DEPARTMENT OF THE ARMY
U.S. ARMY CENTER FOR HEALTH PROMOTION AND PREVENTIVE MEDICINE
5158 BLACKHAWK ROAD
ABERDEEN PROVING GROUNDS, MARYLAND 21010-5403

REPLY TO
ATTENTION OF:

MCHB-TS-EWS

16 May 2003

EXECUTIVE SUMMARY
WATER QUALITY INFORMATION PAPER NO. 31-035
PREVENTIVE MEDICINE CONCERNS OF
M149A2 AND M1112 WATER TRAILERS

1. PURPOSE. This information paper discusses preventive medicine (PVNTMED) concerns related to M149A2 and M1112 water trailers. It includes guidance for the proper inspection, cleaning, and disinfection of the trailers, as well as for maintaining and monitoring chlorine residuals at the unit level. It is intended for use by individuals in field units and by PVNTMED personnel who are responsible for inspecting and using the trailers.

2. CONCLUSIONS. The internal surfaces of some M149A2 and M1112 water trailer tanks have begun to rust, which can impart objectionable color and taste to the water. Until a materiel fix is approved by the Tank-automotive and Armaments Command, performing conscientious inspections, cleanings, and disinfection in accordance with Appendixes B and C will minimize the associated problems. The national stock number (NSN) listed for replacement pipe elbows and faucets in the Technical Manual for the M149A2 water trailer identify incorrect parts that do not fit properly and are not approved for use in water parts. Units should use the NSNs provided in this paper to obtain the correct replacement items. Unit level chlorination kits containing color comparators, diethyl-p-phenylene diamine (DPD) tablets, and glass ampules of calcium hypochlorite have been discontinued in the Army supply system, but the color comparator and DPD tablets are still available commercially. Replacement free available chlorine residual measuring items currently in the supply system include a photometer and chlorine test strips. Bulk calcium hypochlorite and bleach remain available. Units can order these items using the information in Appendix E. Some Army publications contain chlorine-dose estimation charts with outdated and/or incorrect information. Appendix D contains a correct chlorination chart using common units of measure.

3. RECOMMENDATIONS. Units and PVNTMED personnel who inspect, clean, and disinfect water trailers should follow the procedures in Appendixes B and C to minimize potential water quality problems resulting from internal tank material corrosion. Units requisitioning replacement pipe elbows and faucets for the M149A2 water trailers should use the correct NSNs provided in paragraph 4b. Field Sanitation Teams and PVNTMED personnel should consult the supplier information provided in Appendix E to purchase the photometer, or color comparator and DPD tablets to replace the capabilities of the discontinued Chlorination Kit, Water Purification. Units should use either bulk calcium hypochlorite (~70 % available chlorine) or household liquid bleach (~5 % available chlorine) to chlorinate field water supplies in place of the glass ampules containing calcium hypochlorite that are no longer available. Personnel should use the chlorination charts in Appendix D when disinfecting and chlorinating/rechlorinating water trailers and other field water containers.

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DEPARTMENT OF THE ARMY
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2. REFERENCES. Appendix A contains a list of references used in preparing this information paper.

3. BACKGROUND.

a. Army Field Water Trailers. The Army employs the M149A2 (Figure 1) and M1112 (Figure 2) water trailers extensively to distribute drinking water to field units. The M149A2 water trailer was preceded by the M149 and the M149A1 that had elliptical and round double-wall fiberglass tanks, respectively. The fiberglass tank units were replaced by the stainless steel M149A2 unit because the older water tanks developed cracks and became structurally and sanitarily unsound. The M1112 is a newer eight-wheeled water trailer, which has a cylindrical stainless steel tank and a wider footprint that make it more stable during movement.

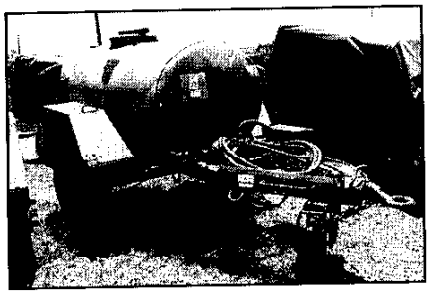

Figure 1. M149A2 Water Trailer

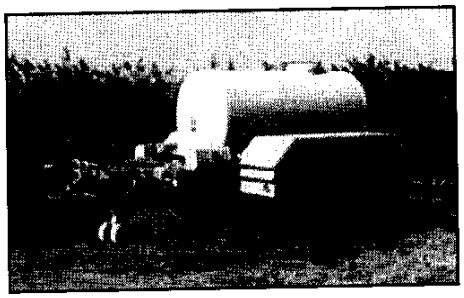

Figure 2. M1112 Water Trailer

b. Field Water Responsibilities.

(1) Potable water is a critical resource for forces in the field. The responsibilities for ensuring that water produced and provided to soldiers and civilians in field environments is safe

are shared among PVNTMED, Corps of Engineers (COE), and Quartermaster Corps (QM) personnel, and Unit Field Sanitation Teams (FST) under the direction of their unit commanders. Prior to establishing water points, COE and PVNTMED personnel, together with QM Water Treatment Specialists (MOS 77W), conduct water supply site reconnaissance surveys to identify potential water sources and determine which sites, if any, should be developed as sources of drinking water. Water sources can include surface water (rivers, lakes, or streams), ground water (aquifer, springs, or wells), and host nation municipal water supplies. The survey personnel consider the quantity of water required, and the quantity, quality, and accessibility of potential sources. They also evaluate each potential source as to its vulnerability to accidental or intentional contamination.

(2) After the water source has been selected, but before the water from it can be given to individuals to drink, the water must be treated to remove particulates and chemical contaminants, and properly filtered and disinfected to remove and inactivate any remaining harmful organisms. The QM Water Treatment Specialists are responsible for treating, disinfecting, and testing the water to make sure the final product is potable (safe to drink). The PVNTMED personnel then test the treated and disinfected water to ensure that it meets the Tri-Service Field Water Quality Standards at a minimum, and if it does, they certify its potability. It should also be noted that only an adequate treatment technique can ensure proper removal or inactivation of microbial contamination since testing for them are expensive and time consuming, if possible at all.

(3) Water treatment and PVNTMED personnel test the free available chlorine (FAC) residual periodically during water production, storage, and distribution to ensure its continued potability. In addition to treating the water, the QM has the lead to coordinate the storage and distribution of the potable water to field units, and may use COE and Transportation Corp assets to make it happen. Water is normally picked up by company-sized field units using their organic M149A2 and M1112 water trailers, and the units assigned the water trailers are responsible to routinely inspect and maintain them before use to protect the quality of the stored water. Army Transformation will see the replacement of these trailers by the "Camel," a two-tank 900-gallon M1082 medium tactical vehicle (MTV) water trailer (see Figure 3), and while it will have many new and improved features based on lessons learned over the past 40 years, routine inspection, cleaning, and disinfection will continue to be an integral part of its lifecycle.

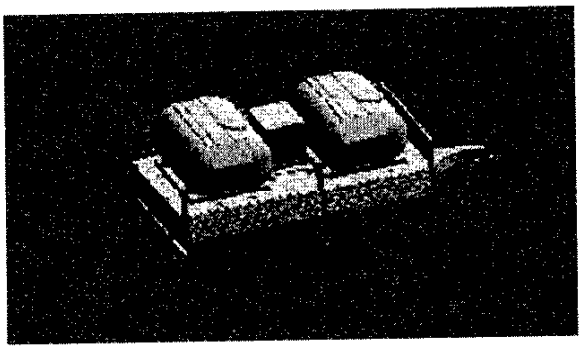

Figure 3. Concept illustration of the Interim Force "Camel" (two 450-gallon Stainless Steel Pods on an M1082 MTV Trailer)

c. Trailer Concerns. Several issues with the use of the M149A2 and M1112 trailers have surfaced in recent years, including: 1) corrosion of the interior surface of the tanks resulting in discolored and poor-tasting water; 2) national stock numbers (NSNs) listed in the trailers' maintenance manuals identify incorrect parts that do not fit properly and are not approved for use in water parts; 3) improper inspection, cleaning, and disinfection procedures for these trailers; 4) inappropriate chlorine residuals to be maintained in the drinking water transported and stored in and distributed from the water trailers; 5) changes in the available test kits for measuring chlorine residual, and 6) chlorine dosage charts that provide measurement instructions using equipment and supplies that are no longer available or have changed with time. These issues are discussed in the following paragraphs.

4. FINDINGS AND DISCUSSION.

a. Internal Corrosion.

(1) Some of the Army's 9,000-plus M149A2 and M1112 water trailers are experiencing various degrees of internal corrosion resulting in scaling and the formation of pinholes in the inner stainless steel liners. These problems occur primarily around the welded areas of the tank that come into direct contact with water. Water can pass through the corroded and pinhole areas into the polyurethane foam insulation material between the inner liner and outer shell. Extensive corrosion of this nature "deadlines" the affected water trailers and removes them from service. The Tank-automotive and Armaments Command (TACOM) and the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) are investigating these problems to determine if they present potential health risks to consumers. Soldiers who perform water trailer inspections should pay particular attention to this, and report severe corrosion to and seek guidance from TACOM at (586) 574-7164 or DSN: 786-7164.

(2) The interior seams of the water trailers are welded and, in some cases, have begun to rust or corrode. There is not yet an approved method of treating the interiors of these water tanks to prevent rusting, although cold-set epoxy coatings have been approved for the 5000-gallon XM1098 water trailer. Only non-metallic brushes should be used to scrub the interiors of the tanks to avoid scratching the welded seams, as well as to prevent the possibility of loose or broken metal bristles getting into the water and from there into a soldier's canteen.

(3) Units and PVNTMED personnel should follow the inspection, cleaning, and disinfection procedures in Appendixes B and C to reduce potential water quality concerns due to internal tank material corrosion. For further information see chapter 7-5 and Appendix C of Technical Bulletin Medical (TB MED) 577 (reference A-5).

b. Replacement Parts.

(1) Water Spigots/Faucets. When the faucets on the water trailers leak or corrode badly, they need to be replaced. The replacement faucet is incorrectly identified in the water trailer technical manual (TM). The faucet identified in the TM is pictured below in Figure 4. These faucets have labels that clearly state, "not to be used with acid, strong alkaline solutions, or potable water." These faucets may contain more than 8% lead, which is contrary to the Safe Water Drinking Act of 1996 requirement that all fixtures used in conjunction with the transport

of potable water contain less than 8% lead. The correct replacement faucet is NSN: 4510-01-433-0396, and its part number is 12406415.

Figure 4. The Incorrect Faucet Replacement (NSN: 4510-00-595-1785)

(2) Pipe Elbows. Frequently, when a spigot needs to be replaced, the pipe elbow to which it is attached also needs to be changed. The replacement pipe elbow listed in the M149A2 water trailer Technical Manual does not fit properly. The NSN for the correct elbow is 4730-01-380-2931 and its part number is MS14308-8 (see Figure 5).

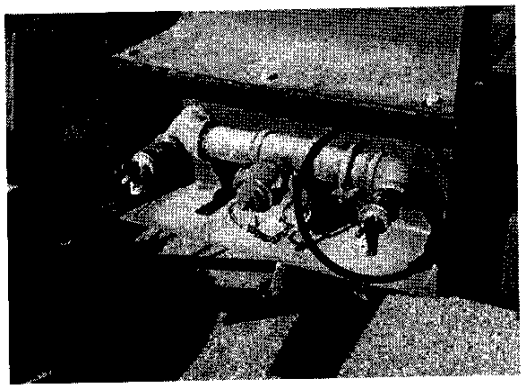

Figure 5. The Correct Replacement Pipe Elbow (NSN: 4730-01-380-2931)

c. Inspection, Cleaning, and Disinfection.

(1) General. Water trailers must be inspected semiannually and cleaned periodically to ensure they are sanitary and prepared to carry potable water. The sanitation inspection consists of looking closely at the water storage and delivery components and noting any problems. Cleaning consists of physically removing dirt, debris, deposits, and rust from the interior of the trailer's water tank. Following cleaning, the water container interior surfaces and delivery

appurtenances must be disinfected in order to kill or inactivate harmful organisms that may reside there even after cleaning. Water trailer inspection and cleaning/disinfection procedures are presented in Appendixes B and C, respectively.

(2) Unit Tasks. Owning units (that is, the FSTs or other soldiers designated by the unit commander) are responsible for ensuring that their water trailers are clean and operable when they reach a water pick-up point. The FST should inspect the unit's trailers prior to each fill up and clean and disinfect them at least quarterly, and as often as necessary to ensure the trailers do not degrade the quality of drinking water that is placed in them. Cleaning procedures are detailed in Appendix C. Often, units leave water in the water trailers after an exercise, and wait until just prior to the next exercise to clean the tanks. Water left in the tank contributes to rust and corrosion, mineral deposits, and algae buildup, and may impart a bad taste and smell to the water for the next exercise. After each exercise, the tank should be emptied completely and allowed to dry.

(3) Preventive Medicine Tasks. The PVNTMED units or sections, as appropriate, inspect water trailers in garrison periodically to ensure that the trailers are prepared to deploy. When PVNTMED personnel perform inspections, they use DA Form 5457-R, Potable Water Container Inspection Checklist to document water container inspections. After completing the inspection, a copy of the completed form is left with the unit for its records. A copy of this form is provided in Appendix B, or it can be printed from USACHPPM Technical Guide 276, Ultimate Preventive Medicine CD-ROM Resource Set, or downloaded from http://www.army.mil/usapa. Units with water trailers should proactively contact their servicing PVNTMED organization to schedule these inspections, to ensure their water trailers are inspected as required, and to assist PVNTMED in implementing the inspection program.

(4) Disinfecting Water Trailer Tank Interiors. Soldiers should disinfect the interior surfaces of the water tanks with a chlorine solution to provide a chlorine residual of approximately 100 mg/L[1] FAC. Soldiers should ensure that the solution contacts all the surfaces in the tank for the required 60-minute contact time specified in TB MED 577 for effective disinfection. Either calcium hypochlorite or liquid bleach can be used to make the required chlorine solution as described in Appendix C. Note that this 100 mg/L concentration is about the same as that used to bleach clothing in a washing machine, so it will discolor the battle dress uniform if it splashes on it. Some older Army publications contain charts indicating how much calcium hypochlorite, household bleach, or chlorine gases to add to water to provide the desired disinfecting concentrations. Some of those charts suggest using a meal, ready-to-eat (MRE) spoon to measure the required amount of bulk calcium hypochlorite or liquid bleach to add. The size of MRE spoons has not been consistent from procurement lot to lot, so using one to measure with may not provide the intended concentration. Note also that mixing 1 gallon of bleach in 100 gallons of water as directed in paragraph C-4.b.(b) of TB MED 577 will provide a chlorine concentration of approximately 500 mg/L rather than the 100 mg/L indicated in that paragraph. Following the mixing directions in Appendix C of this paper will provide the correct concentration. Additionally, a chart is provided in Appendix D that tells how much calcium

[1] The units parts per million (ppm) and milligrams per liter (mg/L) are essentially equivalent when dealing with concentrations of substances in water . The current preference in the environmental engineering field is to use mg/L; therefore, those units are used throughout this paper.

hypochlorite or bleach to use to achieve a desired FAC concentration in different volumes of water using standard sized spoons and cups. It also provides volume conversion factors for some other commonly available measuring devices, and the formulas used to estimate how much bulk chlorine compound is required to achieve a desired FAC concentration in water.

d. Chlorine Test Kits. Water treatment, PVNTMED, and unit FST personnel have traditionally measured chlorine residuals using the issued field-expedient Chlorination Kit, Water Purification (NSN: 6850-00-270-6225). The kit consisted of a color comparator and diethyl-p-phenylene diamine (DPD) tablets to test the chlorine residual, and glass ampules each containing one-half gram of calcium hypochlorite to use to increase the chlorine concentration when necessary. That kit has been discontinued and is no longer available through the Army supply system. The authorized replacement item for measuring chlorine residuals is a $300 Chlorine Photometer (NSN: 6850-01-487-8812). The pH and Chlorine Test Strips (NSN: 6850-00-270-6225 and 6850-01-374-9921), which have been approved by the Army Medical Department Center and School Directorate of Combat and Doctrine Development for determining pH and chlorine residual in drinking water, are also available through supply channels. For those units that have the older comparators, and for those who want to purchase one, the color comparator that was in the discontinued kit, as well as the DPD tablets, are available commercially. Sources and contact information for procuring these items are provided in Appendix E. Units that purchase commercial test kits should be sure that the selected kits can clearly measure FAC concentrations of 1, 2, and 5 mg/L. Units can also order through supply channels a 6-ounce bottle of calcium hypochlorite (NSN: 6810-00-255-0471), to use in place of the calcium hypochlorite ampules that were in the discontinued kit.

e. Chlorine Residuals and Testing Frequencies.

(1) Water Production Points. Reverse Osmosis Water Purification Unit (ROWPU) operators produce water with a minimum 2 mg/L FAC residual concentration after a 30-minute contact period (reference A-4). For water treated by any other method in the field, the required FAC residual concentration is 5.0 mg/L. The TB MED 577 (reference A-5) also requires water production personnel to test the FAC concentration in finished water at least hourly, and to adjust the chlorine dose when necessary to maintain the appropriate residual. This is general guidance applicable when the water pH is between 6.5 and 7.5, and when the temperature is 40° F or higher. For other conditions, see paragraph 6-5, TB MED 577 (reference A-5). The Command Surgeon may direct lower or higher FAC residuals depending on supply, environmental, or threat conditions. Ensuring that there are measurable chlorine residuals in the treated water from the point of production until it is distributed to individuals does not provide an assurance that accidental or intentional contamination has not been introduced into the water during the storage and distribution processes. The presence of a chlorine residual is merely an indicator that a subsequent contamination has not occurred. The general goal is to have a measurable (approximately 0.2 ppm) chlorine residual in the water in a soldier's canteen; however, testing each soldier's canteen water would be impractical and is not required.

(2) Potable Water Issue Points and Bulk Transport. The TB MED 577 requires operators at potable water issue points and during bulk transport operations to check the chlorine residual hourly, and to maintain 2 ppm FAC in the water. The PVNTMED personnel should also monitor these locations periodically as part of the overall field drinking water quality surveillance plan.

(3) Maneuver and Support Units. At unit level, the FST is responsible for testing the water in the water trailers at least twice daily and maintaining a residual FAC concentration of at least 1.0 ppm without regard to the method that was used to produce the water (ROWPU or non-ROWPU). The recommended times to check the residual are in the morning, prior to the morning meal, and in the afternoon, prior to the evening meal, although usage and temperature may dictate a higher frequency and other times.

f. Chlorination of Drinking Water in Trailers. Filled water trailers should arrive at the unit with at least 1 mg/L FAC residual. If testing indicates that the FAC concentration is less than 1 mg/L, additional chlorine should be added to raise the concentration to 1 mg/L. Either calcium hypochlorite or liquid bleach can be used in conjunction with the charts in Appendix D to provide the additional amount of chlorine needed in the following manner:

(1) Mix ½ teaspoon of calcium hypochlorite in a canteen cup (or other suitable container) of water to make a slurry. Then add the slurry to the water in the tank. Alternatively, add 6 teaspoons of unscented household bleach to the water tank.

(2) Stir the water inside the tank using the canteen cup or a clean stick, or drive the water trailer around (to cause mixing). Wait 10 minutes, then flush all the faucets and check the FAC concentration in a sample from one of them. If it is less than 1 mg/L go to step (3). If it is equal to or greater than 1 mg/L, continue to step (4).

(3) If the measured FAC concentration was less than 1 ppm, add a small amount (a "pinch"- technically 1/12 teaspoon) of calcium hypochlorite or a teaspoon of bleach to the water in the tank, and repeat step (2).

(4) If the concentration measured in step (2) was at least 1 mg/L, wait an additional 20 minutes for the chlorine to kill any harmful microorganisms, flush the faucets again, and check the FAC concentration in a sample from one of them. If it is now less than 1 mg/L, go to step (2). If the FAC concentration is still equal to or greater than 1 mg/L, approve the water for distribution.

5. CONCLUSIONS. The internal surfaces of some M149A2 and M1112 water trailer tanks have begun to rust, which can impart objectionable color and taste to the water. Until a materiel fix is approved by TACOM, performing conscientious inspections, cleanings, and disinfection in accordance with Appendixes B and C will minimize the associated problems. The NSNs listed for replacement pipe elbows and faucets in the TM for the M149A2 water trailer identify incorrect parts that do not fit properly and are not approved for use in water parts. Units should use the NSNs provided in this paper to obtain the correct replacement items. Unit level chlorination kits containing color comparators, DPD tablets, and glass ampules of calcium hypochlorite have been discontinued in the Army supply system, but the color comparator and DPD tablets are still available commercially. Replacement FAC residual measuring items currently in the supply system include a photometer and chlorine test strips. Bulk calcium hypochlorite and bleach remain available. Units can order these items using the information in Appendix E. Some Army publications contain chlorine-dose estimation charts with outdated and/or incorrect information. Appendix D contains a correct chlorination chart using common units of measure.

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7. ACKNOWLEDGMENTS AND ADDITIONAL SUPPORT. CPT Kirsten Dickhut, an Army Reservist Medical Service Corps Sanitary Engineer, prepared portions of this information paper while on active duty for training with the USACHPPM. Additional support on health-related topics associated with the M149A2 and M1112 water trailers can be obtained from the USACHPPM, Water Supply Management Program, DSN 584-3919, commercial (410) 436-3919 or electronically at water.supply@apg.amedd.army.mil.

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APPENDIX A
REFERENCES

1. TM 9-2330-267-14&P, Operator's, Organizational, Direct Support, and General Support Maintenance Manual for Trailer, Tank, Potable Water, 400 Gallons, 1 l/2-Ton, 2-Wheel, M149, M149A1, M149A2, and M625, 30 July 1991.

2. TM 9-2330-397-14&P, Operator's, Organizational, Direct Support, and General Support Maintenance Manual for Trailer, Tank, Potable Water, 400 Gallons, 1 1/2 Ton, 8-Wheel, M1112, April 2000.

3. Field Manual (FM) 4-25.12 (replaced FM 21-10-1), Unit Field Sanitation Team, Headquarters, Department of the Army (HQDA), Washington, DC, 25 January 2002.

4. FM 21-10-1/MCRP 4-11.1D (replaced FM 21-10), Field Hygiene and Sanitation, HQDA and Commandant, Marine Corps, Washington, DC, 21 June 2000.

5. TBMED 577, Sanitary Control and Surveillance of Field Water Supplies, March 1986 (currently under revision).

6. HQDA Message R 291451Z March 1995, subject: Clarification of Disinfection Standard for ROWPU Produced Field Drinking Water.

7. Miller Analytical Web Page; http://www.milleranalytical.com.

8. Recreonics Web Page; http://www.recreonics.com.

9. Recreation Supply Company Web Page; http://www.recsupply.com.

APPENDIX B
PROCEDURES FOR INSPECTING WATER TRAILERS

Interior of Tank:

a. Inspect the interior tank surfaces for stains, rust, mineral deposits, chips, flaking, cracks, punctures, and leaks.

b. Staining by natural water impurities is permitted, provided the stains do not interfere with disinfection. Formation of particulates, such as rust and calcium deposits, will interfere with disinfection and need to be removed when cleaning the tank.

Exterior of Tank:

a. The words "POTABLE WATER ONLY" will be stenciled onto the side of the water tank.

b. The overall appearance should be clean and present a good state of repair.

c. Spigots on both sides of the tank should be clean and operate effectively without excessive leaking. The cover over the spigots should open and close easily to keep dust and dirt out. The "T" handle that allows for the flow of water from the tank to the spigots should also open and close freely.

d. The manhole cover should seal effectively to keep the interior of the tank from being contaminated. No rust is permitted in the manhole cover area. The sealing gasket will be intact and fit properly, will not have any cracks or missing pieces and show no signs of dry rot.

e. The pressure relief valve should operate effectively. To test the pressure relief valve blow into the bottom of the valve. The valve is operating effectively if air escapes through the holes in the top of the valve.

f. The drain plug should be operable and installed only hand-tight. The drain plug mount should be kept clean to avoid corrosion build-up. Do not paint the exterior of the water tank with the drain plug intact. The drain plug should be removed and the hole taped over to avoid paint contamination inside the tank. The drain plug should be removed from the water tank during storage. If the exterior of the tank is damaged severely (i.e., punctures, interior chipping) the trailer should be turned into direct support for repair. The drain plug must be removable! If it is rusted shut, glued in place, or tightened beyond hand tight the trailer cannot be used until the drain plug is repaired.

g. A copy of DA FORM 5457-R, Potable Water Container Inspection, is provided on the following two pages. It may be downloaded from the Official Army Publications and Forms Website: http://www.army.mil/usapa/

POTABLE WATER CONTAINER INSPECTION

For use of this form see TB MED 577; the proponent of this form is the Office of The Surgeon General.

REPORT DATE

TO

FROM

INSPECTION RATING	SERIAL NUMBER	MAP COORDINATE LOCATION
OWNING UNIT	MAINTENANCE NCO	UNIT REPRESENTATIVE
INSPECTION UNIT	DATE/TIME GROUP	INSPECTED BY

SECTION I. WATER TRAILER INSPECTION CRITERIA

		YES	NO
1. CONTAINER EXTERIOR	a. Marked "POTABLE WATER ONLY"		
	b. Clean/Good Repair		
2. MANHOLE COVERS	a. Rubber Gasket Intact		
	b. Locking Mechanism Functions		
	c. No Rust/Insulation Intact		
	d. Pressure Relief Valve Operates		
3. DISPENSING SPIGOTS	a. All Spigots Function		
	b. "T" Handle Operates Easily		
	c. Protective Box Intact		
	d. Locking Devices Function		
4. DRAIN	a. Plug Installed Hand-Tight		
	b. Cracks Do Not Expose Fiberglass		
	c. Plug/Hole Threads Undamaged		
	d. Threads Not Rusted		
5. CONTAINER INTERIOR: STAINLESS STEEL AND ALUMINUM	a. Clean/Good Repair		
	b. No Rust		
	c. Not Painted/Coated		
	d. No Cracks/Dents Exposing Polyurethane		
6. CONTAINER INTERIOR: FIBERGLASS	a. Clean/Good Repair		
	b. Cracks/Chips Less Than 10%		
	c. Fiberglass Exposed		
	d. Paint Surface Not Flaking		

SECTION II. WATER TANK TRUCK INSPECTION CRITERIA

1. CONTAINER EXTERIOR	a. Marked "POTABLE WATER ONLY"		
	b. Clean/Good Repair		
2. MANHOLE COVERS AND FILLING PORTS	a. Rubber Gaskets Intact		
	b. Locking Mechanisms Function		
	c. No Rust/Insulation Intact		
3. DISPENSING VALVES	a. Valves Operate Easily		
	b. Hose Coupling Threads Undamaged		
	c. Dust Caps Attached to Valve Ports		
4. TANK INTERIOR	a. Clean/Good Repair		
	b. No Rust		
	c. Steel/Aluminum Not Painted		

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SECTION III. FABRIC TANK/DRUM INSPECTION CRITERIA			
		YES	NO
1. CONTAINER EXTERIOR	a. Marked "POTABLE WATER ONLY"		
	b. Clean/Good Repair		
	c. Plugs/Patches Secure		
2. VALVE ASSEMBLY	a. Check-Valve Adapter Undamaged		
	b. Coupler Valve Operates Easily		
	c. Dust Cap Attached to Coupler		

SECTION IV. CONTAINER LOCATION (FIELD USE) INSPECTION CRITERIA			
1. SITE CONDITIONS	a. Manholes/Parts Closed		
	b. Soakage Pits Constructed Beneath Spigots		
2. WATER CONDITIONS	a. Chlorine Residual Adequate (____ ppm)		
	b. Procured From: _____		

COMMENTS AND RECOMMENDATIONS:

PRINTED/TYPED NAME AND GRADE OF PVNTMED INSPECTOR:	SIGNATURE:

REVERSE OF DA FORM 5457-R, OCT 85 USAPPC V1.00

2

APPENDIX C
PROCEDURES FOR CLEANING AND DISINFECTING WATER TRAILERS

NOTE: Prior to general cleaning, rust and mineral deposits should be removed.

Rust: DO NOT use a mechanical grinder or sanding device to remove rust. These devices will degrade the surface of the tank and cause more rust. To remove the rust in a stainless steel tank clean the rusted areas with water and scouring powder (NSN: 7930-01-423-1147), and a non-metallic, nylon brush (NSN: 7920-00-061-0038). Be sure to flush the tank thoroughly with clean water.

Mineral Deposits: Mineral deposits on the bottom of the tank can be removed by putting 8 gallons of vinegar (NSN: 8950-01-079-3978), in the tank and leaving it for 5-6 hours, then emptying and flushing the tank with clean water.

General Cleaning Procedures:

a. Clean the outside of the water trailer with water and a stiff brush (soap is recommended, but is optional).

b. Remove the drain plug located beneath the rear portion of the water trailer.

c. Elevate the front of the trailer so the water will flow toward the drain.

d. Prepare a soap solution by adding 1/3 cup of liquid detergent to 10 gallons of hot water.

e. Thoroughly wash the inside surfaces of the water tank with the soap solution and a long handle scrub brush such as the one identified by NSN 7920-00-061-0038.

f. Clean the valves and spigots by flushing the soap solution through them. Drain the tank by removing the drain plug.

g. Rinse the tank and spigots twice with water (preferably warm water) to completely remove the soap solution.

h. Disinfect the tank prior to filling it with drinking water.

Disinfection:

Method 1: Use this method if both water and the required chemicals are plentiful.

a. Fill the tank full of water with about a 100 mg/L chlorine concentration (see options below).

b. Mix or slosh it around so it contacts all the surfaces.

c. Run some of the solution through the valves and spigots.

d. Keep all interior surfaces wet with the solution for at least 60 minutes.

e. Drain the disinfecting solution into a sanitary sewer or other approved location (not into a lake, stream, or storm drain).

f. Rinse the tank and spigots twice with potable water.

Method 2: Use this method if either water or the required chemicals are in short supply.

a. Prepare 5 gallons of water with a 100 mg/L chlorine concentration (see options below).

b. Using a long-handled brush, stick, or rod with a cloth secured to the end (or some other method), swab the interior walls of the tank every 10 minutes or as often as necessary to keep the walls wet with the solution.

c. Run some of the solution through the valves and spigots.

d. Drain the accumulated solution from the tank into a sanitary sewer or other approved location (not into a lake, stream, or storm drain).

e. Rinse the tank and spigots twice with potable water.

After Completing Either Method:

If the water trailer is not going to be used for more than 30 days, open the faucets, valve, drain plug and manhole cover, and allow the tank to air dry. After it is dry, close it up, and repeat the cleaning and disinfection procedures prior to using it.

Options for Making 100 mg/L Chlorine Water Solutions: The following mixtures will result in a concentration in the water of approximately a 100 mg/L chlorine (refer to Appendix D for additional information):

a. 5 Gal of water, approximately 100 mg/L :

	Bleach (5%)	Dry HTH (70%)	HTH Solution (~2.3%)
Drops	568	n/a	1243
mL	38	1.2	82.8
Tsp	8	1/4	17
tbls	2.5	.08	5.6

b. 400 gallons of water, approximately 100 mg/L:

	Bleach (5%)	Dry HTH (70%)	HTH Solution (~2.3%)
mL	n/a	92	n/a
Tsp	n/a	19	n/a
tbls	n/a	6 (6.2)*	n/a
Oz	102	3 (3.1)	224

(400 gallons of water, approximately 100 mg/L – continued)

	Bleach (5%)	Dry HTH (70%)	HTH Solution (~2.3%)
Cup	13	0.40	28
Pt	6.5	0.20	14
Qt	3 (3.2)	0.10	7
L	3	0.10	6.5 (6.6)
Gal	0.8	n/a	1.75

***more accurate values are shown in parentheses**

APPENDIX D
CHLORINATION CHARTS

The following tables provide volumes in drops (dp), milliliters (mL), teaspoons (tsp), tablespoons (tbls), cups (cp), liters (L), and gallons (gal) of liquid bleach, dry calcium hypochlorite (DCH), and a concentrated calcium hypochlorite solution that, when added to the indicated volume of water, will provide the approximate chlorine dose indicated. The chlorine residual achieved using these values will be dependent on the chlorine demand exerted by the water that is chlorinated. If there is no chlorine demand, the residual should equal the dose. The greater the chlorine demand, the lower the residual will be.

Table D-1. Rounded-up volumes of 5% liquid bleach that will provide approximately the indicated chlorine dose when added to the listed volume of water.

Gallons to be Chlorinated	1 mg/L	2 mg/L	5 mg/L	10 mg/L	100 mg/L
5	6 dp	0.75 mL	1.9 mL	3.8 mL	8 tsp
10	0.75 mL	1.5 mL	3.8 mL	1.5 tsp	16 tsp
25	2 mL	3.8 mL	2 tsp	4 tsp	1 cp
36	3 mL	5.5 mL	2.75 tsp	2 tbls	1.25 cp
50	4 mL	1.5 tsp	4 tsp	3 tbls	1.75 cp
100	7.7 mL	3 tsp	3 tbls	5 tbls	3.25 cp
400	2 tbls	4.25 tsp	0.75 cp	1.5 cp	3 qt
500	3 tbls	0.33 cp	1 cp	1.75 cp	1 gal
1000	0.33 cp	0.67 cp	1.75 cp	3.25 cp	2 gal

Table D-2. Volumes of 70% dry calcium hypochlorite (or solution concentrate*) that will provide approximately the indicated chlorine dose when added to the listed volume of water (more accurate volumes are shown in parentheses).

Gallons to be Chlorinated	1 PPM	2 PPM	5 PPM	10 PPM	100 PPM
5	0.9 mL	1.7 mL	4.1 mL	8.3 mL	0.25 tsp
10	1.7 mL	3.3 mL	8.3 mL	16.6 mL	0.5 tsp
25	4.1 mL	8.3 mL	20.7 mL	41.4 mL	1.25 tsp
36	6 mL	11.9 mL	29.8 mL	0.9 mL	1.75 tsp
50	8.3 mL	16.6 mL	0.6 mL	0.25 tsp	2.5 tsp
100	16.6 mL	33 mL	0.25 tsp	0.5 tsp	5 tsp
400	0.92 mL	1.9 mL	1 tsp	2 tsp	19 tsp
500	1.3 mL	0.5 tsp	1.25 tsp	2.5 tsp	0.5 cp
1000	0.5 tsp	1 tsp	2.5 tsp	5 tsp	1 cp

***The shaded area of the table indicates the volume of a concentrated solution made from dissolving 1 teaspoon of DCH in a half canteen cup (1½ cups) of water.**

CONVERSION FACTORS

Table D-3, below, is useful in converting from one unit of measure to another. It shows equivalent values for common units of measurement. Unit volumes increase from left to right and top to bottom. All volumes on the same horizontal line (row) are equal. So, looking at the "**ounce**" row, we can see that one ounce (oz) is equal to 444 dp, 30 mL, 6 tsp, 2 tbls, and 1 ounce (oz). Continuing to the right on the same row indicates that an oz is also equal to 0.125 or 1/8th cp (see Table D-4), 0.063 pints (pt), 0.031 quarts (qt), and so on across the table.

If you need to add 7 mL of bleach to a container of water, but you only have an eyedropper, you can see that each mL contains 15 dp, so 7 mL would be equivalent to 7 * 15 or 105 dp.

The values following down a single column represent how many of the units at the top of the column make up one of the units on the left of the table. For example, following down the **drop** column, there are 15 dp in a mL, 74 dp in a tsp, 3550 dp in a cp, and a whopping 56,775 dp in a gal. Similarly, looking at the **ounce** column, there are only 0.002 oz in a dp, 0.5 oz in a tbls, and 32 oz in a qt.

Table D-3. Equivalent volumes.

	drop	mL	tsp	tbls	ounce	cup	pint	quart	liter	gal
drop	1	0.067	0.013	0.004	0.002					
mL	15	1	0.200	0.067	0.033	0.0042	0.0021	0.0011	0.0010	
tsp	74	5	1	0.333	0.167	0.021	0.010	0.005	0.005	0.001
tbls	222	15	3	1	0.500	0.063	0.031	0.016	0.015	0.004
ounce	444	30	6	2	1	0.125	0.063	0.031	0.030	0.008
cup	3550	237	48	16	8	1	0.500	0.250	0.240	0.063
pint	7100	473	96	32	16	2	1	0.500	0.480	0.125
quart	14200	946	192	64	32	4	2	1	0.960	0.25
liter	15000	1000	203	68	34	4.2	2.1	1.06	1	0.26
gal	56775	3785	768	256	128	16	8	4	3.785	1

FRACTIONS AND DECIMALS

The following table shows the equivalence between common fractions and decimals.

Table D-4. Common fractions and their decimal equivalents.

Fraction	Decimal
1/16	0.0625
1/8	0.125
3/16	0.1875
1/4	0.25
5/16	0.3125
3/8	0.375
7/16	0.4375
1/2	0.500

Fraction	Decimal
9/16	0.5625
5/8	0.625
11/16	0.6875
3/4	0.75
13/16	0.8125
7/8	0.875
15/16	0.9375
16/16	1.0000

CHLORINATION FORMULAS

If the volume and/or concentration you are working with is not in the tables above, use the following equations to calculate the volume of required bleach, DCH, or concentrated calcium hypochlorite solution in mL, then use Table D-3 above to convert that volume to enable using the best measuring device you have available.

For Liquid Bleach (~ 5% available chlorine):

$$\text{mL required} = \frac{\text{desired concentration in mg/L x number of gallons to be treated}}{13.2}$$

For Dry Calcium Hypochlorite (~70% available chlorine)

$$\text{mL required} = \frac{\text{desired concentration in mg/L x number of gallons to be treated}}{434.6}$$

For a solution made from adding 1 level tsp DHC to half a canteen cup of water:

$$\text{mL required} = \frac{\text{desired concentration in mg/L x number of gallons to be treated}}{6.04}$$

For example, to chlorinate 10 gallons of water to 5 mg/L (ppm), would require the following:

$\frac{5 \times 10}{13.2}$ = 3.8 mL of bleach

$\frac{5 \times 10}{434.6}$ = 0.115 mL of dry calcium hypochlorite, or

$\frac{5 \times 10}{6.04}$ = 8.3 mL of hypochlorite solution made from 1 level tsp DHC in half a canteen cup (1 ½ cups).

If your measuring device is not as precise as the number you come up with, it is generally advisable to round the calculated number up to ensure you provide at least the dose you intended to provide. For water destined for drinking, it is always important to test the water after chlorinating to ensure the desired residual has been achieved (see Appendix C).

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APPENDIX E
SUPPLIER CONTACT INFORMATION

As of September 2002

Company:	Miller Analytical 3158 Fairway Avc. Bristol, PA 19007 (877) 664-2288 http://www.milleranalytical.com		
Products:	LaMotte DPD #1 Tablets - Box of 50 LaMotte DPD #1 Tablets - Box of 100 LaMotte DPD #1 Tablets - Box of 500 LaMotte DPD #1 Tablets - Box of 1000	$5.50 $8.95 $44.10 $73.45	Item No. 6999-H Item No. 6999-J Item No. 6999-L Item No. 6999-M
Company:	Orbeco Analytical Systems, Inc. (800) 922-5242 http://www.orbeco.com		
Products:	LaMotte DPD #1 Tablets - Box of 50	$5.75	Item No. 431IT
Company:	Recreation Supply Company PO Box 2757 Bismarck, ND 58502 1-800-437-8072 http://www.recsupply.com		
Products:	LaMotte DPD #1 Tablets – Box of 100 LaMotte DPD #1 Tablets – Box of 500 LaMotte DPD #1 Tablets – Box of 1000	$6.25 $31.25 $60.00	Item No. BB-6999-02
Company:	Recreonics, Inc. 4200 Schmitt Avenue Louisville, KY 40213 1-800-428-0133 http://www.recreonics.com		
Products:	LaMotte DPD #1 Tablets - Box of 100 LaMotte DPD #1 Tablets - Box of 1000 10 mL Test Tubes – each	$10.77 $55.50 $4.40	Item No. 56387 Item No. 56387.1000 Item No. 0102
Company:	TrueTech Inc. 680 Elton Street Riverhead, NY 11731 (631) 727-8600		
Products:	Color Comparator	$5.00	No item number*

***NOTE: Explain to the receptionist taking the order that this is the color comparator used in the Military Chlorination Kit, Water Purification with the NSN 6850-00-270-6225.**