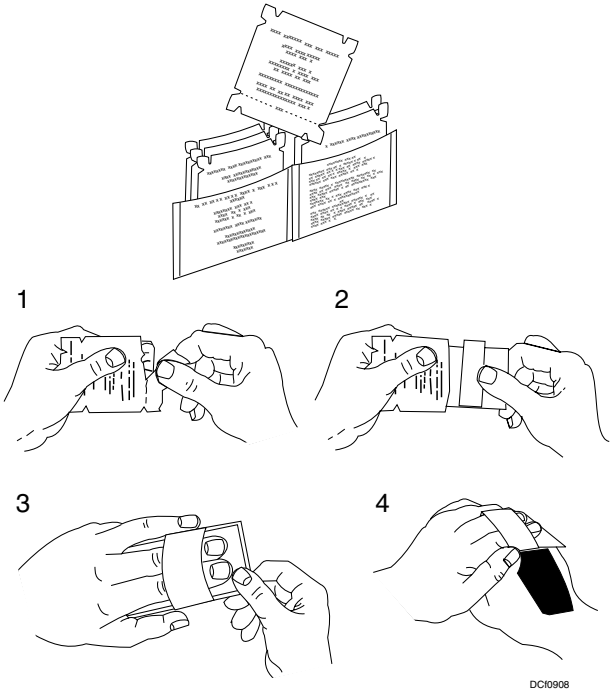


Figure 9-8. Use of the M291 Skin Decontamination Kit (SDK).

Stage 1. Gross decontamination of masks, boots, and gloves before reentering the ship. Gross decontamination is performed outside the entrance to the CCA or the Chemical Protective Systems decontamination station to reduce the danger of spreading liquid contamination into the ship.

Stage 2. Removal of outer garments and equipment subjected to liquid contamination. The chemical protective overgarment shall be cut off the person being decontaminated (doffee). This step is performed as close to the point of entry into the interior of the ship as possible.

Stage 3. Removal of inner clothing.

Stage 4. Showering.

Stage 5. Medical review. A medical department representative screens all doffees for symptoms of agent exposure and other medical problems such as heat stress.

Conventional Decontamination (Decon) Station

Specific sanitary spaces are designated in ships' plans as decontamination stations. Normally, a ship that does not have a CPS will have at least two conventional decon stations, one forward and one aft. Smaller ships may have only one. Large ships may have two additional stations amidships, one port and one starboard. Conventional decontamination stations generally have saltwater nozzles in the shower stalls in addition to freshwater nozzles. Large ships may have additional saltwater decontamination stations. Multiple decon stations and the availability of both salt and fresh water provide for working around contaminated areas and battle-damaged areas. It is desirable to have two accesses to each decon station to permit designation of one as the entrance, or dirty side, and one as the exit, or clean side. In a typical head or washroom, the entrance should be in the sink area and the exit in the shower area. Where variations from this arrangement are necessary, tape will be used to mark traffic lanes to separate the clean and dirty areas.

It is essential to ensure decon stations are properly outfitted with proper items and inspections are performed routinely. The outfitting requirements for chemical decontamination of 100 individuals are listed in table 9-3.

The contamination control area (CCA) shown in figure 9-9 is either a liquid chemical hazard area or a biological infectious hazard area. This area provides a place for removal of contaminated individual protective equipment or outer garments and preparation of personnel for processing through a conventional decontamination station. Removal of items in the CCA prevents liquid chemical contamination and infectious biological hazards from reaching the rest of the ship's interior.

The CCA should have access directly from the weather deck and have a separate exit into the interior

Table 9-3. Outfitting for Chemical Decontamination of 100 Individuals

Item	Stock Number (NSN)	Unit of Issue	Conv. Station	CCA	CPS Station
Calcium Hypochlorite	6810–00–255–0471	6 oz.		48	48
Metal Trash Cans 35 gal		each	1	4	2
Plastic Bags 55 gal	8105–01–183–9764	100		25 bags	25 bags
2'x 2' X 6" Bootwash tray				1	1
Utility Pails (5 gal)	7240–01–094–4305	each		2	2
Pan, Steam Table (scissors)	7310–00–576–4614	each		1	
Sponge, Cellular	7920–00–240–2555	each		3	3
Scissors, Bandage	6515–00–935–7138	dozen	2 ea.	10 ea.	12 ea.
Deck Brush, Scrub	7920–00–240–7171	each		3	3
Handle, Deck Brush	7920–00–141–5452	each		3	3
Boot Wash Brush	7920–00–255–7536	each		2	2
Gen. Purpose Detergent or Detergent Wetting Agent	7930–00–282–9699	gal		1	1
	6850–00–644–2008	50 lb		1	1
Measuring Cup (8oz)	7240–00–138–7983	each		1	1
M291 Kit	4230–01–276–1905	box		1	1
M8 Paper Booklets	6665–00–050–8529	each		4	4
M256A1 Kit	6665–01–016–8399	each	2		2
Bench or Stool				1	1
Twine 1 lb. Ball	4020–00–231–5870	each			
Tape, Press. Sensitive, Orange or Duct Tape, 2"	9390–00–656–1186 5640–00–103–2254	each each		1 1	
Bags, Plastic 10 gal	8105–01–183–9765		100		100
Towels		each	100		100
Soap, bars			10		10
Hose Assembly, 3/4" ID	4720–00–230–6577	each			1
Nozzle, Hose Adjustable, 3/4"	4730–00–223–6731	each			1

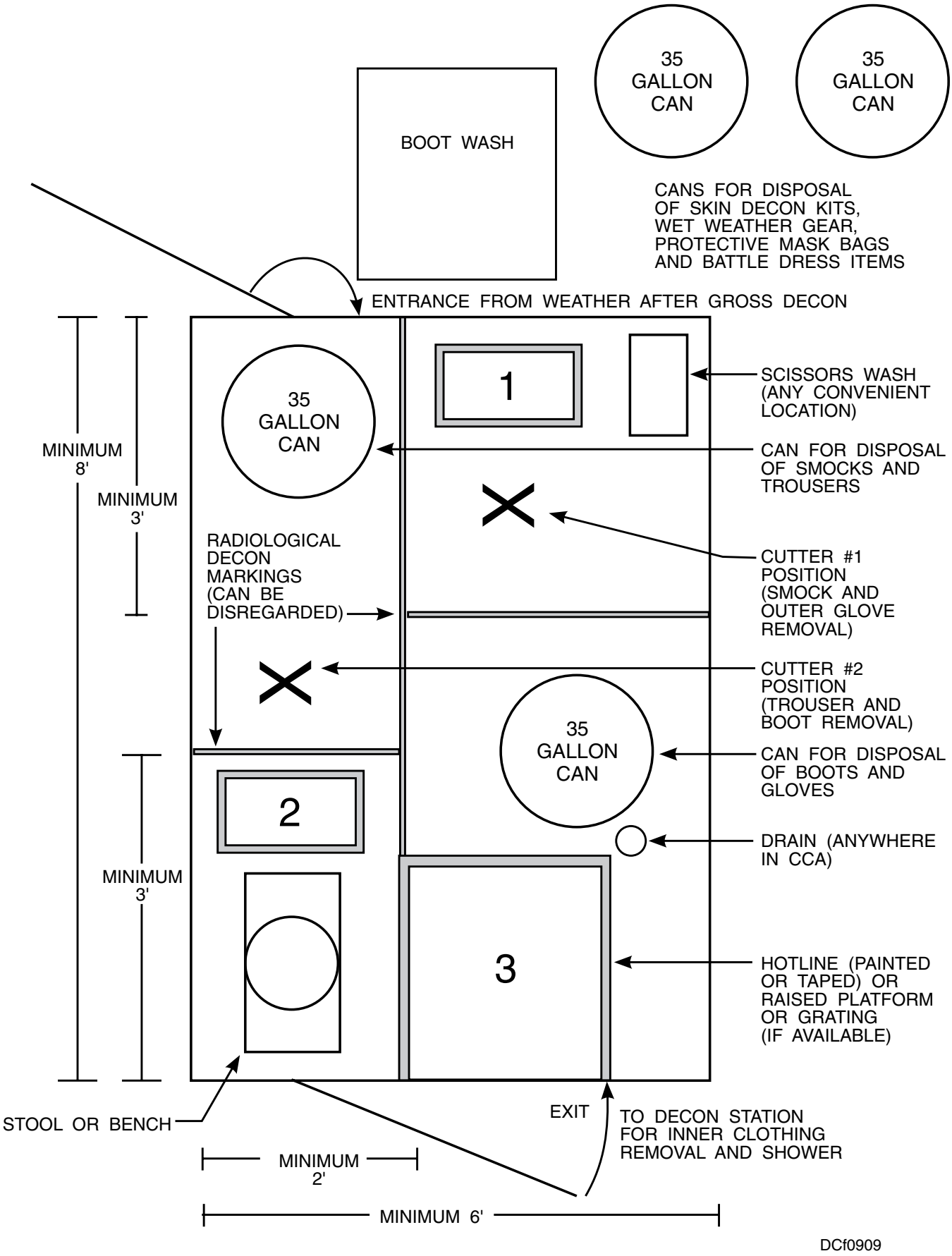


Figure 9-9. Generic contamination control area (CCA).

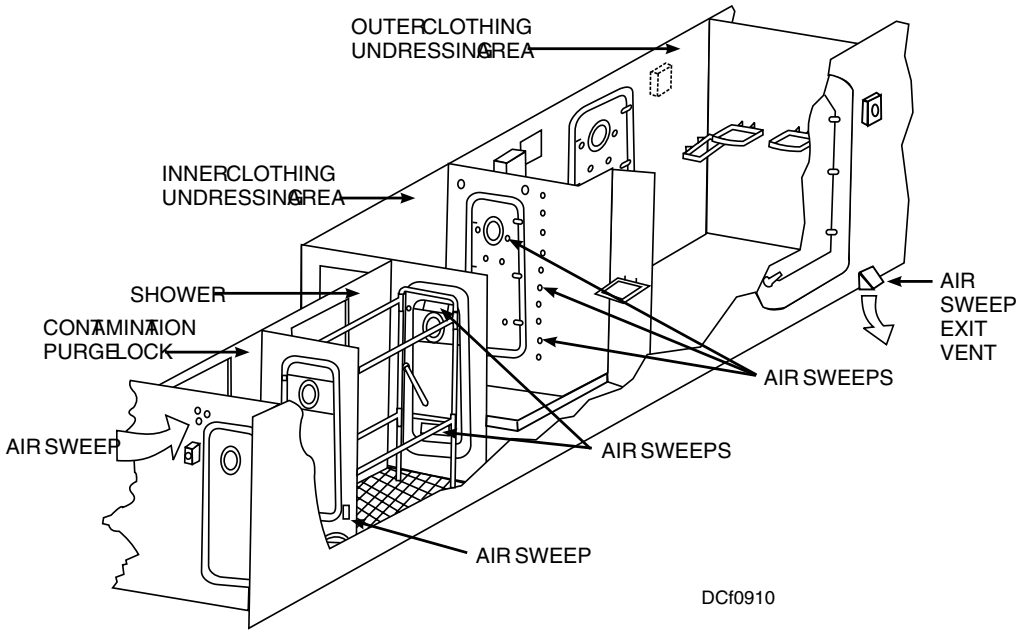


Figure 9-10. Typical CPS System.

of the ship. The optimum size of CCA spaces should be approximately 6' x 8'. A larger space can be used if available; however the minimum space is 5' x 7'. The space should be adjacent to or as near as possible to the outer skin at the weather entrance. If possible, the CCA should be located just inside the area marked as the Decontamination Station entrance. If suitable interior space is unavailable, a designated deck area outside the superstructure, preferably with overhead cover, can be used.

NOTE

Some ships do not have a space with these dimensions available. In these cases, a space with approxi- mately the same square footage will suffice as long as the cutter has enough room to do his job effectively. CCAs are not intended to be permanent locations and spaces with other functions can be used. Alternate spaces must be identified for use in the event the designated location is unusable due to battle damage.

COLLECTIVE PROTECTION SYSTEM (CPS)

The collective protection system (CPS) is a ventilation system that prevents the entry of airborne chemical, biological, and radiological contamination into the interior of the ship. Spaces serviced by the ship's CPS (fig. 9-10) can be used as a decon station for that area of the ship.

The CPS is a system that uses fans as the same purposes as a conventional HVAC system. It also has CBR filters that have the capability to remove CBR agents in any form. CPS provides two levels of protection. In total protection (TP) zones, all CBR contaminants in any physical state are filtered from the incoming air supply and a slight positive pressure is maintained to keep airborne contamination from entering by other routes. Any leakage of air at the zone boundaries is from the inside out. The air pressure inside a TP zone is maintained slightly above atmospheric with high pressure fans that supply air to the zone, with devices that control the flow of exhaust air from the zone and with air locks that prevent excessive pressure loss when someone enters or exits the zone. TP zones provide a toxic free environment where it is not necessary to wear protective clothing or masks. Total protection may not be affordable in compartments with extremely high airflow requirements, such as machinery spaces. CPS provides a lower level of safety for these areas called limited protection (LP). Chemical and biological aerosols are removed from the incoming air supply to LP zones by High Efficiency Particulate Air (HEPA) filters. The standard supply fans do not create a positive pressure and the HEPA filters do not entrap chemical agent vapor. A protective mask is required for protection from chemical agent vapor and the full Chemical Protective Ensemble (CPE) is needed for a chemical vapor hazard that has the capability to be absorbed through the skin.

A back-fit version, the Selected Area Collective Protection System (SACPS) has been developed for

ships that were built before CPS was introduced. CPS coverage for a small number of selected vital operational spaces and safe havens can be back fitted onto existing ships. SACPS fans and CBR filters are added. Incoming air is filtered and pressurized, but at a lower positive pressure than new construction CPS. Recirculation systems that were already installed within the selected zones are retained. The system is generally used where a more extensive CPS is impractical or too costly to back fit.

CPS Maintenance Responsibilities

Replacement of CPS filters and prefilters and leak tests on CBR filter systems are performed by an intermediate maintenance facility. Other troubleshooting and maintenance actions are performed by the ship's force.

CPS and Selected Area Collective Protection System (SACPS) Technical Documentation

Maintenance and operation of the CPS, SACPS, and their components should be in compliance with each ship's specific preventive maintenance system (PMS) requirements. Details of maintenance requirements are presented in the technical manuals listed below.

SS200-AF-MMM-010, *Technical Manual for Navy Shipboard Collective Protection System (CPS),* "System Description, Operation and Maintenance"

SS200-AG-MMM-010, *Technical Manual for Navy Shipboard Collective Protection System (CPS),* "Chemical, Biological, and Radiological (CBR) Filter System Operation and Maintenance"

SS200-AH-MMM-010, *Technical Manual for Navy Shipboard Collective Protection System (CPS),* "Alarm System Operation and Maintenance"

SS200-AJ-MMM-010, *Technical Manual for Navy Shipboard Collective Protection System (CPS),* "Pressure Control Valve (PCV) Operation and Maintenance"

SS200-AL-MMM-A10, *Technical Manual for LHA 1 Class Organizational and Intermediate Level Maintenance Navy Selected Area Collective Protection System (SACPS)*

UPDATING THE CHEMICAL, BIOLOGICAL, AND RADIOLOGICAL (CBR) DEFENSE BILL

The CBR Defense Bill constitutes the hull-specific application of doctrinal concepts and technical procedures. The rapid technological changes in the CBR countermeasures program mandates that all departments maintain an ongoing review and revision of the CBR Defense Bill. An outline for the CBR Defense Bill can be found in *NWP* 3-20.31, Appendix B.

REVIEW QUESTIONS

Q12. What type of decontamination does the countermeasure washdown system provide?

1. Active
2. Passive
3. Rapid
4. Temporary

Q13. What type of decontamination is performed outside CCA?

1. Rapid
2. Gross
3. Detailed
4. Intensive

Q14. What are the three steps of decontamination when the M291 Kit is used?

1. Physical removal, absorption, and spreading
2. Physical removal, absorption, and neutralization
3. Containment, absorption, and neutralization
4. Containment, absorption, and spreading

Q15. The collective protection system (CPS) is a ventilation system that prevents the entry of airborne chemical, biological, and radiological contamination into the interior of the ship.

1. True
2. False

SUMMARY

In this chapter, you were introduced to chemical warfare and biological warfare operations, defense, and countermeasures. The various types of BW agents and CW agents were also described. Finally, you were introduced to various methods and equipment that are used to detect either CW agents or BW agents. Advancements are continuously being made to ensure that the Navy will be able to conduct CW and BW defensive and countermeasures effectively. As new equipment and systems are introduced to the Navy, read the manufacturer's technical manual to familiarize yourself with the new equipment and systems.

REVIEW ANSWERS

A1. The MCU-2/P protective mask comes in a total of how many sizes? **(3) Three**

A2. What is the minimum number of C2 canisters issued with a MCU2/P protective mask? **(2) Two. A third C2 canister is issued by the ship.**

A3. What is the maximum life expectancy of a C2 canister when opened in a noncontaminated area? **(2) 60 days**

A4. What is the maximum life expectancy of a C2 canister in a contaminated environment? **(1) 30 days**

A5. There are a total of how many sheets of M-8 detector paper in an unopened booklet? **(3) 25**

A6. What color does M-9 turn when a nerve or blister agent is detected? **(3) Red**

A7. The M256A1 detector kit is used to test for what form of chemical agent? **(2) Vapor**

A8. What is the primary function of the AN/KAS-1? **(1) To provide U.S. Navy ships with the capability to detect and identify a chemical warfare (CW) agent attack**

A9. Which of the following life forms is an example of a disease vector? **(4) Arachnid**

A10. There is always an incubation period between the time an organism enters a body and the first signs of the symptoms of an illness. **(1) True**

A11. An indication of biological warfare is when the number of casualties reaches epidemic proportions within days, with most occurring within 24 hours. **(1) True**

A12. What type of decontamination does the countermeasure washdown system provide? **(1) Active**

A13. What type of decontamination is performed outside CCA? **(2) Gross**

A14. What are the three steps of decontamination when the M291 Kit is used? **(2) Physical removal, absorption, and neutralization**

A15. The collective protection system (CPS) is a ventilation system that prevents the entry of airborne chemical, biological, and radiological contamination into the interior of the ship. **(1) True**