

# TECHNICAL MANUAL

OPERATOR  
AND  
ORGANIZATIONAL  
MAINTENANCE

WATER QUALITY  
ANALYSIS/SETS

PREVENTIVE MEDICINE  
NSN 6630-00-140-7826

ENGINEER  
NSN 6630-00-140-7820

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Operator and Organizational Maintenance Manual

**WATER QUALITY ANALYSIS/SETS  
PREVENTIVE MEDICINE  
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## **WARNING**

### ELECTRICAL

- Prior to attempting to operate from 110/220-volt power sources, be absolutely sure that the source and the component to be powered are properly grounded.

### CHEMICAL

- Dangerous chemicals are provided in this equipment. Death, health hazards or injuries such as severe burns, impaired vision and internal tissue destruction may be experienced if personnel fail to observe precautions. Do not allow reagents, buffer solutions or acids to come in contact with skin or eyes.
- Do not ingest solutions, tablets, droplets or spillage from lab ware. Do not inhale fumes from products or mixing reactions.
- Cyanide is extremely poisonous. Potassium Cyanide should be stored away from water and acids. Always add Cyanide AFTER ADDING Potassium Hydroxide and NEVER BEFORE.
- Many products furnished are highly inflammable, some have explosive potential.
- Most acids are corrosive.
- Keep all bottles and containers capped and sealed to prevent accidental spillage and to increase shelf-life.
- Never pipet chemical reagent solutions or unknown water samples by mouth.

## WARNING

- DO NOT INDUCE VOMITING if any of the following chemicals are ingested:

Alkalinity Titration Reagent (Sulfuric Acid)  
Alkaline Potassium Iodide Solution  
Spadns Reagent  
Hydrochloric Acid  
Reagent "A" (Potassium Bisulfate and Copper Sulfate Pentahydrate)  
Reagent "D" (4(Nitrobenzyl) Pyridine and Potassium Perchlorate and Urea)  
Reagent "E" (Potassium Carbonate)  
Reagent "G" (Halazone Tablets)  
Reagent "H" (Dimethoxybenzidine)  
Reagent "I" (Potassium Carbonate and Sodium Metaphosphate)  
Reagent "J" (Perdox" (Sodium Borate)  
Reagent "X" (Orthotolidine Dihydrochloride)  
Substrate Solution (Ligroine and 2, 6 Dichloroindophenol Acetate)  
Trihydroxymethyl aminomethane (TRIS)

- INDUCE VOMITING if any of the following chemicals are ingested:

Isopropyl Alcohol  
DPD (Diethyl-P-Phenylene Diamine)  
Wide Range pH Indicator Solution  
Arsenite Solution  
Nessler's Reagent APHA  
Sulfaver IV  
Sodium Hydroxide Standard Solution  
Chloride Titrant (Silver Nitrate)  
Phenolphthalein Indicator Solution  
Manganese Sulfate Solution  
Sodium Thiosulfate Solution  
Zinc Reagent  
Standard Barium Chloride Reagent  
Reagent "K" (Acetone and Zylenes)

### IMPORTANT

Refer to the specific "Step-By-Step" instructions relative to accidents as defined in the paragraphs covering each specific chemical.

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**OPERATOR AND ORGANIZATIONAL MAINTENANCE MANUAL**

**WATER QUALITY ANALYSIS/SETS  
PREVENTIVE MEDICINE  
NSN 6630-00-140-7826  
ENGINEER  
NSN 6630-00-140-7820**

**REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS**

You can help improve this manual. If you find any mistakes, or if you know of a way to improve these procedures, please let us know. Mail your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in the back of this manual directly to: Commander, US Army Aviation and Troop Command, ATTN: AMSAT-I-MP, 4300 Goodfellow Blvd., St. Louis, MO 63120-1798. You may also submit your recommended changes by E-mail directly to <mpmt%avma28@st-louis-emh7.army.mil>. A reply will be furnished directly to you. Instructions for sending an electronic 2028 maybe found at the back of this manual immediately preceding the hard copy 2028.

\*This manual supersedes TM 5-6630-215-12 dated 16 June 1977 and all changes.

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## CHAPTER 1 INTRODUCTION

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#### 1-1 SCOPE.

**Type of Manual:** Operator and Organizational Maintenance.

**Model Number and Equipment Name:** Water Quality Analysis Sets Preventive Medicine, NSN 6630-00-140-7826, Engineer, NSN 6630-00-140-7820.

**Purpose of Equipment:** To provide immediate information concerning the presence of chemical contamination of water in order to determine the type of purification equipment and to monitor the equipment when installed in the field.

#### 1-2. MAINTENANCE FORMS AND RECORDS.

Department of the Army forms and procedures used for equipment maintenance will be those prescribed by DA Pam 738-750, The Army Maintenance Management System (TAMMS).

#### 1-3. ADMINISTRATIVE STORAGE.

**a.** Placement of equipment in administrative storage should be for short periods of time when a shortage of maintenance effort exists. Items should be in mission readiness within 24 hours or within the time factors as determined by the directing authority. During the storage period appropriate maintenance records will be kept.

**b.** Before placing equipment in administrative storage, current maintenance services and equipment serviceable criteria (ESC) evaluations should be completed, shortcomings and deficiencies should be corrected, and all modification work orders (MWO's) should be applied.

**c.** Storage site selection. Inside storage is preferred for items selected for administrative storage. If inside storage is not available, trucks, vans, conex containers and other containers may be used.

#### 1-4. DESTRUCTION OF ARMY MATERIAL TO PREVENT ENEMY USE.

**a.** Submergence of equipment and repair parts underwater (lakes, ponds, bogs, swamps, etc.) or by concealment by hiding material in caves, or, preferably by burial, can be used effectively.

**b.** Dispersal. Widely dispersed scattering of material, preferably into heavy underbrush, can serve as a denial or delaying measure. In the event the area is recaptured, effort should be made to recoup concealed items.

**c.** TM 750-244-3. Procedure for Destruction of Equipment to Prevent Enemy Use, contains further information.

1-5. REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIR).

EIR can and must be submitted by anyone who is aware of an unsatisfactory condition with the equipment design or use. It is not necessary to show a new design or list a better way to perform a procedure, just simply tell why the design is unfavorable or why a procedure is difficult. EIR may be submitted on SF 368 (Quality Deficiency Report). Mail directly to Commander, U.S. Army Troop Support Command, ATTN: AMSTR-QX, 4300 Goodfellow Boulevard, St. Louis, MO 63120-1798. A reply will be furnished directly to you.

Section II. EQUIPMENT DESCRIPTION AND DATA

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1-6. DESCRIPTION.

a. General. This manual describes two sets; the Water Quality Analysis Set (WOAS) - Preventive Medicine (fig. 1-1) and the Water Quality Analysis Set (WOAS) - Engineer (fig. 1-2). Each unit is designed for field use.

b. Preventive Medicine. This set is designed for on-site monitoring of the quality of raw water sources waste water effluents and drinking water produced. Its main components are:

- (1) Acidity test kit.
- (2) High range chloride test kit.
- (3) Iron test kit.
- (4) Dissolved oxygen test kit.

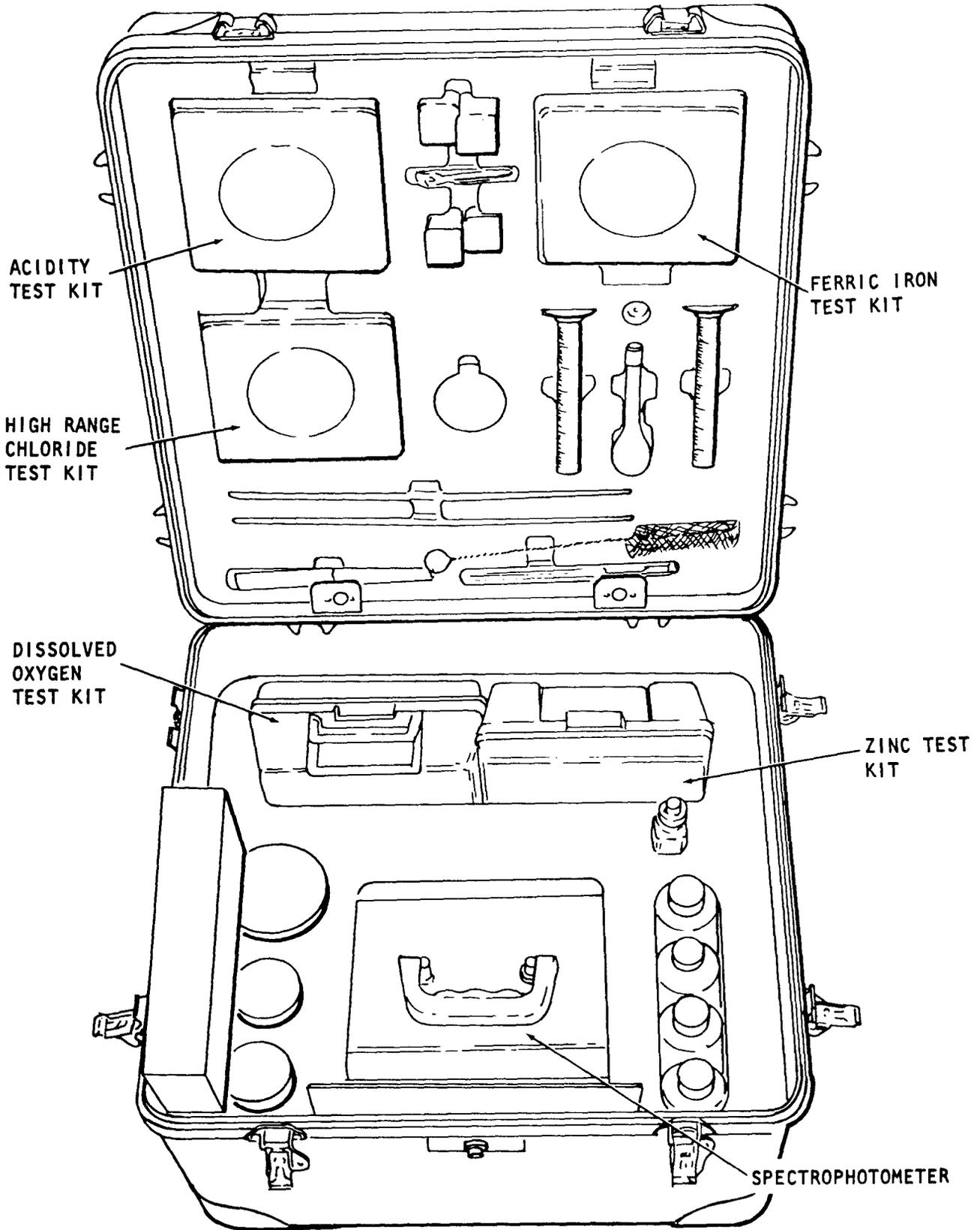


Figure 1-1. WQAS - Preventive Medicine

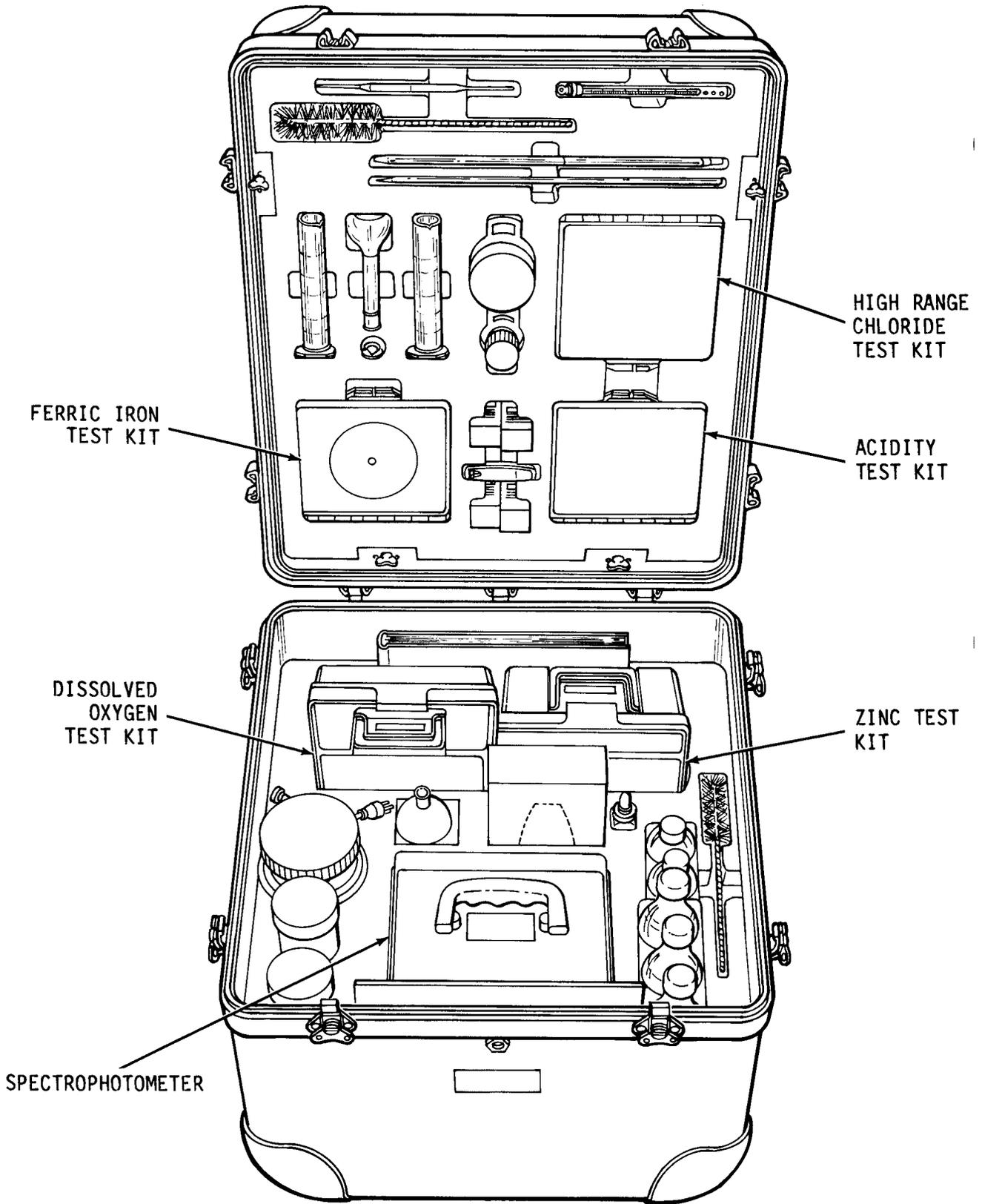


Figure 1-1.1. WOAS - Preventive Medicine (Not Used in Buys 1 and 2)

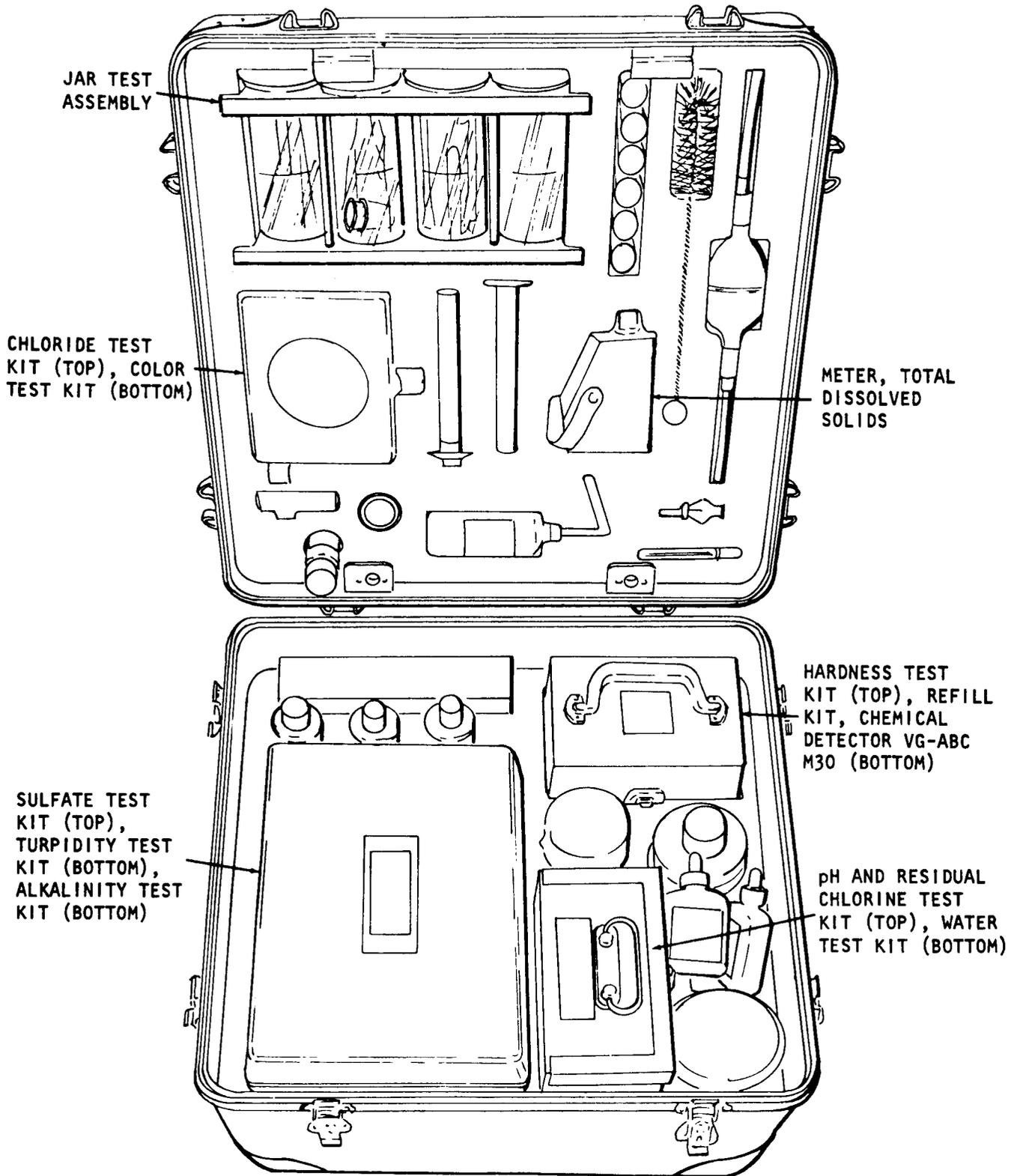


Figure 1-2. WQAS - Engineer

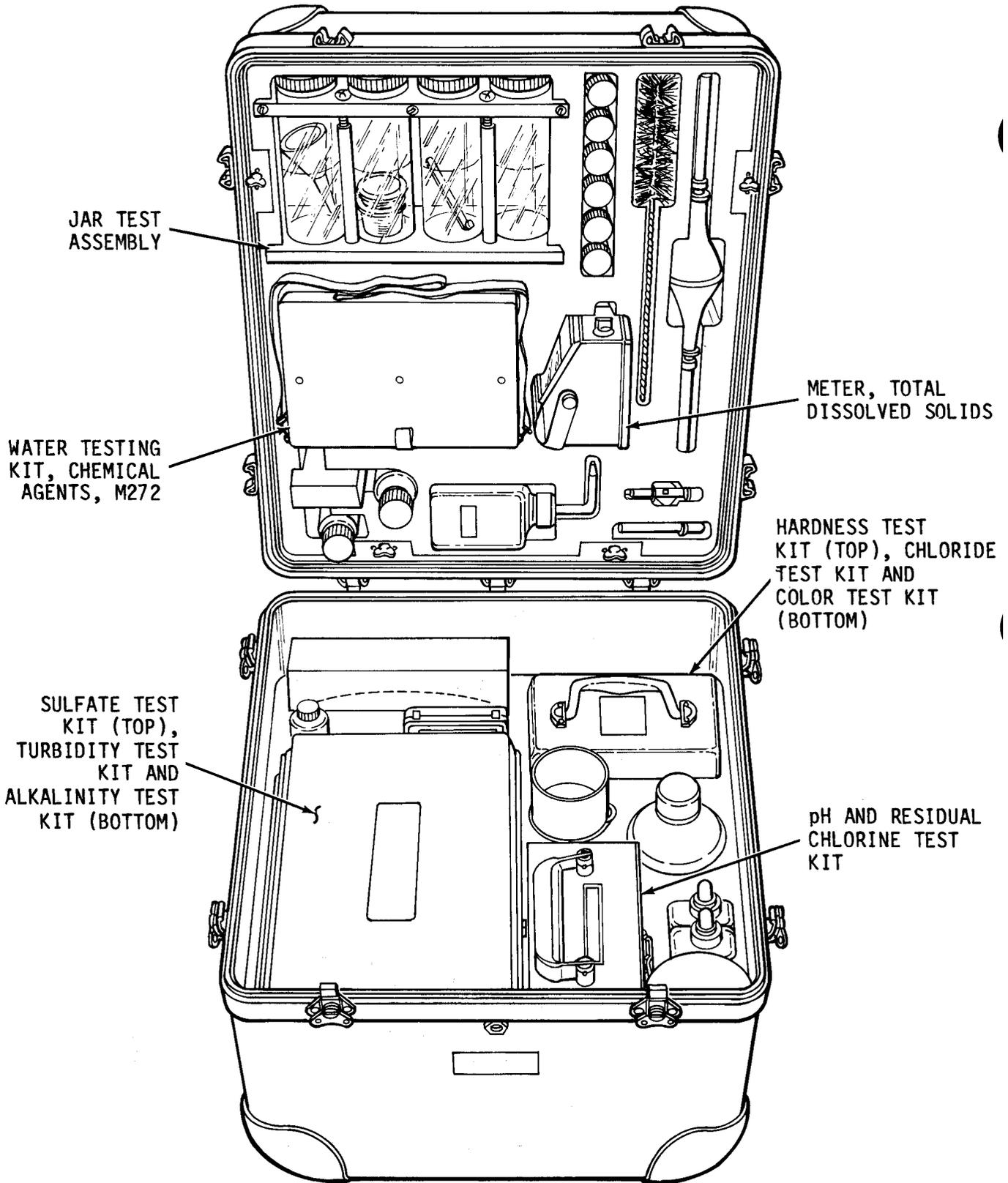


Figure 1-2.1. WOAS - Engineer (Not Used in Buys 1 and 2)

- (5) Zinc test kit.
- (6) Multipurpose test spectrophotometer.
- (7) Supporting lab-ware and reagents.

c. WQAS - Engineer. This set is designed to provide immediate information concerning the presence of chemical contamination of water in order to determine the type of purification equipment required and to monitor the equipment when installed. Its main components are:

- (1) Turbidity test kit.
- (2) Low-range chloride test kit.
- (3) Sulfate test kit.
- (4) Hardness test kit.
- (5) Alkalinity test kit.
- (6) Color test kit.
- (7) pH and residual chlorine test kit.
- (8) Conductivity meter.
- (9) Water testing kit of chemical agents -AN- M2. (Supplied in buys 1 and 2 only.)
- (10) Refill kit, chemical detector, VG, ABC-M30. (Supplied in buys 1 and 2 only.)
- (11) Supporting lab-ware and reagents.
- (12) Water testing kit, chemical agents - M272. (Not supplied in buys 1 and 2.)

d. (DELETED)

#### 1-7. TABULATED DATA.

a. Identification, Warning Labels and Instruction Plates. The contents are covered in the operating instructions in Chapter 2. It should be noted that when test instructions cannot be affixed to the inside cover, they will be positioned nearby. Each chemical container has warning and identification labels attached directly on the container. First aid and antidote information is contained in the warning label when necessary. The location of labels and instructions are listed in table 1-1 below.

b. Weight. The WQAS (preventive medicine) and the WQAS (engineer) are proportioned so as to weigh less than 65 pounds each. Each set may be carried by one man.



Table 1-1. Location of Labels and Instructions

WQAS Manual TM 5-6630-215-12 is located in the WQAS-Engineer case (10, fig. 1-6).

Items	I.D. Labels	Warnings*	Instructions
Kits	Top		Inside Cover
Solutions	Front	Back or side	
Powders	Front	Back or Side	
Cleaning	Front	Back or Side	
Water	Front		
Packages	Front/Top	Back or Side	Inside Package

\*As applicable.

### 1-8. LOADING DIAGRAMS.

**a.** WQAS-Preventive Medicine Loading Diagram is presented as a sketch of contents in the upper and lower carrying case (fig. 1-5).

**b.** WQAS-Engineer Loading Diagram is presented as a sketch of contents and the upper and lower carrying case (fig. 1-6).

**c.** Mission Completion. Upon completion of a mission, all components of the sets, and the kits included in the sets, are to be stowed in the spaces provided for them as illustrated in the loading diagrams (fig. 1-5 and 1-6). Lab-ware and containers of chemicals are to be cleaned, evaluated for function and shortages noted (para 3-2). Since interference substances will affect test results, particular effort shall be made to keep the lab-ware in as clean and sterile a condition as possible.

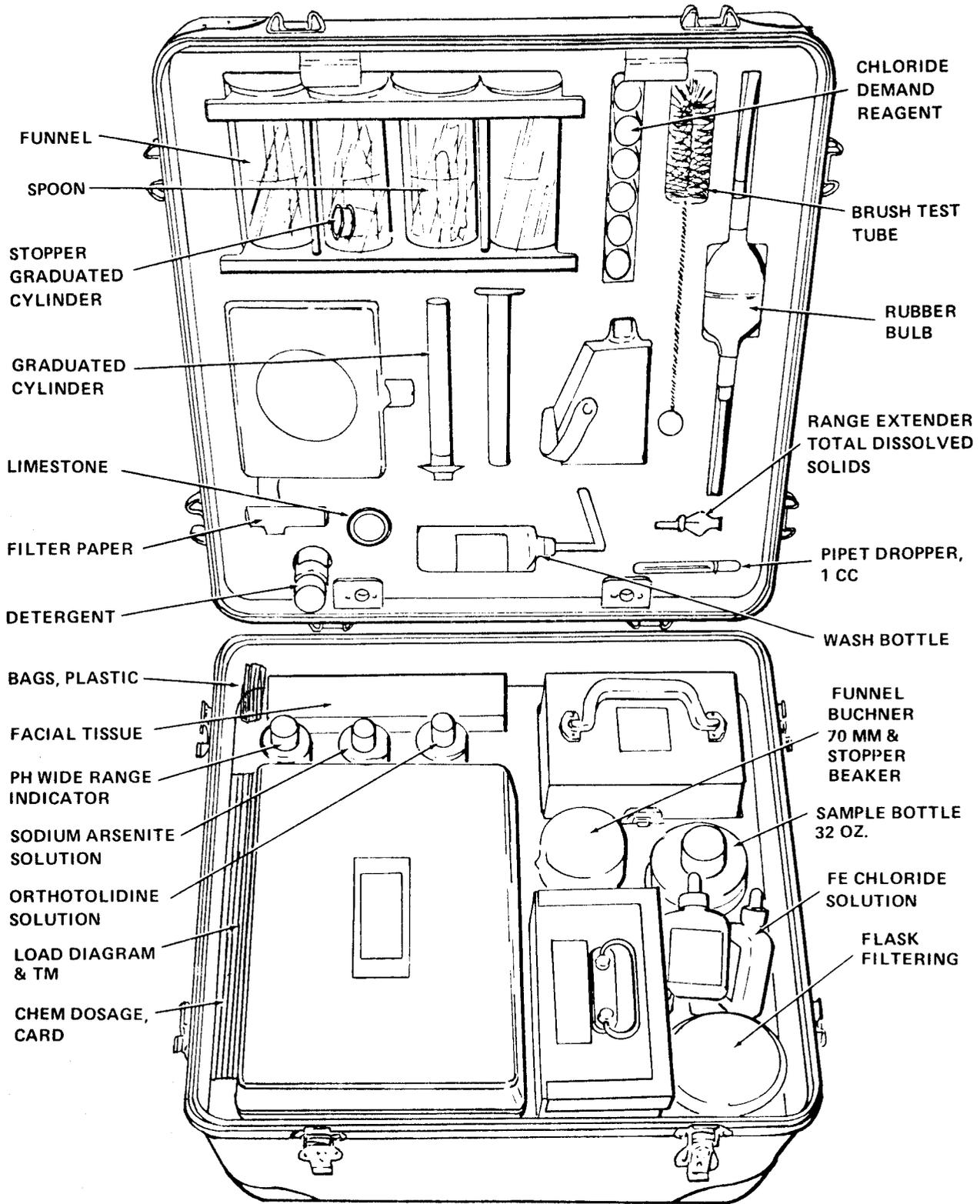


Figure 1-4. WQAS - Engineer, Lab-Ware and Support Items

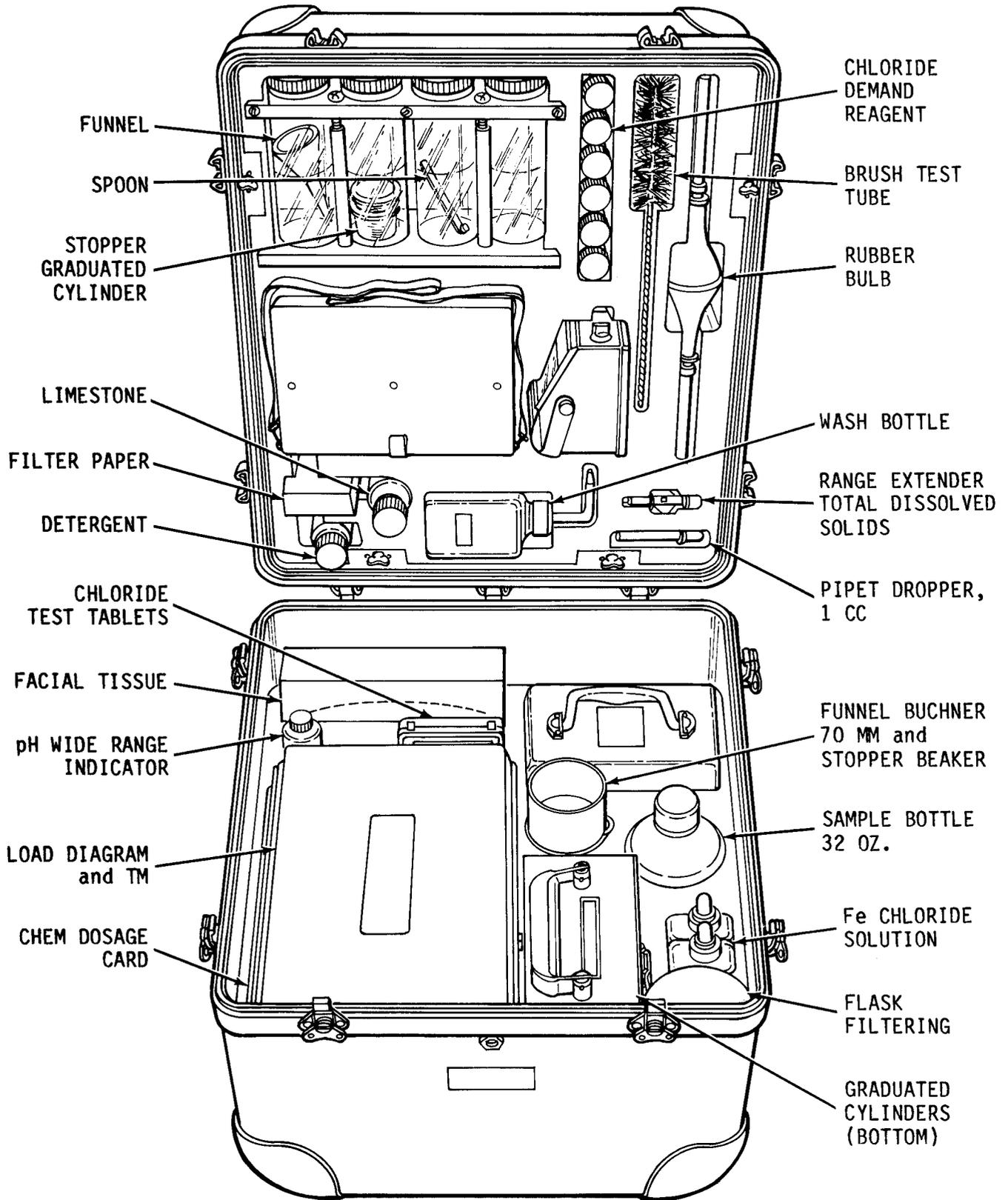


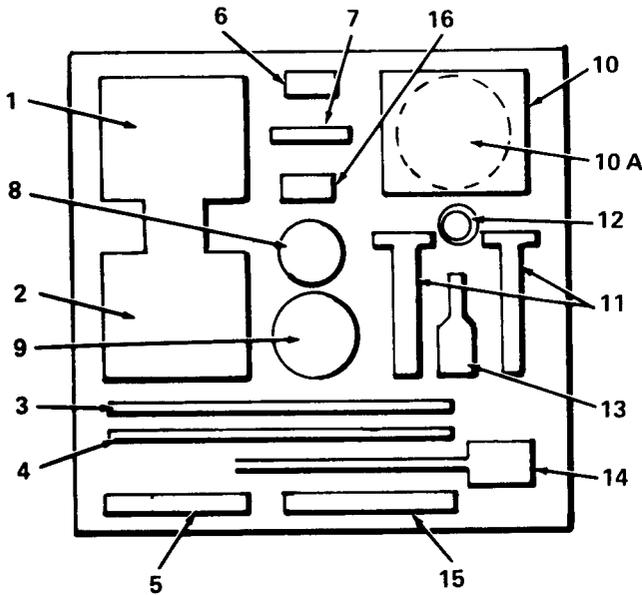
Figure 1-4.1. WQAS - Engineer, Labware and Support Items  
(Not Used in Buys 1 and 2)



**LOADING DIAGRAM**

**CASE, TOP**

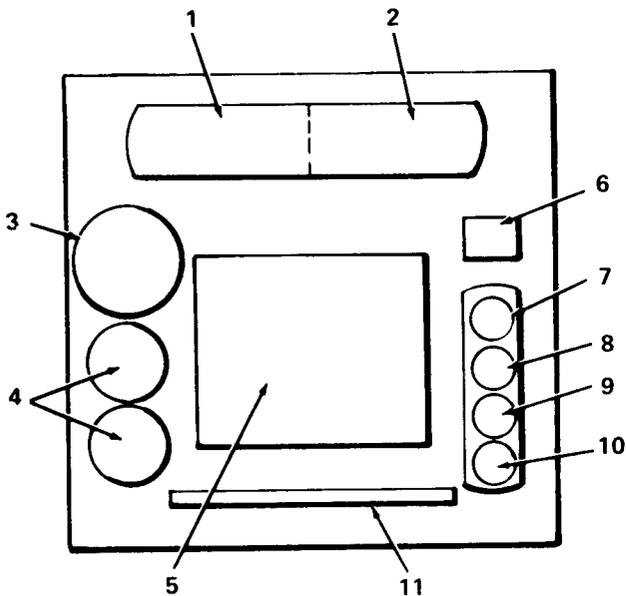
**WATER QUALITY ANALYSIS - PREVENTIVE MEDICINE**



1. Acidity Test Kit (No. 13222E0614)
2. Chloride Test Kit, High Range (No. 13222E0615)
3. Pipet, Volumetric Transfer, 1 ML
4. Pipet, Volumetric Transfer, 5 ML
5. Thermometer
6. Ferrover, for 5 ML Samples (No. 13222E0714)
7. Clipper, Large Powder Pillow
8. Detergent
9. Ferrous Iron Test Reagent Powder Pillows (No. 13222E0715)
10. Ferric Iron Test Kit (No. 13222E0617)
- 10A. Color Disc (0-10.0 mg/L)
11. Cylinder, Graduated, 25 ML
12. Stopper, Volumetric Flask
13. Flask, Volumetric, 25 ML
14. Brush, Test Tube
15. Pipet, Micro
16. Ferrover, for 25 ML Samples (No. 13222E0657)

**LOADING DIAGRAM**

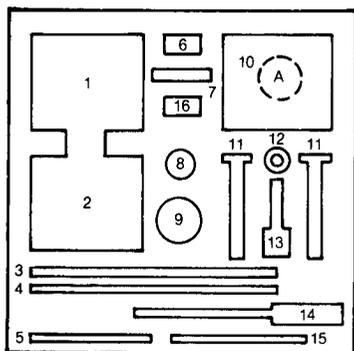
**CASE, BOTTOM**



1. Dissolved Oxygen Test Kit
2. Zinc Test Kit
3. Nitrate Test Reagent Powder Pillows
4. Sulfate Test Reagent, Powder Pillows
5. Spectrophotometer
6. Salt Solution, Rochelle
7. Flouride Solution, Standard
8. Flouride Solution, Spadns Method
9. Indicator Solution, ph Wide Range
10. Reagent Test Solution, Nessler's, APHA
11. Instruction Card for Multi-Purpose Test Kit and Loading Plan

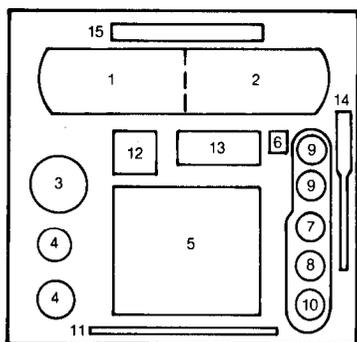
Figure 1-5. WQAS - Preventive Medicine, Loading Diagram

### LOADING DIAGRAM CASE, TOP WATER QUALITY ANALYSIS SET, PREVENTIVE MEDICINE



1. ACIDITY TEST KIT
2. CHLORIDE TEST KIT, HIGH RANGE
3. PIPET, VOLUMETRIC, TRANSFER, 1ml
4. PIPET, VOLUMETRIC, TRANSFER, 5ml
5. THERMOMETER
6. FERRIC IRON, PHENANTHROLINE, 5-ml SAMPLES
7. CLIPPER, LARGE, POWDER PILLOW
8. DETERGENT
9. FERROUS IRON, TEST REAGENT, POWDER PILLOWS
10. FERRIC IRON TEST KIT  
A. COLOR DISC
11. GRADUATED CYLINDER, 25ml
12. STOPPER, VOLUMETRIC FLASK
13. VOLUMETRIC FLASK, 25ml
14. BRUSH, TEST TUBE
15. MICRO PIPET
16. FERRIC IRON, PHENANTHROLINE, 25ml SAMPLES

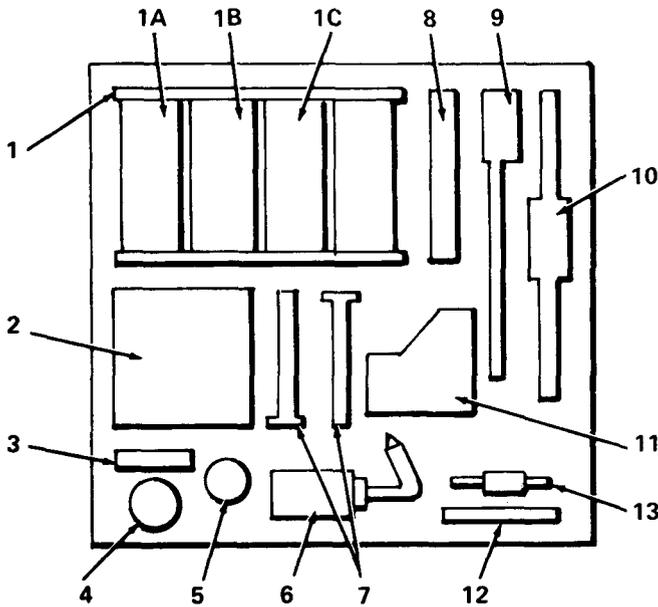
### LOADING DIAGRAM CASE, BOTTOM WATER QUALITY ANALYSIS SET, PREVENTIVE MEDICINE



1. DISSOLVED OXYGEN TEST KIT
2. ZINC TEST KIT
3. NITRATE TEST REAGENT, POWDER PILLOWS
4. SULFATE TEST REAGENT, POWDER PILLOWS
5. SPECTROPHOTOMETER
6. SALT SOLUTION, ROCHELLE
7. FLUORIDE SOLUTION, STANDARD
8. FLUORIDE SOLUTION, SPADNS METHOD
9. INDICATOR SOLUTION, SPADNS METHOD
10. REAGENT TEST SOLUTION, NESSLERS, APHA
11. INSTRUCTION CARD FOR MULTIPURPOSE TEST KIT AND LOADING PLAN
12. FILLER, SAFETY
13. TISSUE, FACIAL
14. BRUSH, SAMPLE CELL
15. TECHNICAL MANUAL

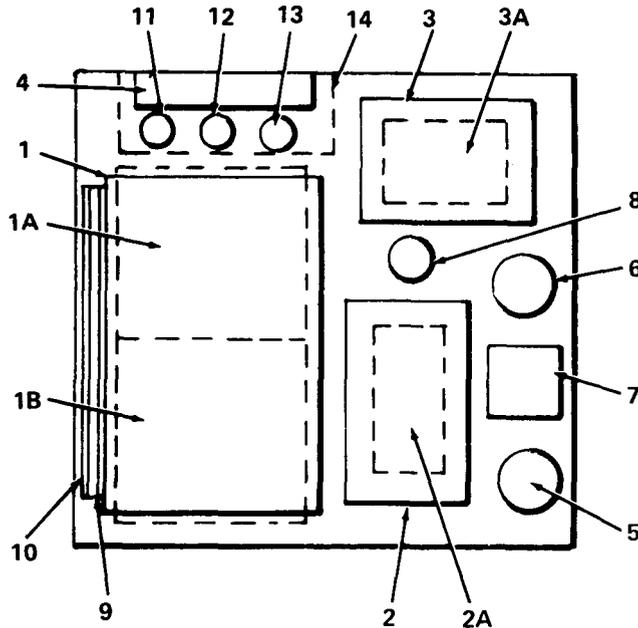
Figure 1-5. 1. WQAS - Preventive Medicine, Loading Diagram  
(Not Used in Buys 1 and 2)

**LOADING DIAGRAM  
CASE TOP  
WATER QUALITY ANALYSIS SET – ENGINEER**



1. Jar Test Assembly (No. 13222E0745)
  - A. Funnel, 45 mm
  - B. Stopper, Graduated Cylinder (2 ea.)
  - C. Spoon, Measuring, .05 gm
2. (TOP) Chloride Test Kit, Low Range, (No. 13222E0622)  
(BOTTOM) Color, Test Kit (No. 13222E0623)
3. Paper, Filter, 7.0 cm
4. Detergent (No. 13222E0712)
5. Limestone, Powdered, Analytical Grade, (No. 13222E0746)
6. Bottle, Wash, 250 ML w/Resin (No. 13222E0736)
7. Cylinder, Graduated, 25 ML (2 ea.)
8. Halazone (No. 13222E0738) (6 ea.)
9. Brush, Test Tube
10. Bulb, Rubber
11. Meter, Total Dissolved Solids
12. Pipet, Dropper, 1 cc
13. Range Extender for Total Dissolved Solids Meter

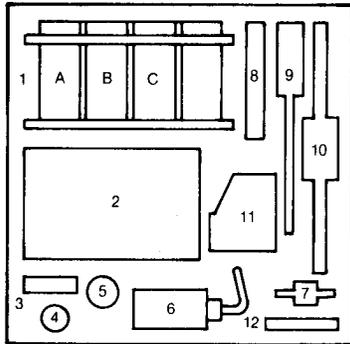
**LOADING DIAGRAM  
CASE BOTTOM**



1. Sulfate Test Kit (No. 13222E0625)
  - A. Turbidity Test Kit (No. 13222E0626)
  - B. Alkalinity Test Kit (No. 13222E0619)
2. Comparator, Color, Hydrogen Ion and Residual Chlorine
  - A. Water Test Kit, Chemical Agent, AN-M2
3. Hardness Test Kit (No. 13222E0634)
  - A. Refill Kit, Chemical Agent Detector, V-G Components, ABC-M30-A1
4. Tissue, Facial
5. Flask, Filtering, 500 ML
6. Bottle, Sample, 32 oz.
7. Ferric Chloride Solution (2 ea.)
8. Funnel, Buchner, 700 mm w/Stopper and 250 ML Beaker
9. Loading Diagram
10. Operator's Manual
11. Solution, Wide Range D ph Indicator
12. Solution, Arsenite
13. Orthotolidine Solution
14. Plastic Bags

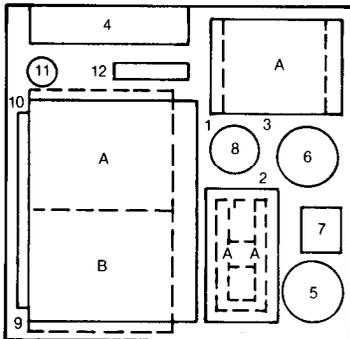
Figure 1-6. WQAS - Engineer, Loading Diagram

## LOADING DIAGRAM CASE, TOP WATER QUALITY ANALYSIS SET, ENGINEER



1. JAR ASSEMBLY
  - A. FUNNEL, 45 mm
  - B. (2 EACH) STOPPER, GRADUATED CYLINDER
  - C. MEASURING SPOON, 0.05 gm
2. WATER TESTING KIT, CHEMICAL AGENTS M272
3. FILTER PAPER, 7.0cm
4. DETERGENT
5. LIMESTONE
6. WASH BOTTLE
7. RANGE EXTENDED FOR TOTAL DISSOLVED SOLIDS METER
8. CHLORINE DEMAND REAGENT (6 EACH)
9. TEST TUBE BRUSH
10. RUBBER BULB
11. TOTAL DISSOLVED SOLIDS METER
12. PIPET DROPPER, 1cc

## LOADING DIAGRAM CASE, BOTTOM WATER QUALITY ANALYSIS SET, ENGINEER



1. SULFATE TEST KIT
  - A. TURBIDITY TEST KIT
  - B. ALKALINITY TEST KIT
2. COLOR COMPARATOR
  - A. GRADUATED CYLINDER, 25ml
3. HARDNESS TEST KIT
  - A. TOP-CHLORIDE TEST KIT
  - BOTTOM-COLOR TEST KIT
4. FACIAL TISSUE
5. FLASK, FILTERING, 500ml
6. SAMPLE BOTTLE, 32oz
7. FERRIC CHLORIDE SOLUTION (2 EACH)
8. FUNNEL, BUCHNER, 70mm AND STOPPER, BEAKER, 250ml
9. LOAD DIAGRAM, INSTRUCTION CARDS
10. OPERATION MANUAL
11. pH WIDE-RANGE INDICATOR SOLUTION
12. CHLORINE TEST TABLETS

Figure 1-6. 1. WQAS - Engineer, Loading Diagram  
(Not Used in Buys 1 and 2)

## 1-9. INITIAL PREPARATION.

The contents and nomenclature of the WQAS has been illustrated in the forgoing pages. If the actual sets are available, familiarize yourself with them. Review the names of the chemicals carried on the labels, lab-ware and support items contained therein. Remember the danger involved in the careless handling of chemicals. Heed the warnings given in front of each test described in Chapter 2 and summarized on the Warning page.

## 1-10. HAND RECEIPT

Hand receipts for Components of End Item (COEI), Basic Issue Items (BII), and Additional Authorization List (AAL) items are published in a Hand Receipt manual, TM 5-6630-215-12HR. This manual is published to aid in property accountability and is available through Commander, US Army AG Publications Center, 2800 Eastern Boulevard, Baltimore, MD 21220.



## CHAPTER 2

## OPERATING INSTRUCTIONS

## Section I. OPERATING PROCEDURES

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## 2-1. WATER TEST INFORMATION

2-2. GENERAL. The purpose of this section is to provide information which will be useful to the operator who has limited training or experience in water testing. A brief review of some of the needs for and some of the properties of water which necessitate water testing are as follows:

a. Water. An adequate water supply is a matter of life or death for troops, or other human beings in the field. Man might survive for months without food but would die in about a week without drinkable water. Water makes up approximately 60% of a man's weight, or on the average about 47 liters (50 quarts). Every day, man must replenish about 2.37 liters (2.5 quarts) of it. Water is essential for blood circulation, waste removal and muscle movements. As a substance water is odorless, tasteless and colorless. As a chemical, it is a weak acid and remarkable solvent. It draws away from most organic (carbon compounds) substances but is strongly attracted toward the absorption of inorganic substances. Water is so benign that many forms of life can thrive within it - and so corrosive that, given time, it will

disintegrate the toughest metal. These germs, bacteria, and minute toxic particles remain within it in a suspended state. When ingested they affect taste and smell; can be harmful or deadly poisonous to the body's organs, muscle tissue, brain cells and nervous system. Water, to be used, must be restored to the drinkable state commonly referred to as potable water. Potable water can contain certain measured amounts of inclusions which medical and other evaluations have determined can be tolerated by the body mechanisms. The operator will test the available water and measure these inclusions to determine whether or not they are within these limits (table 2-8).

b. Water Cleansing Systems. There are various methods and systems to restore or to make water which is acceptable for human consumption. These are covered in other manuals.

c. Water Samples. Methods for collecting, measuring and preparing water samples are described and illustrated. The Glossary should be referred to for definitions of vocabulary and abbreviations used in the text. Some meanings of terms and methods of lab-ware use, common to both the Preventive Medicine and Engineer Sets are set forth below.

**CAUTION**

The shelf life of reagents and standards may be significantly shortened if they are exposed to direct sunlight, extremes of heat, or moisture. By protecting them from these environmental conditions, maximum shelf life will be gained.

2-3. STABILITY OF REAGENTS AND STANDARDS. There is a useful lifetime for any chemical preparation. Each bottle or container has imprinted on the label the manufactured lot number and expiration date. It is recommended that occasional checks of the reagents be made by performing tests with standard solutions. If the results compare favorably, tests can be conducted with confidence. If the result does not agree, it may be due to an incorrectly performed procedure, a deteriorated reagent, or even a defective standard solution.

2-4. TAKING WATER SAMPLES. Water samples collected for analysis should be collected in such a way as to provide the most representative sample possible. In general, they should be taken near the center of the vessel or duct and below the surface. Use only clean bottles, beakers, etc. for collecting samples and rinse the container several times with the water to be sampled. Samples should be taken as close as possible to the source of the supply to minimize the effect of a distribution system. Enclosed water systems should be allowed to run for a sufficient time to flush the system and the sample container should be filled slowly with a gentle stream to avoid turbulence and air bubbles. Water samples from wells should be collected after the pump has run long enough to be delivering water that is representative of the ground water feeding the well.

a. Multiple Tests. It is difficult to obtain a truly typical sample when collecting surface water samples. More meaningful results can be obtained by running a series of tests with samples taken from several locations and depths and at different times. The results can then be used to establish patterns applicable to that particular body of water.

b. Time Lapse. As little time as possible should lapse between collecting the sample and making the analysis. Depending on the nature of the test, special precautions in handling the sample may also be necessary to prevent natural interferences such as organic growth or loss or gain of dissolved gases.

c. Best Test Temperature. All of the calorimetric and titrimetric tests described in this manual should be performed with sample temperature between 20°C (68°F) and 25°C (77°F). If certain tests require closer temperature control, it will be indicated in the procedure notes.

d. Volume Measurement Accuracy. The sample cells are marked to indicate approximately 25 ml or 50 ml. In most tests it is sufficiently accurate to fill to the mark without premeasuring in a graduated cylinder. In tests where volume measurements are critical, the procedure specifies the appropriate method.

## **WARNING**

Never pipet chemical solutions or unknown water samples by mouth.

(1) The moist, warm interior surfaces of the mouth form an incubator which will harbour and breed germs, bacteria, viruses and harmful toxic ingredients. Always prevent lacerated areas in the gums and interior mouth surfaces from coming in contact with the sample water, this will provide an entry into the body by direct absorption. When pipetting by mouth a certain amount of absorption by inhalation can be experienced. Over-suction of suspect water can cause an accidental swallowing or at the least a flooding of the mouth area. Placing the pipet in the mouth after rinsing (para 2-4) in the suspect water will be direct introduction. A safety pipet filler is provided in the preventive medicine set to permit transfer of chemicals and unknown water samples without using the mouth.

(2) If a sample must be diluted, it is strongly recommended that the pipet be used for volume measurement. Accuracy is important since a slight mistake in the measurement of a small sample will cause a substantial error in the result; for instance a 0.1 ml mistake in a measurement of a 1.0 ml sample produces a 10 percent error in the results.

(a) Mixing Water Samples. The following two methods may be helpful in tests where it is necessary to mix the water sample with chemicals (usually indicated by the instructions, "Swirl to mix").

1. When mixing is done in a square sample cell, the swirling motion is attained by a simple twisting motion as shown in figure 2-1. This is done by grasping the neck of the cell with the thumb and index finger of one hand while resting the concave bottom of the cell on the tip of the index finger on the other hand. Rotate the cell quickly, first one way and then the other, to mix the samples.

2. A swirling motion is also recommended when the mixing takes place in a graduated cylinder or a titration flask. In this case, however, grip the cylinder (or flask) firmly with the tips of three fingers (fig. 2-1). Hold the cylinder at a 45 degree angle and twist the wrist. This motion will move the cylinder in an approximately 12-inch circle, thereby giving liquids an intense rotation which accomplished complete mixing in a few turns.

(b) Reading the Meniscus. When small sample quantities are used, the accuracy of the measurements is very important. Figure 2-2 illustrates the proper way of reading the sample level or the meniscus formed when the liquid wets the cylinder or pipet walls.

**WARNING**

Never pipet chemical solutions or unknown water samples by mouth.

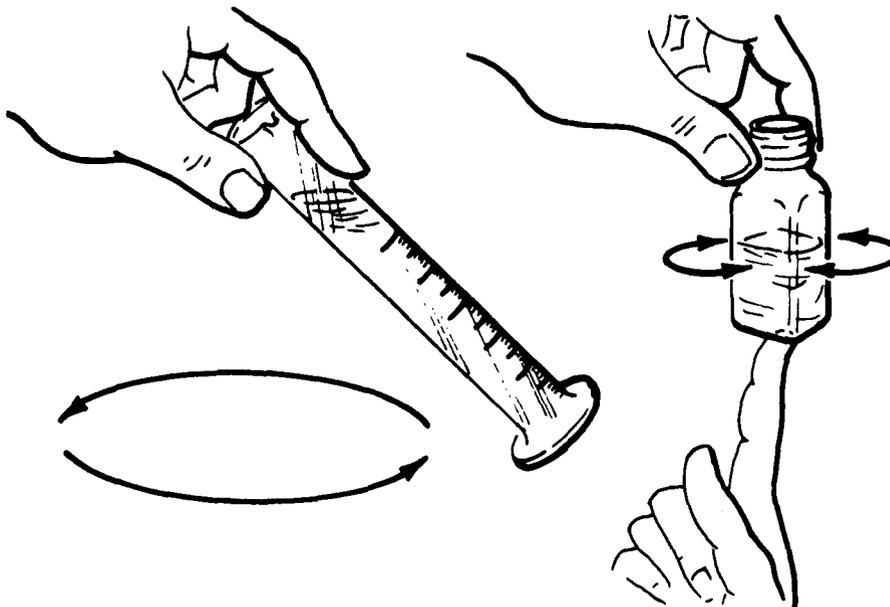


Figure 2-1. Swirling Techniques

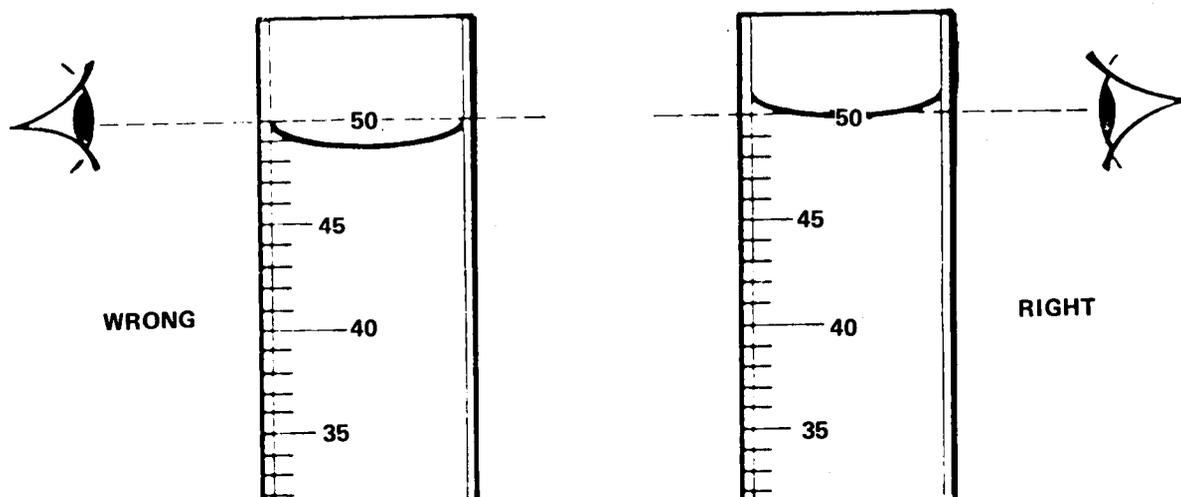


Figure 2-2. Reading the Meniscus

e. Use of Pipets and Cylinders. Rinse the pipet or cylinder two or three times with the sample to be tested before filling. Use a safety pipet filler to draw the sample into the pipet. When filling a pipet, keep the tip of the pipet below the surface of the sample as the sample is drawn into the pipet, or you will lose the suction and possibly introduce surface particles.

(1) Serological Pipets. Serological pipets are long tubes with a series of calibrated marks to indicate the volume of liquid that will be delivered by the pipet. The calibrated marks may extend to the tip of the pipet or may only be on the straight portion of the tube. Fill serological pipets to the zero mark and discharge the sample by allowing the sample to drain until the meniscus is level with the desired mark. If the serological pipet has calibrated marks extended to the tip of the pipet, the sample must be blown out of the tip for accurate sample measurements.

(2) Transfer Pipets. Transfer pipets are long tubes with a single ring to indicate the volume of liquid that will be delivered when it is filled to the mark. To discharge the sample from a transfer pipet, hold the tip of the pipet at a slight angle against the container wall and allow the sample or reagent solution to drain. Do not attempt to discharge that portion of the sample or reagent that remains in the tip of the pipet after draining. Transfer pipets are manufactured so that a reproducible amount of sample always remains in the tip of the pipet.

(3) The Rubber Bulb Pipet Filler. There are several types which may be used. The rubber bulb assembly can be used as illustrated (fig. 2-3). Insert the pipet into the sample; depress the bulb; restrict the intake end of the rubber tubing and release the bulb. Observe the pipet to ensure that the direction of suction is illustrated.

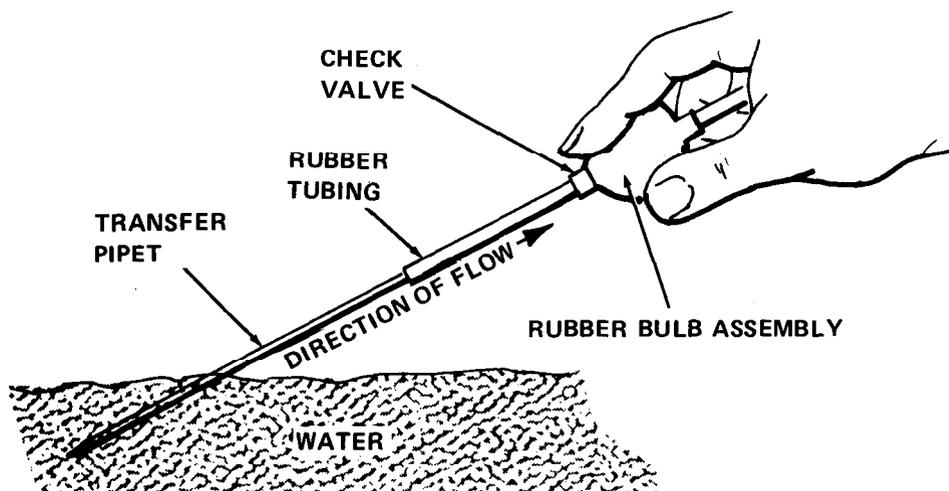


Figure 2-3. Rubber Bulb Pipet Filter

2-5. DROP COUNT METHOD. When titrating by drop count, the most accurate results will be obtained with the sample and titrating solution at room temperature and with the solution dispensed from a vertical dropper at the rate of 1 drop per second.

2-6. REAGENT POWDER PILLOWS. Dry powdered reagents are used wherever possible to minimize the problems of leakage and deterioration. For greatest convenience, the powders are packaged in individual, pre-measured, polyethylene or saran "Powder Pillows." Each pillow contains sufficient reagent for one test and is easily opened with nail clippers or scissors.

2-7. REAGENT BLANK-COLORIMETER TESTS. The term "reagent blank" refers to that effect wherein the reagent itself adds some color or turbidity to the sample being tested, thus giving erroneously high readings. In several of the tests, the blank is of such magnitude that compensation must be made each time the test is performed. This is done by zeroing the instrument on a blank sample, as in the case of the ammonia nitrogen test, paragraph 2-18d(1)(d). In most cases, however, the reagent blank is so very small that the instrument is zeroed on either an untreated portion of the original water sample or demineralized water. This is done routinely without any significant loss of accuracy, except where extremely small amounts of a constituent are sought. In such a case, it is best for the analyst to determine the reagent blank by performing the test on a sample of high-quality, turbidity-free demineralized water. The result is expressed as the milligrams per liter reagent blank and is subtracted from the results of subsequent tests using that particular bottle of reagent. It is necessary to determine the reagent blank only when the material is first used, and at intervals of several months, unless subsequent contamination is suspected.

2-8. REAGENT BLANK-TITRIMETRIC TESTS. Although a reagent blank is of lesser influence in titrimetric tests other than in calorimetric tests, occasionally it must be considered. In the usual procedure, the required amount of buffer and/or indicator are added to a small amount of demineralized water in the titrator flask to be used. This mixture is very carefully adjusted with titrant to obtain the desired end point. The amount of titrant used represents the reagent blank and should be deducted from the amount used in the test on the unknown sample.

2-9. INTERFERENCES. Analytical determinations are subject to interference from other substances present in the samples.

a. Interference may also be caused by a high concentration of the constituent under analysis. For example, the presence of a large excess of iron (say 30 mg/l) will cause the test to read less than full scale. Dilution of the sample to 5 mg/l will result in a reading higher than full scale. This indicates the need for even further dilution until meter indication is "on scale."

b. When a result is suspect (unusual answer is obtained, a color other than that expected is formed, or an unusual odor or turbidity is noticed), the test should be repeated on a sample diluted with demineralized water (para 2-10a.) and the result compared with the result of the original test. If these two results are not identical the original result is probably in error and a further dilution should be made to check the second test (first dilution).

2-10. SAMPLE DILUTION TECHNIQUES.

a. Colorimetric Tests (Spectrophotometers). Twenty-five milliliters (ml) is the specified size for the calorimetric tests. However, in some tests, the color that develops in the sample may be too intense to be measured, in other tests, colors other than those expected may occur. In both cases, it is necessary to dilute the original sample or investigate for possible interfering substances.

(1) For example, when performing a test, the spectrophotometer (operation described in para 2-17) may read above 0.5 mg/l on the pertinent meter scale. Since this is beyond the last division of the meter scale, a sample dilution is necessary. The test must be repeated, but with a 25-ml graduated cylinder filled to the 12.5-ml mark with the sample and then to the 25-ml mark with demineralized water. Since the sample was diluted to twice its original volume (12.5 to 25-ml), the meter reading should be multiplied by 2 to give the correct concentration.

(2) To accomplish the sample dilution conveniently, pipet the chosen sample portion into a clean graduated cylinder (or clean volumetric flask for more accurate work), and fill the cylinder (or flask) to the desired volume with demineralized water. Mix well, then use this diluted sample when running the test.

(3) As an aid, the following sample dilution table 2-1 shows the amount of water sample taken, the amount demineralized water used to bring the volume up to 25 ml, and the multiplication factor.

**Table 2-1. Sample Dilutions**

Water sample	Demineralized Water Used to bring the volume to 25 ml	Multiplication factor
25.0 ml	0.0 ml	1
12.5 ml	12.5 ml	2
*10.0 ml	15.0 ml	2.5
* 5.0 ml	20.0 ml	5
* 2.5 ml	22.5 ml	10
* 1.0 ml	24.0 ml	25
* 0.250 ml	24.75 ml	100

**\*Note: For sample sizes of 10 ml or less, a pipet should be used to measure the sample into the graduated cylinder or volumetric flask.**

b. **Titrimetric Test.** In conducting some tests the color change takes place after using only a few drops of titrant indicating a smaller amount of the substance being tested for. It is then desirable to use a larger sample and additional titrant to obtain more accurate results. The number of indicator powder pillows (and amount of liquid buffer, if any) must be increased by the same factor as the sample size. The result, also, must be divided by this factor. For example, if it is desired to titrate with 4 measuring tubes in the determination of total hardness, four indicator powder pillows and a 4 ml of buffer solution, are required and the result is divided by four (table 2-2). Dilution is recommended when a sample contains unusually large quantities of the substance to be determined and, consequently, requires many burettes full of titrant. In this case, a procedure similar to the one described previously (para 2-10) is recommended. If the sample size for titration is less than 25 ml, use only that portion of the dilution necessary to run the test. The multiplication factor will remain the same. For example, if it is desired to dilute to 1/5 of the original sample concentration for the determination of hardness, 5 ml of sample would be added to a graduated cylinder then add demineralized water to fill to 25 ml. The titration would then be performed with one measuring tube full of this dilution. The results would then be multiplied by 5.

c. **Standard Additions** is a widely accepted technique whereby an analyst can check the validity of his test results. Also known as "Spiking" and "Known Additions" the technique can also be used to check the performance of the reagents, the instruments and apparatus, and the procedure itself.

Table 2-2. Sample Sizes for Low Concentrations

Measuring - Water sample Tube size	Multiply indicator (and buffer, if any) used by:	Divide Result By
1 15 ml	1	1
2 30 ml	2	2
3 45 ml	3	3
4 60 ml	4	4

(1) Standard additions is performed by adding a small amount of a standard solution to a previously analyzed sample and then repeating the analysis using the same reagent, instrument and technique. The amount of increase in the test result should exactly equal the amount of standard added.

(2) For example, if a 25-ml water sample is analyzed for iron and is found to contain 1.0 mg/l, the result can be checked by adding 0.10 ml of a 50.0 mg/l iron standard solution to another 25-ml portion of the water sample and repeating the analysis. The result of the analysis on the second sample should be 1.2 mg/l iron since the standard added has a value of 0.2 mg/l; i.e.,

$$\frac{0.1 \text{ ml}}{25 \text{ ml}} \times 50 \text{ mg/l} = 0.2 \text{ mg/l}$$

If 0.2 mg/l is recovered from the 0.2 mg/l addition, the analyst can conclude that the first answer was correct and that the reagents, instruments and method used are all working properly.

Table 2-3. Dilutions for High Concentrations

Water sample (use pipet)	Demineralized water used to bring volume to approximately 50 ml (use graduated cylinder)	Multiplication factor
50.0 ml	0 ml	1
25.0 ml	25 ml	2
10.0 ml	40 ml	5
5.0 ml	45 ml	10

(3) Should the second analysis not give the correct amount of increase in the iron content, it must be concluded that the first answer may also be incorrect. The analyst must then determine why the technique did not work. By using a logical troubleshooting approach, the source of the problems can be determined whether the fault lies in the reagent, the instrument and apparatus, the test procedure or an interfering substance present in the test sample.

2-11. INSTRUCTIONS FOR USE OF MICRO BURETTE (Fig. 2-4). The micro burette consists of a graduated barrel (2) with a tipped plunger (1) that slides freely back and forth inside the barrel. The standard micro burette has twenty major (numbered) divisions (3) and each major division is divided into five subdivisions. All readings are made where the bottom of the plunger tip (4) intersects the graduated scale. Special dispenser flasks (5) and titration vials are used. These flasks include stoppers (6) into which the tip of the micro burette is inserted. To prevent leaking a tight fit is required, and the first use may require some pressure when inserting the burette tip into the fitting.

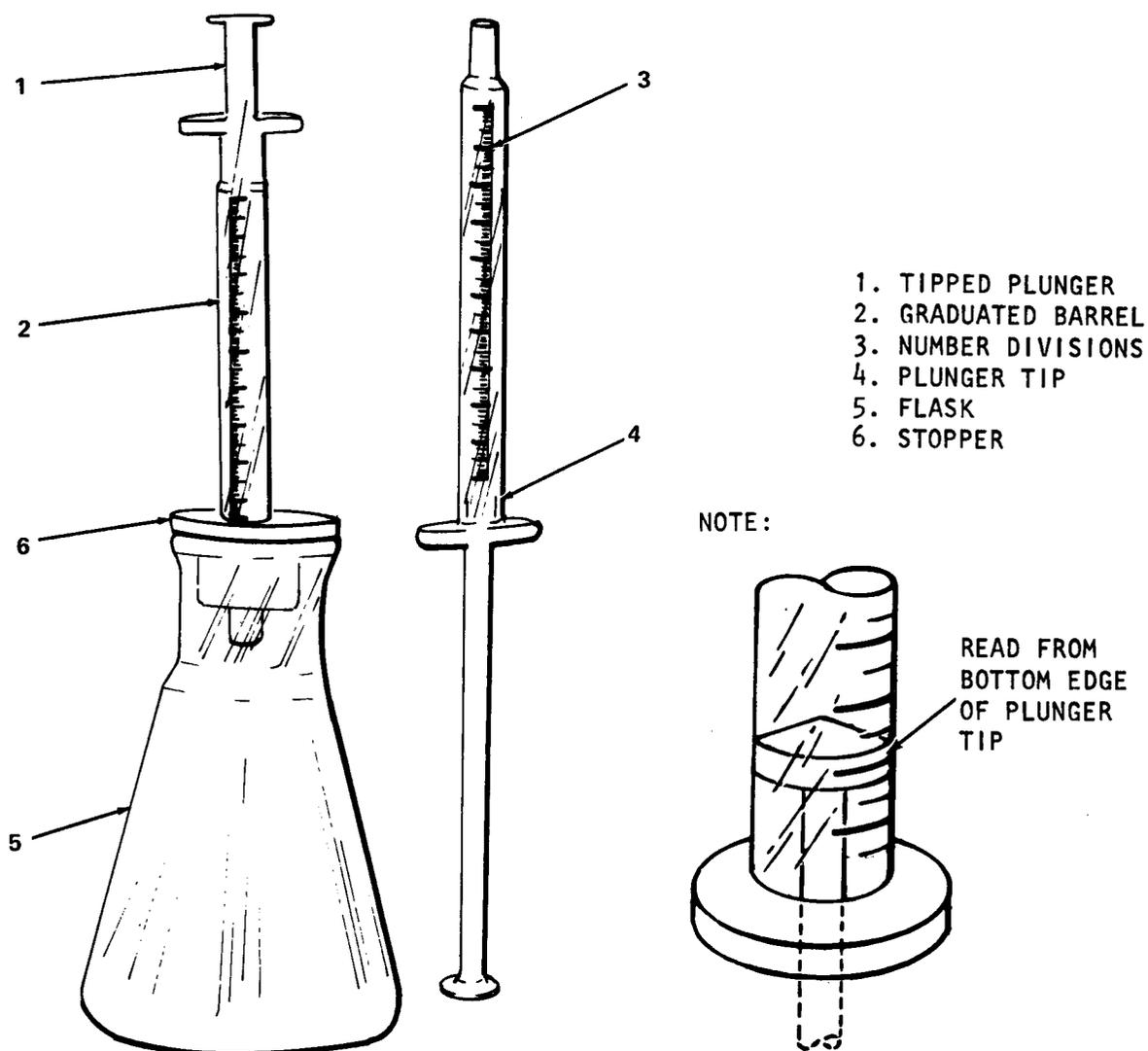


Figure 2-4. Micro Burette - Method of Using with Dispenser Bottles

- a. Carefully read the instructions given in the test procedure. Fill the titration vial with the proper amount of water sample. The necessary indicator, buffer, etc., should be added as outlined in the instruction and mixed with the test sample.
- b. Remove the cap from the titration reagent bottle, thus exposing the special plastic fitting. The plunger of the burette is depressed so that the plunger tip is resting on the bottom of the barrel. This expels the air from the barrel with the exception of a small amount of air in the constricted tip. The tip of the micro burette is pressed downward into the hole in the fitting.
- c. With the burette firmly inserted in the fitting, invert the bottle so that the solution in the bottle covers the tip of the burette. (This is the same action used by the doctors and nurses when they fill hypodermic syringes.) Withdraw the plunger which will fill the barrel with titration solution. The plunger is withdrawn until the bottom of the plunger tip is opposite the zero mark on the graduated scale. Turn the bottle right side up before removing the burette. Wipe the tip of the micro burette of any solution adhering to the outside of the tip. Recap the bottle of titrating solution. On some occasions, a small air bubble may appear under the tip of the plunger. Usually the air bubble can be expelled by partially filling the barrel with titrating solution, then expelling the solution back into the inverted reagent container. As the lowest graduation of the scale (line 20) is above the bottom of the barrel, the presence of this air bubble will not affect the accuracy of the reading. Be certain that the plunger tip is level with the zero graduation and that the final reading is made at the point on the scale opposite the bottom of the plunger.
- d. Hold the titration vial in one hand and the micro burette in the other. Slowly depress the plunger of the micro burette to expel the titration reagent. A slight rotating or twisting motion permits the plunger to move smoothly as it is depressed.
- e. Swirl the titration vial (fig. 2-1) so that each addition of titration reagent is thoroughly mixed with the sample. Continue adding titration reagent until the color change takes place in the test sample. If no color change is noted by the time the plunger tip reaches line 20, refill the burette from the titration reagent bottle, wipe off the tip, and continue adding titration reagent until the color change is observed.
- f. Do not count the number of drops of titration reagent added to the sample. The amount of titration reagent added is recorded in micro burette divisions. With experience, drops of different sizes may be expelled from the micro burette depending upon the angle at which it is held. If the micro burette is held vertically, the drops are large. As the burette is held more in a horizontal position, the drop size becomes smaller (this is useful when approaching the color endpoint and smaller increments of titration reagent are desired).

g. If a second filling of the micro burette is necessary, as mentioned above, make certain that the final result includes the value of the original divisions as well as the additional quantity added. For example, a color endpoint is reached at the 13.4 (two subdivisions below the 13 line) mark on the second filling of the micro burette. The result is 13.4 plus 20 or a total of 33.4 divisions. This number of divisions is then multiplied by the specific constant factor listed in each titrimetric procedure to yield the concentration of the parameter being tested.

h. As soon as the specific color change is observed (endpoint), stop any further movement of the micro burette plunger.

i. Read the result of the test at that point on the scale that is directly opposite the bottom of the plunger tip.

j. If additional tests, using the same reagents, are to be performed, the burette is refilled to the zero graduation. If no additional tests are to be made, the titration solution in the burette is discarded and the burette and titration vial are thoroughly rinsed with demineralized water and returned to the kit.

2-12. WASH BOTTLE WITH RESIN. The wash bottle contains mixed bed demineralize resin which will provide water of a purity beyond that of ordinary distilled water.

a. Refill the wash bottle with resin with the cleanest water available. If the water is turbid filter with turbidity - free water filter equipment (para 2-21).

b. The wash bottle with resin may be used until the resin changes from blue to yellow. On rare occasions, a raw water may carry an anaerobic bacteria which will grow in the resin and liberate a rotten odor. If this happens, the wash bottle with resin must be replaced.

2-13. CONVERSION FACTORS.

a. Hardness-Alkalinity Calcium Carbonate ( $\text{CaCO}_3$ ) (table 2-4).

b. Oxygen, Dissolved. Table 2-5 lists the mg/l dissolved oxygen in water at saturation for various temperatures and atmospheric pressures. The table was formulated in a laboratory using pure water; thus the values given should be considered as only approximations when estimating the desired oxygen content of a particular body of surface water.

Table 2-4. Conversion Factors

Calcium Hardness - (Calcium Carbonate - CaCO <sub>3</sub> , Calcium Oxide - CaO)								
Units of Measure	mg/l CaCO <sub>3</sub>	British gr/gal. Imperial CaCO <sub>3</sub>	American gr/gal. (US) CaCO <sub>3</sub>	French parts/100,000 CaCO <sub>3</sub>	German parts/100,000 CaO	mg/l	g/l CaO	lb/cu ft CaCO <sub>3</sub>
mg/lCaCO <sub>3</sub>	1.0	0.07	0.058	0.1	0.056	0.02	5.6x10 <sup>-4</sup>	6.23x10 <sup>-5</sup>
English gr/gal. CaCO <sub>3</sub>	14.3	1.0	0.83	1.43	0.8	0.286	8.0x10 <sup>-3</sup>	8.91x10 <sup>-4</sup>
USgr/gal.CaCO <sub>3</sub>	17.1	1.2	1.0	1.72	0.96	0.343	9.66x10 <sup>-3</sup>	1.07x10 <sup>-3</sup>
Fr.p/100,000 CaCO <sub>3</sub>	10.0	0.7	0.58	1.0	0.56	0.2	5.6x10 <sup>-3</sup>	6.23x10 <sup>-4</sup>
Ger.p/100,000 CaO	17.9	1.25	1.04	1.79	1.0	0.358	1.0x10 <sup>-2</sup>	1.12x10 <sup>-3</sup>
mg/l	50.0	3.5	2.9	5.0	2.8	1.0	2.8x10 <sup>-2</sup>	3.11x10 <sup>-3</sup>
g/lCaO	1,790.0	125.0	104.2	179.0	100.0	35.8	1.0	0.112
lb/cu ft CaCO <sub>3</sub>	16,100.0	1,123.0	935.0	1,610.0	300.0	321.0	9.0	1.0

Nitrogen

- Nitrite (NO<sub>2</sub>) = Nitrogen (N) x 3.28
- Nitrate (NO<sub>3</sub>) = Nitrogen (N) x 4.42
- Ammonia (NH<sub>3</sub>) = Nitrogen (N) x 1.22
- Ammonium (NH<sub>4</sub>) = Nitrogen (N) x 1.29

Phosphate

- Phosphorus (P) = Phosphate (PO<sub>4</sub>) x 0.326
- Phosphorus Pentoxide (P<sub>2</sub>O<sub>5</sub>) = Phosphate (PO<sub>4</sub>) x 0.75

**WEIGHTS/VOLUME CONSTANTS (FROM - TO, MULTIPLY BY)**

- 1 TROY LB - 0.373 KG
- 1 GRAM - 0.038 AVOIR. OZ.
- 1 U.S. FLUID OZ. - 29.573 ML
- 1 GRAM - 18.432 GRAINS
- 1 AVOIR. LB - 0.454 KG
- 1 GRAM - 0.032 TROY OZ.
- 1 BRIT. FLUID OZ. - 28.412 ML
- 1 KG. - 2.205 AVOIR. LB

**TEMPERATURE (CELSIUS/FAHRENHEIT) [(KELVIN °K = °C + 273°)]**



**INCHES - CENTIMETERS**



Table 2-5. Temperature Vs Pressure (mm, inches Hg) for Dissolved Oxygen (mg)

Temp		Pressure in Millimeters and Inches Hg							
		775	760	750	725	700	675	650	625 mm
°F	°C	30.51	29.92	29.53	28.54	27.56	26.57	25.59	24.61 inches
32.0	0	14.9	14.6	14.4	13.9	13.5	12.9	12.5	12.0
33.8	1	14.5	14.2	14.1	13.6	13.1	12.6	12.2	11.7
35.6	2	14.1	13.9	13.7	13.2	12.9	12.3	11.8	11.4
37.4	3	13.8	13.5	13.3	12.9	12.4	12.0	11.5	11.1
39.2	4	13.4	13.2	13.0	12.5	12.1	11.7	11.2	10.8
41.0	5	13.1	12.8	12.6	12.2	11.8	11.4	10.9	10.5
42.8	6	12.7	12.5	12.3	11.9	11.5	11.1	10.7	10.3
44.6	7	12.4	12.2	12.0	11.6	11.2	10.8	10.4	10.0
46.4	8	12.1	11.9	11.7	11.3	10.9	10.5	10.1	9.8
48.2	9	11.8	11.6	11.5	11.1	10.7	10.3	9.9	9.5
50.0	10	11.6	11.3	11.2	10.8	10.4	10.1	9.7	9.3
51.8	11	11.3	11.1	10.9	10.6	10.2	9.8	9.5	9.1
53.6	12	11.1	10.8	10.7	10.3	10.0	9.6	9.2	8.9
55.4	13	10.8	10.6	10.5	10.1	9.8	9.4	9.1	8.7
57.2	14	10.6	10.4	10.2	9.9	9.5	9.2	8.9	8.5
59.0	15	10.4	10.2	10.0	9.7	9.3	9.0	8.7	8.3
60.8	16	10.1	9.9	9.8	9.5	9.1	8.8	8.5	8.1
62.6	17	9.9	9.7	9.6	9.3	9.0	8.6	8.3	8.0
64.4	18	9.7	9.5	9.4	9.1	8.8	8.4	8.1	7.8
66.2	19	9.5	9.3	9.2	8.9	8.6	8.3	8.0	7.6
68.0	20	9.3	9.2	9.1	8.7	8.4	8.1	7.8	7.5
69.8	21	9.2	9.0	8.9	8.6	8.3	8.0	7.7	7.4
71.6	22	9.0	8.8	8.7	8.4	8.1	7.8	7.5	7.2
73.4	23	8.8	8.7	8.5	8.2	8.0	7.7	7.4	7.1
75.2	24	8.7	8.5	8.4	8.1	7.8	7.5	7.2	7.0
77.0	25	8.5	8.4	8.3	8.0	7.7	7.4	7.1	6.8
78.8	26	8.4	8.2	8.1	7.8	7.6	7.3	7.0	6.7
80.6	27	8.2	8.1	8.0	7.7	7.4	7.1	6.9	6.6
82.4	28	8.1	7.9	7.8	7.6	7.3	7.0	6.7	6.5
84.2	29	7.9	7.8	7.7	7.4	7.2	6.9	6.6	6.4
86.0	30	7.8	7.7	7.6	7.3	7.0	6.8	6.5	6.2
87.8	31	7.7	7.5	7.4	7.2	6.9	6.7	6.4	6.1
89.6	32	7.6	7.4	7.3	7.0	6.8	6.6	6.3	6.0
91.4	33	7.4	7.3	7.2	6.9	6.7	6.4	6.2	5.9
93.2	34	7.3	7.2	7.1	6.8	6.6	6.3	6.1	5.8
95.0	35	7.2	7.1	7.0	6.7	6.5	6.2	6.0	5.7
96.8	36	7.1	7.0	6.9	6.6	6.4	6.1	5.9	5.6
98.6	37	7.0	6.8	6.7	6.5	6.3	6.0	5.8	5.6
100.4	38	6.9	6.7	6.6	6.4	6.2	5.9	5.7	5.5
102.2	39	6.8	6.6	6.5	6.3	6.1	5.8	5.6	5.4
104.0	40	6.7	6.5	6.4	6.2	6.0	5.7	5.5	5.3
105.8	41	6.6	6.4	6.3	6.1	5.9	5.6	5.4	5.2
107.6	42	6.5	6.3	6.2	6.0	5.8	5.6	5.3	5.1
109.4	43	6.4	6.2	6.1	5.9	5.7	5.5	5.2	5.0
111.2	44	6.3	6.1	6.0	5.8	5.6	5.4	5.2	4.9
113.0	45	6.2	6.0	5.9	5.7	5.5	5.3	5.1	4.8
114.8	46	6.1	5.9	5.9	5.6	5.4	5.2	5.0	4.8
116.6	47	6.0	5.9	5.8	5.6	5.3	5.1	4.8	4.7
118.4	48	5.9	5.8	5.7	5.5	5.3	5.0	4.8	4.6
120.2	49	5.8	5.7	5.6	5.4	5.2	5.0	4.7	4.5
122.0	50	5.7	5.6	5.5	5.3	5.1	4.9	4.7	4.4

2-14. WATER QUALITY ANALYSIS SET (WQAS) - PREVENTIVE MEDICINE.
----------------------------------------------------------------

2-15. INTRODUCTION. The operator should read the general water test information (para 2-1 through 2-10), prior to using the WQAS. The instructions for use of the kits are arranged alphabetically by test kit title. Each test kit instruction and test procedure is introduced with a brief chemical discussion to familiarize the operator with the causes of the condition. This is followed by a step-by-step procedure to accomplish measurement of the degree of the condition. Common use lab-ware supplied in the main case (fig. 1-1) for accessory use with the kits is identified with the stored locations item number in the WQAS Loading Diagram (fig. 1-5). The tests are to be conducted with the following principal equipment:

- a. Acidity test kit.
  - (1) FREE ACIDITY - 0 to 500 mg/l.
  - (2) TOTAL ACIDITY - 0 to 500 mg/l.
- b. High-range chloride test kit - 1,000 to 20,000 mg/l.
- c. Iron test kit - 0 to 10 mg/l.
- d. Dissolved oxygen test kit - 0 mg/l to SATURATION.
- e. Zinc test kit - 0 to 10 mg/l.
- f. Multipurpose test kit (Spectrophotometer).

2-16. SPECTROPHOTOMETER TESTS (para 2-10). The following test categories are covered within the ranges specified.

- a. Fluoride - 0.0 to 2.0 mg/l.
- b. Iron
  - (1) TOTAL IRON - 0 to 2.0 mg/l.
  - (2) FERRIC IRON (Fe ++ ) - 0.0 to 2.0 mg/l.
  - (3) FERROUS IRON (Fe ++ ) - 0.0 to 2.0 mg/l.
- c. Ammonia nitrogen - 0.0 to 2.0 mg/l.
- d. Nitrate nitrogen - 0.0 to 30.0 mg/l.
- e. pH - 4.0 to 10.0 units.
- f. Sulfate - 0 to 150 mg/l.
- g. Turbidity - 0 to 500 FTU

2-17. WOAS - PREVENTIVE MEDICINE KIT TESTS.

**WARNING**

- Dangerous chemicals are provided in these test kits. Death, health hazards or injuries such as severe burns, impaired vision and internal tissue destruction may be experienced if personnel fail to observe precautions.
- Do not allow reagents, buffer solutions or acids to come in contact with skin or eyes.
- Do not ingest solutions, tablets, droplets or spillage from lab-ware.
- Do not inhale fumes from products or mixing reactions. Cyanide is extremely poisonous. Potassium Cyanide should be stored away from water and acids. Always add cyanide after adding potassium hydroxide and never before. Many products furnished are highly inflammable, some have explosive potential. Most acids are corrosive.
- Keep all bottles and containers capped and sealed to prevent accidental spillage and to increase shelf-life. Never pipet chemical reagent solutions or unknown water samples by mouth. Use the safety pipet filler.
- Do Not Induce Vomiting if any of the following chemicals are ingested:

Alkalinity Titration Reagent (Sulfuric Acid)  
Alkaline Potassium Iodide Solution  
Spadns Reagent  
Hydrochloric Acid  
Reagent "A" (Potassium Bisulfate and Copper Sulfate Pentahydrate)  
Reagent "D" (4(Nitrobenzyl) Pyridine and Potassium Perchlorate and Urea)  
Reagent "E" (Potassium Carbonate)  
Reagent "G" (Halazone Tablets)  
Reagent "H" (Dimethoxybenzidine)  
Reagent "I" (Potassium Carbonate and Sodium Metaphosphate)  
Reagent "J" (Perdox" (Sodium Borate))  
Reagent "X" (Orthotolidine Dihydrochloride)  
Substrate Solution (Ligroine and 2, 6 Dichloro-indophenol Acetate)  
Trihydroxymethyl aminomethane (TRIS)


**WARNING**

- Induce Vomiting if any of the following chemicals are ingested:

Isopropyl Alcohol  
 DPD (Diethyl -P-Phenylene Diamine)  
 Wide Range pH Indicator Solution  
 Arsenite Solution  
 Nessler's Reagent APHA  
 Sulfamer IV  
 Sodium Hydroxide Standard Solution  
 Chloride Titrant (Silver Nitrate)  
 Phenolphthalein Indicator Solution  
 Manganese Sulfate Solution  
 Sodium Thiocyanate Solution  
 Zinc Reagent  
 Standard Barium Chloride Reagent  
 Reagent "K" (Acetone and Zylenes)

Important

Refer to the specific "Step-By-Step" instructions relative to accidents as defined in paragraphs covering each specific chemical.

- a. Acidity Test Kit (fig. 2-5).

(1) Acidity is a method of expressing the capacity of water to donate hydrogen ions and gives an indication of the water's corrosiveness. The acidity of natural water is normally very low unless strongly acidic industrial water has been introduced. Water is very weak acid.

(a) Acidity is caused by carbon dioxide dissolved in water, or tannic acid, or hydrolyzing inorganic salts such as ferrous and/or aluminum sulfate. The presence of mineral acids such as hydrochloric or sulfuric acids from industrial wastes may contribute acidity (paras 2-19f and 2-2 d).

(b) Acidity is classified as methyl orange or "free" acidity, which is made up of strong mineral acids such as hydrochloric and sulfuric acids, and phenolphthalein; or "total" acidity, which is the methyl orange acidity plus weak acids such as carbon dioxide, and organic acids. These two classes of acidity may be determined separately.

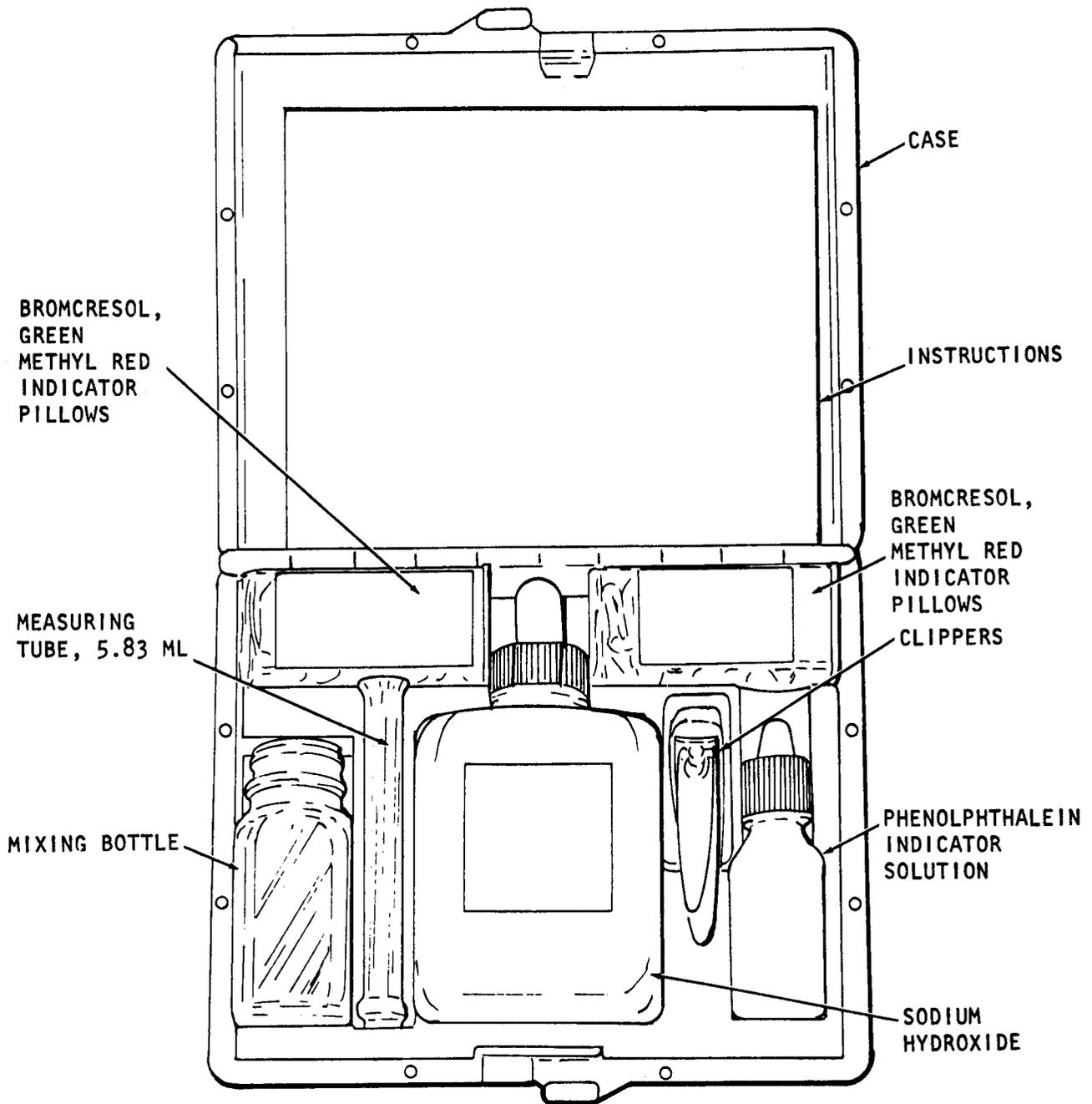


Figure 2-5. Acidity Test Kit

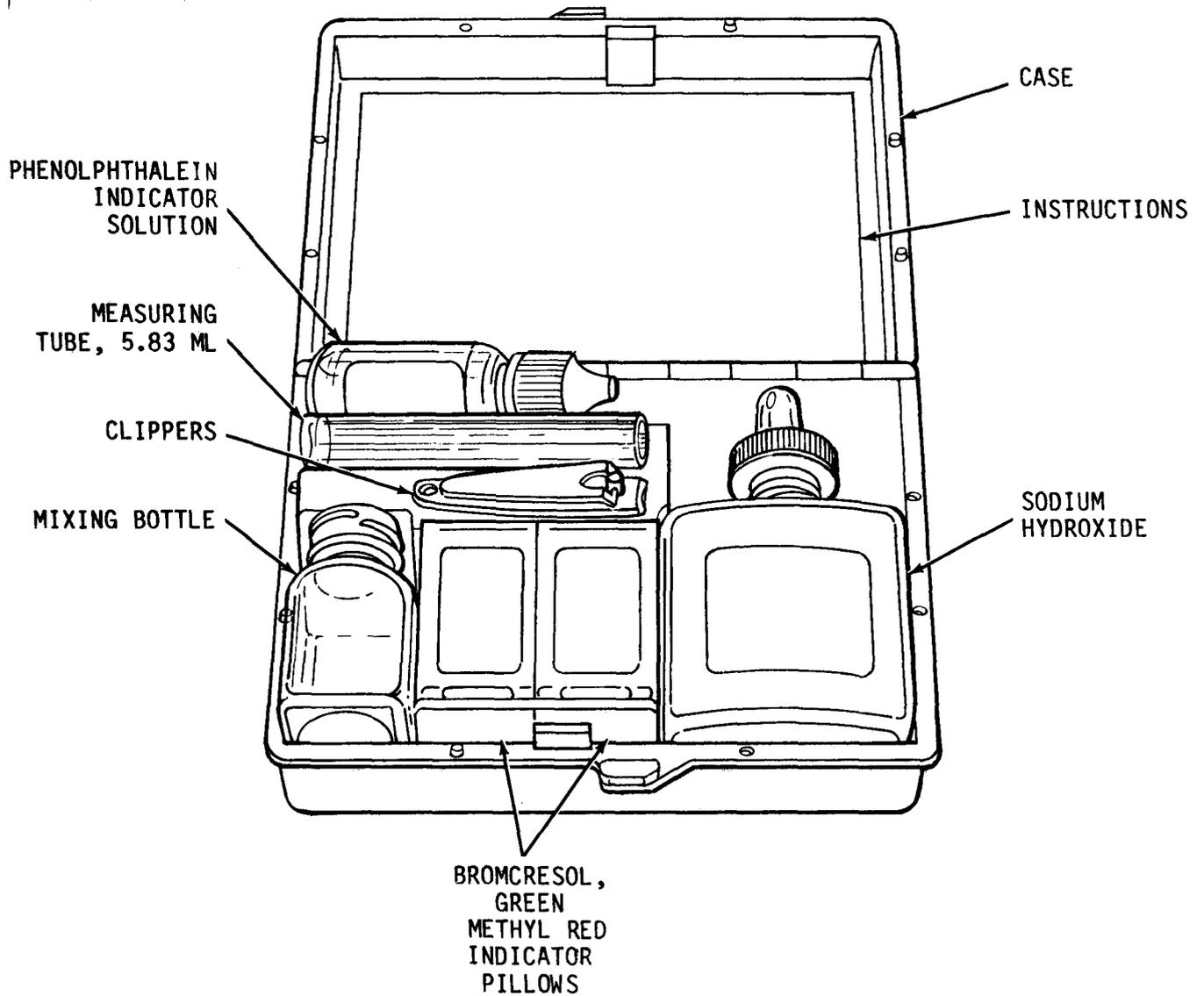


Figure 2-5.1. Acidity Test Kit (Not Used in Buys 1 and 2)



(c) Acidity is measured by titrating with a strong base to an end point determined by the equivalence point. Phenolphthalein acidity is acid. The methylorange acidity is determined by titrating to a pH of 4 or 5, the carbonic acid equivalence point. Phenolphthalein acidity is measured by titrating the sample to the bicarbonate equivalence point of pH 8.3. When titrated at boiling temperature, the phenolphthalein acidity gives an estimate of the lime requirement for treating domestic water supplies. Heating also speeds the hydrolysis of iron and aluminum sulfate, giving a sharper end point.

**WARNING**

- Phenolphthalein Indicator Solution. For test purposes only. Keep out of reach of children. If swallowed call a physician at once. Induce vomiting by giving a tablespoon of salt in a glass of warm water, repeating until vomit is clear. May cause irritation. Avoid prolonged and repeated contact with skin.
- Sodium Hydroxide Standard Solution. Poison, may be fatal if swallowed. May cause permanent blindness. External contact: flush with water. Ingestion: induce vomiting. Call physician immediately.

(2) High Range Free Acidity Test (0-20 gr/gal., 0-500 mg/l).

(a) Fill the plastic measuring tube level full of the water that is to be treated and pour it into the square mixing bottle.

(b) Add the contents of one Brom Cresol Green-Methyl Red Indicator Powder Pillow to the Water Sample and swirl to mix.

(c) If the water turns gray-blue, blue or green, the free acidity is zero.

(d) If the water turns pink, add sodium hydroxide standard solution dropwise (with constant swirling of the mixing bottle and counting of the drops) until the water just begins to turn gray-blue. The dropper must be held vertical.

(e) The free acidity in mg/l is equal to 17.2 times the number of drops of Sodium Hydroxide Standard Solution required to titer.

(3) Low Range Free Acidity Test (0-150 mg/l).

(a) Fill the bottle to the 15-ml mark with the water to be tested.

(b) Add the contents of one Brom Cresol Green-Methyl Red Indicator powder pillow, to the water sample and swirl to mix.

(c) If the water turns gray-blue, blue or green, the free acidity is zero.

(d) If the water turns pink, add sodium hydroxide standard solution dropwise (with constant swirling of the mixing bottle and counting of the drops) until the water just begins to turn gray-blue. The dropper must be held vertical.

(e) The free acidity in mg/l is equal to 6.88 times the number of drops of Sodium Hydroxide Standard Solution required to titer.

(4) Total Acidity Test.

(a) The directions for total acidity are the same as for free acidity except that one drop of phenolphthalein indicator solution is used instead of brom cresol green-methyl red, and the titration is carried from colorless to the first slight pink color.

(b) If the sample turns pink on addition of the indicator only, the total acidity is zero.

b. Chloride Test Kit High Range 1,000 to 20,000 mg/l (fig. 2-6).

(1) Chlorides are present in all potable water supplies and in sewage, usually as a metallic salt. When sodium is present in drinking water, chloride concentrations in excess of 250 mg/l give a salty taste. If the chloride is present as a calcium or magnesium salt, the taste detection level may be as high as 1000 mg/l chloride.

(a) Chloride is essential in the diet and passes through the digestive system unchanged to become one of the major components of raw sewage. The wide use of zeolite in water softeners also contributes a large amount of chloride to sewage and wastewaters.

(b) High chloride concentrations in water are not known to have toxic effects on man, though large amounts may act corrosively on metal pipes and be harmful to plant life. The maximum allowable chloride concentration of 250 mg/l in drinking water has been established for reasons of taste rather than as a safeguard against physical hazard.

**WARNING**

Do not allow reagents to come in contact with skin or eyes. Do not ingest solutions containing Silver Nitrate and Methanol. May be fatal if swallowed. May cause permanent blindness. Chemical reagents are corrosive or poisonous or both. External contact: flush. Ingestion: induce vomiting.

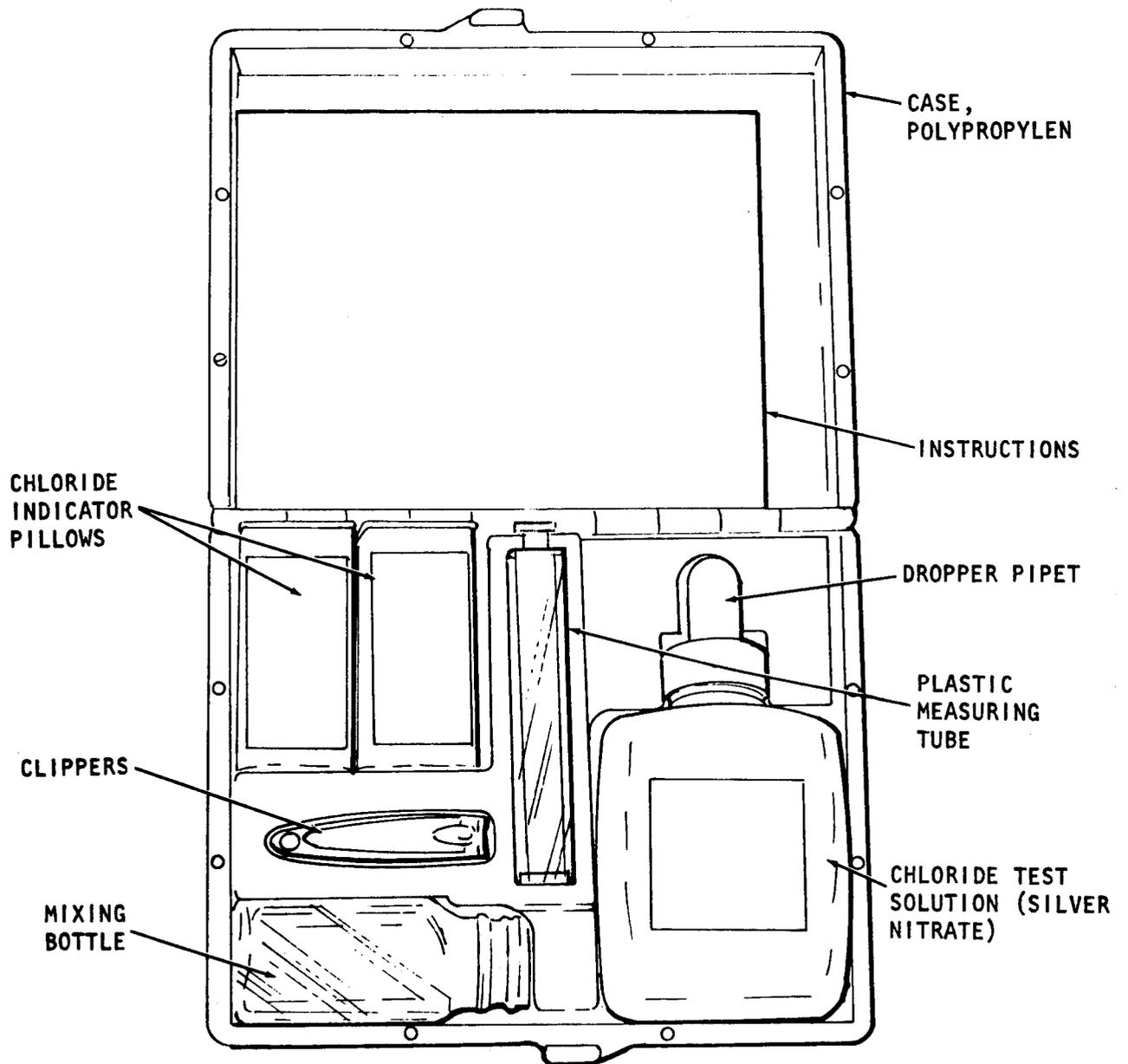


Figure 2-6. High Range Chloride Test Kit

(2) Chloride Test - High Range 1,000 -20,000 mg/l.

(a) Fill the plastic measuring tube level full of the water that is to be tested and pour it into the Volumetric flask (Fig. 1-5, item 13).

(b) Add the contents of one Chloride Indicator Powder Pillow. Swirl to mix.

NOTE

The dropper pipet is shipped separately from the solution because the solution slowly attacks the rubber of the dropper. The dropper must be conditioned (wetted) by allowing it to soak in the test solution for approximately two hours before using it. Otherwise the drop size may be too small and the resulting answers too large.

(c) Add the Chloride Titrant Solution dropwise, stopper and shake very vigorously between each addition. Count the drops until the color changes to orange. Hold the dropper in a vertical position.

NOTE

If the precipitate is orange and the solution is yellow, greater agitation is required. The test must be repeated.

(d) Each drop Chloride Titrant Solution is equal to 606 mg/l of chloride.

(e) Remove dropper from solution bottle and rinse. Replace original cap at completion of test. Keep bottle tightly capped.

c. Ferric Iron Test Kit Range 0-10.0 mg/l (fig. 2-7).

(1) Iron in water. Natural waters contain variable but minor amounts of iron. Iron in ground waters is normally present in the ferrous ( $Fe^{++}$ ) or soluble state which is easily oxidized to ferric ( $Fe^{+++}$ ) or insoluble iron on exposure to air. Iron can enter a water system by leaching natural deposits from ironbearing industrial wastes, effluents from pickling operations, or acidic mine drainage.

(a) Iron in domestic water supply systems stains laundry and porcelain, causing more of a nuisance than a potential health hazard. Taste thresholds of iron in water are 0.1 mg/l ferrous iron and 0.2 mg/l ferric iron, giving a bitter or astringent taste. Water used in industrial processes must usually contain less than 0.2 mg/l total iron. Domestic water suppliers containing more than 0.3 mg/l total iron are objectionable due to staining and taste considerations.

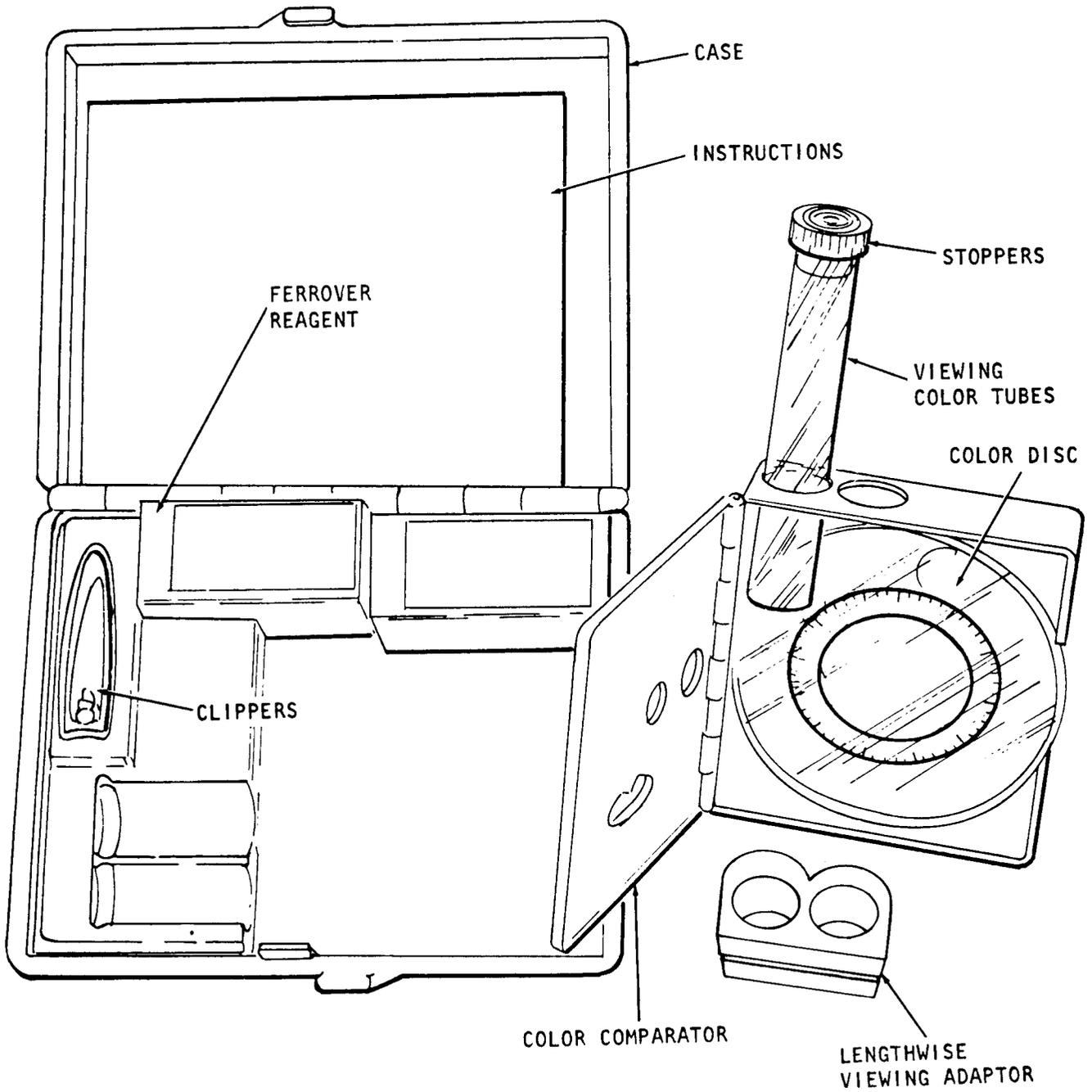


Figure 2-7. Ferric Iron Test Kit

(b) The Ferric Iron Test Kit contains a Comparator, one color disc (0 to 1.0 mg/L range) and other equipment and reagent necessary to determine the iron content of water. The accuracy of the test is  $\pm 0.1$  mg/L at 0.3 mg/L and  $\pm 0.3$  mg/L at 4.0 mg/L. The kit contains enough Ferrover to perform not less than 100 tests in the Range 0-1.0 mg/L. Additional Ferrover for use in performing not less than 100 tests at 0.3 mg/L range is available in the Preventive Medicine carrying case top. Additional Ferrover and an additional color disc are provided in the Preventive Medicine carrying case top for use in performing tests in the range 0-10 mg/L.

(2) Ferric Iron Test. Procedure - Low Range 0-10 mg/L

NOTE

- Air bubbles should not be present in either tube when reading the comparator.
- The shelf life of the Ferrover reagent is 24 months. To test the reagent activity, test a sample that contains visual rust. If no color develops, the reagent has deteriorated.

(a) Fill one of the sample tubes to within 1/16 inch of the top with a sample water. Add the contents of one Ferrover Iron Reagent Powder Pillow to the sample. Stopper the tube and invert to mix. Allow the solution to stand 2 minutes. If iron is present an orange color will develop.

(b) Place the "lengthwise viewing adapter" in the comparator (fig. 2-8).

(c) Place the prepared water sample in the opening nearest the middle in the back of the comparator.

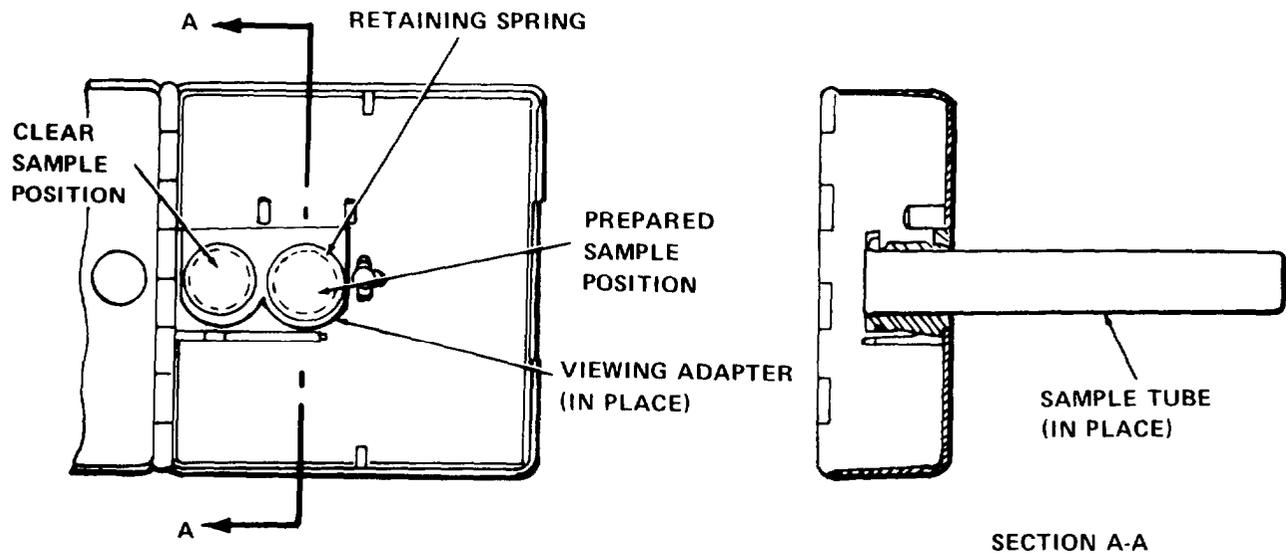
(d) Fill the other sample tube with clear water, stopper the tube, and insert the tube in the other opening in the back of the comparator.

(e) Hold the comparator up to a light source (window, the sky, or a lamp) and view through the openings in the front of the comparator. Rotate the comparator disc (0 to 1.0 mg/l range) until a color match is obtained. Read the mg/l iron through the scale window in the front of the comparator.

(3) Ferric Iron Test Procedure - High Range (0 to 10.0 mg/l).

NOTE

- Air bubbles should not be present in either tube when reading the comparator.
- The shelf life of the Ferrover reagent is 24 months. To test the reagent activity, test a sample that contains visual rust. If no color develops, the reagent has deteriorated.



*Figure 2-8. Viewing Adapter, Details - Low Range*

(a) If the lengthwise viewing adapter is in place, remove it. (Figs. 2-7 and 2-8).

(b) Using a 25 ml graduated cylinder, add 5 ml of sample water to one of the sample tubes. Add the contents of one Ferrover Iron Reagent Powder Pillow to the sample. Stopper the tube and invert and mix. Allow the solution to stand 2 minutes.

(c) Replace the 0 to 1.0 mg/l range comparator disc with the 0 to 10.0 mg/l range comparator disc.

(d) Place the prepared water sample in the right top opening of the comparator.

(e) Add 5 ml of clear water (using a 25 ml graduated cylinder) to the other sample tube and insert this tube in the left top opening of the comparator.

(f) Hold the comparator up to a light source and view through the openings in the front of the comparator. Rotate the comparator disc until a color match is obtained. Read the mg/l iron through the scale window in the front of the comparator.

d. Dissolved Oxygen Test Kit. (Fig. 2-9)

(1) Dissolved Oxygen is one of the most important analyses in determining the quality of natural waters. The effect of oxidation wastes on streams, the suitability of water for fish and other organisms and the progress of self-purification can all be measured or estimated from the dissolved oxygen content. In aerobic sewage treatment units, the minimum objectionable odor potential, maximum treatment efficiency, and stabilization of wastewater are dependent on maintenance of adequate dissolved oxygen. Frequent dissolved oxygen measurement is essential for adequate process control.

**WARNING**

- Do not allow reagent to come in contact with skin or eyes. Do not ingest. Chemical reagents are corrosive or poisonous or both. Sulfuric acid is a strong acid.
- Alkaline Potassium Iodide Solution. For test purposes only. Corrosive Alkali. May cause severe burns - avoid breathing vapors - not for internal use. In case of contact with skin or eyes, flush well with water; for eyes, get medical attention. If swallowed, call physician at once. Give large amounts of dilute (1:4) vinegar, lemon, or grapefruit juice. Follow with milk or raw egg whites beaten in water.
- Sulfuric Acid. For test purpose only. Corrosive acid. May cause burns - avoid breathing vapors. Not for internal use. In case of contact with skin or eyes, flush well with water, call a physician at once. Do not induce vomiting. Give milk of magnesia with large amounts of water. Follow with milk or raw egg whites beaten in water. Keep away from children.
- Sodium Thi osulphate and Manganese. Sul fate reagents. For test purpose only, do not ingest. If ingested induce vomiting.

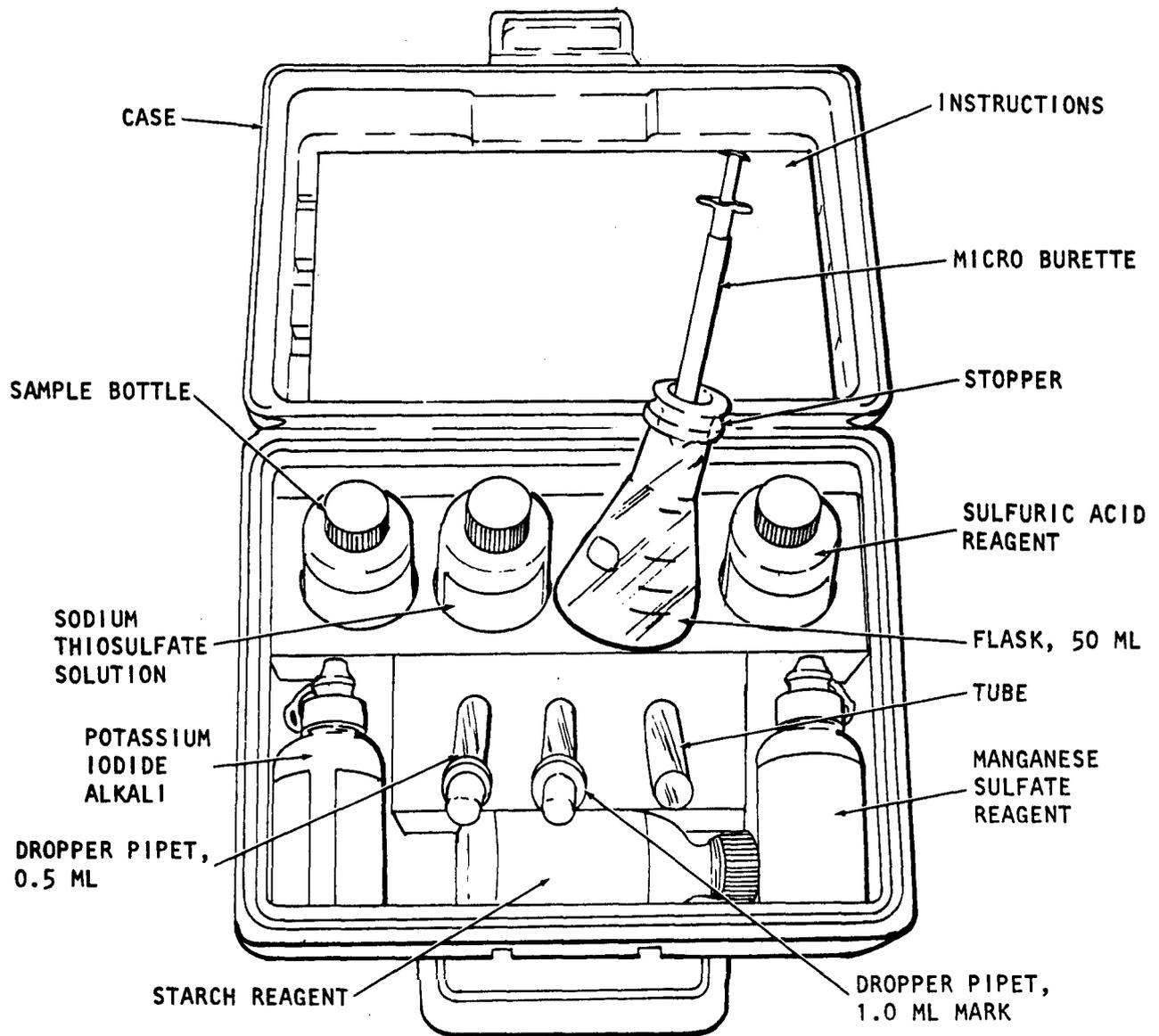


Figure 2-9. Dissolved Oxygen Test Kit

**CAUTION**

No air should be introduced with the reagents. Reagents are added by allowing the drops to fall onto the test sample. Because of the greater density of the reagents, they will quickly descend into the sample. After each addition of reagent or reagents, the bottle is carefully capped for mixing, making sure that no air bubbles are formed.

(2) Dissolved Oxygen Test. Thoroughly rinse the sample bottle with the water to be tested and replace the cap. Completely submerge the capped sample bottle in an upright position under the surface of the water source. Remove the cap and allow the water to enter the bottle. With the bottle still submerged, gently squeeze or tap the sides to eliminate any trapped air bubbles and replace the cap prior to removing the bottle from the water. After bringing the bottle to the surface, inspect it to be certain that no air bubbles have been trapped inside.

(a) To the sample, using the plastic dropper-pipet, add 8 drops of manganese sulfate solution, rinse the pipet and add 8 drops of alkaline potassium iodide solution. Rinse the pipet, carefully cap the bottle, mix by gently inverting, then allowing the precipitate to settle below the shoulder of the bottle.

(b) Using the 0.5 ml dropper pipet, add one measure (0.5 ml) of sulfuric acid, cap the bottle and mix until the precipitate is completely dissolved.

## NOTE

Following the completion of step (b), the contact of water sample with air will not affect the final reading. Samples collected in the field can be "fixed" by carrying out steps (a) and (b) on locations and the actual titration step (c) can be completed at a later time.

(c) Fill the titration flask to the 50 ml line with the prepared water sample.

(d) Fill the micro burette with standard sodium thiosulfate solution in the manner described in paragraph 2-11.

(e) Titrate with standard sodium thiosulfate solution until the brown iodine color has nearly disappeared. Remove the micro burette and cap and using the plastic dropper pipet add 8 drops of starch solution. The test sample will turn blue. Titration is continued with the standard sodium thiosulfate until the blue color just disappears. If the test solution contains little or no brown iodine color, the starch solution can be added at the very beginning

of the titration. If the oxygen content of the sample is very high, it may be necessary to refill the micro burette before the endpoint is reached. In this case, a record should be kept of the total amount of sodium thiosulfate solution used in the titration.

#### NOTE

- Each major division on the mini burette is equivalent to 0.2 mg/l dissolved oxygen and each minor division to 0.04 mg/l.
- Calculation - Dissolved Oxygen: If it required 18 major and 2 minor divisions to reach the titration endpoint, the reading would be  $(18 \times 0.2)$  plus  $(2 \times 0.04) = 3.68$  mg/l.
- Sample Handlings are important considerations in obtaining meaningful results. The dissolved oxygen content of the water being tested can be expected to change with depth, turbulence, temperature, sludge deposits, lights, microbial action, mixing, travel, time, and other factors. A single dissolved oxygen test rarely reflects the accurate overall condition of a body of water. Several samples taken at different times, locations and depths are recommended. The solvability of oxygen in pure water at various temperatures and pressures is given in para 2-12 and table 2-5.

#### e. Zinc Test Kit (fig. 2-10).

(1) Zinc Concentrations in most water supplies average about 1 mg/l but may range as high as 50 mg/l in some areas. Though zinc is commonly found in many natural waters, the deterioration of galvanized iron and the leaching of brass can add substantial amounts. Industrial effluents may contribute large amounts of zinc, and high concentrations suggest the presence of lead and cadmium, common impurities from the galvanizing process.

(a) Zinc is essential to human metabolism and has been found to be necessary for proper body growth.

(b) High concentrations of zinc in water act as stomach irritants but the effects are temporary. Concentrations above 5 mg/l show no harmful physiological effects but can cause a bitter taste and/or an opalescence in alkaline drinking water.

(c) For the above reasons, the maximum recommended zinc concentrations in public water supplies has been set at 5 mg/l.

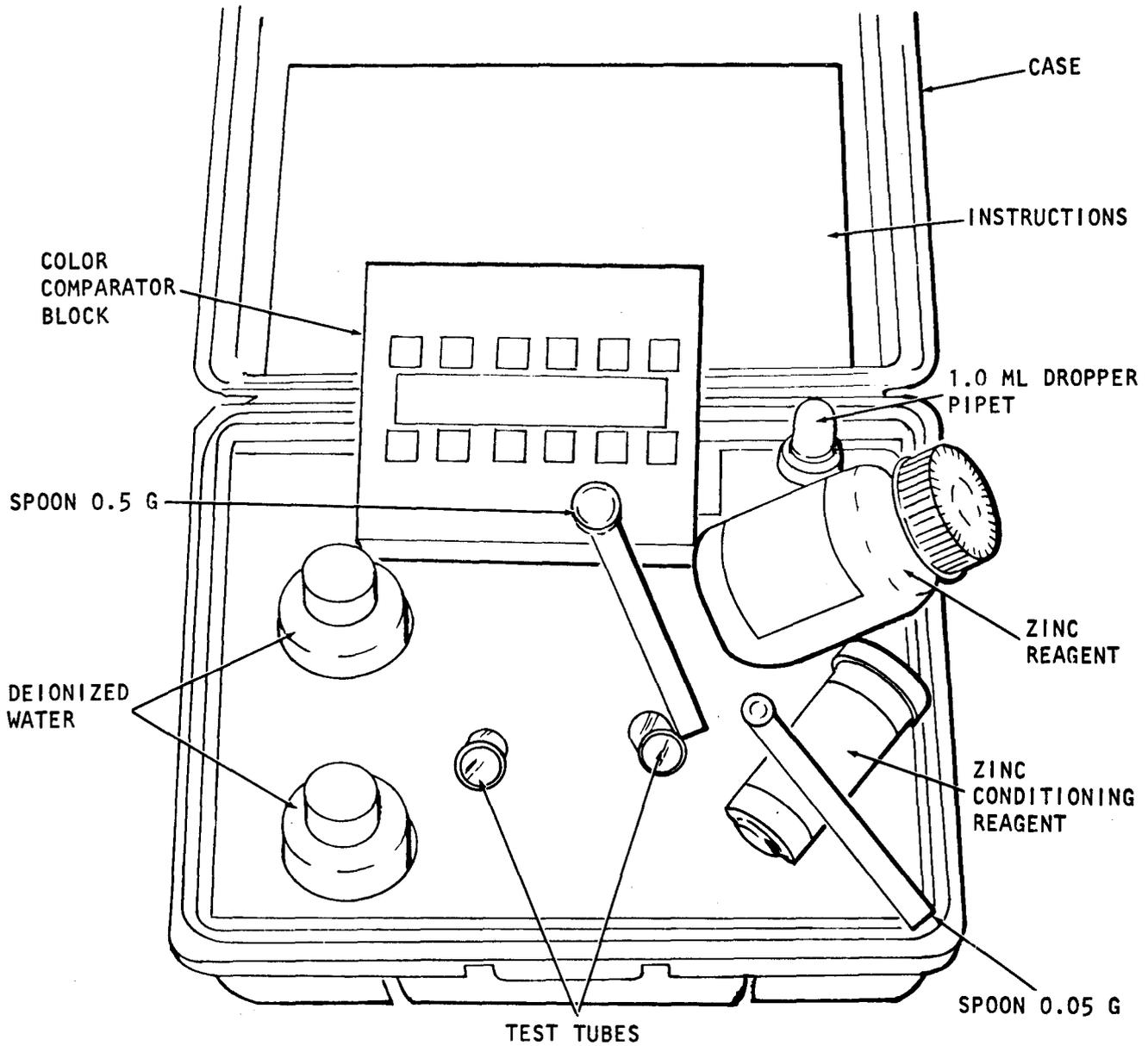


Figure 2-10. Zinc Test Kit

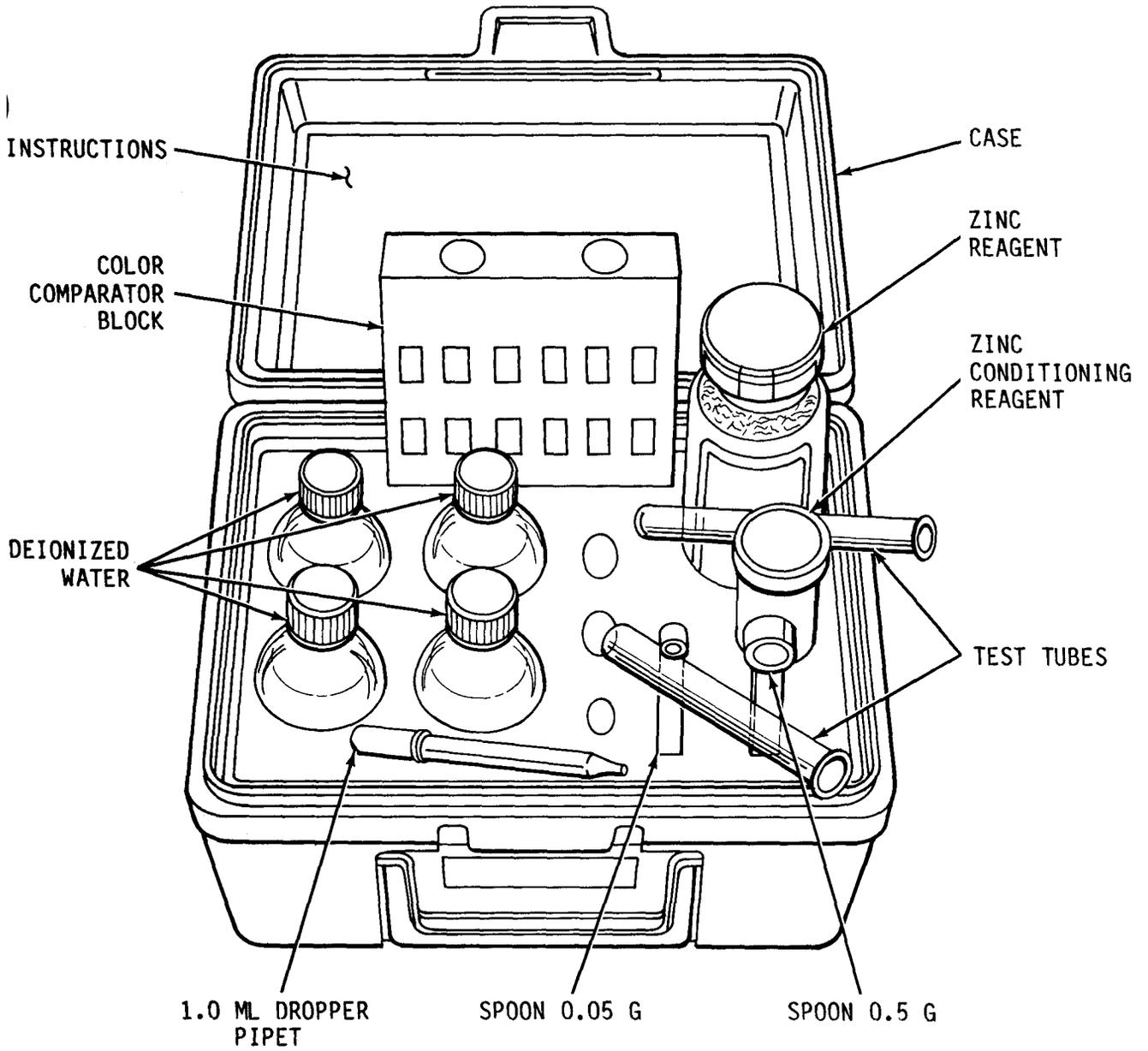


Figure 2-10.1. Zinc Test Kit (Not Used in Buys 1 and 2)



**WARNING**

Do not allow reagents to come in contact with eyes. Do not ingest. Chemical reagents are corrosive or poisonous or both. If ingested, induce vomiting.

(2) Zinc Test Procedure, 0 to 10.0 mg/l range.

(a) Using the 1 ml dropper, add 2 ml (2 droppers full) of the test sample to one of the graduated test tubes.

(b) Add de-ionized water exactly to the mark and mix. Add one small measure (0.05g) of the Zinc conditioning reagent.

(c) Using the large measure marked 0.5g, add one level measure of zinc test reagent. Close tube with finger and shake for 15 seconds. Some of the reagent may not dissolve, but do not shake for longer than the specified 15 seconds.

(d) Compare immediately with the zinc color standard block.

NOTE

Should the amount of zinc reagent added be too little or too much, the intensity of the test color may differ slightly from that of the color standards. However, since each zinc color standard shows a distinct difference in shade, it should be possible to make an accurate reading even though there is a difference in the intensity.

(e) Copper Interference - If copper is present in the water sample, it will interfere with the zinc test. For samples containing copper, the procedure is as follows: After steps (a) and (b) add 0.05g of Zinc Conditioning Reagent and shake to dissolve. Continue with steps (c) and (d).

(3) Zinc Test Procedure, 2.0 - 20.0 mg/l Range. If the color of the test sample exceeds that of the 10.0 mg/l value, use 1 ml sample, then proceed with step b. of paragraph 2-17e(2) above. The color standard value must now be multiplied by a factor of 2.

2-18. MULTIPURPOSE TEST KIT (SPECTROPHOTOMETER). The Spectrophotometer is a single-beam optical, analytical instrument designed to provide direct readouts of concentrations of particular substances in water when the substances are reacted chemically with specific reagents to cause color developments proportional to the degree of concentration. A variable interference light filter, or filter wedge, provides a means of adjusting the wavelength of the light when it penetrates the reacted sample and is seen by the photocell. The wavelength is adjustable anywhere within the range of 400 to 700

nanometers (nm), with an accuracy of + or - 2.5 nm and a bandpass of less than 17 nm. An individual filter of very high light wavelength for measuring suspended solids in water is also included on the filter wedge.

a. Spectrophotometer - Operation.

**(1) Controls and Indicators.** See figure 2-11 and table 2-6 for location and description of each control and indicator.

**WARNING**

When operating with 110/120-volt power sources, make sure that source and equipment are in ground potential.

(2) Power. The spectrophotometer may be operated on 110/120 volt AC or DC battery power. A battery pack holder for eight D-size dry cell batteries is included as standard equipment and is located in the bottom of the case. A line voltage plug for 110/120 volt operation is supplied with each instrument. The instruments normally have the 110-volt plug installed on the power supply board.

**CAUTION**

- Insure that the power cell connections are correct for the desired voltage prior to connecting to power source.
- Before removing the faceplate turn wedge to position "F" to avoid interference and possible damage to the color filters.

(a) Before attempting to operate the spectrophotometer, a visual check should be made to ensure that the power cable connections are correct for the desired voltage mode of operation. To check, adjust the wavelength dial to the lowest setting, loosen the two captive screws on the front panel, and remove the spectrophotometer panel from its case to view the underside.

(b) Verify that the proper connections are made. For AC operation, the cable originating at the case receptacle must be connected to the power supply circuit board. A second AC power cable, originating at the power supply circuit board and marked HC5, must be connected to the amplifier circuit board at BC5. Verify that the proper line voltage plug is connected on the power supply board. The plugs are stamped 115 v or 220 v. Line voltage plugs are for 115 or 220 volt operation are supplied with each instrument.

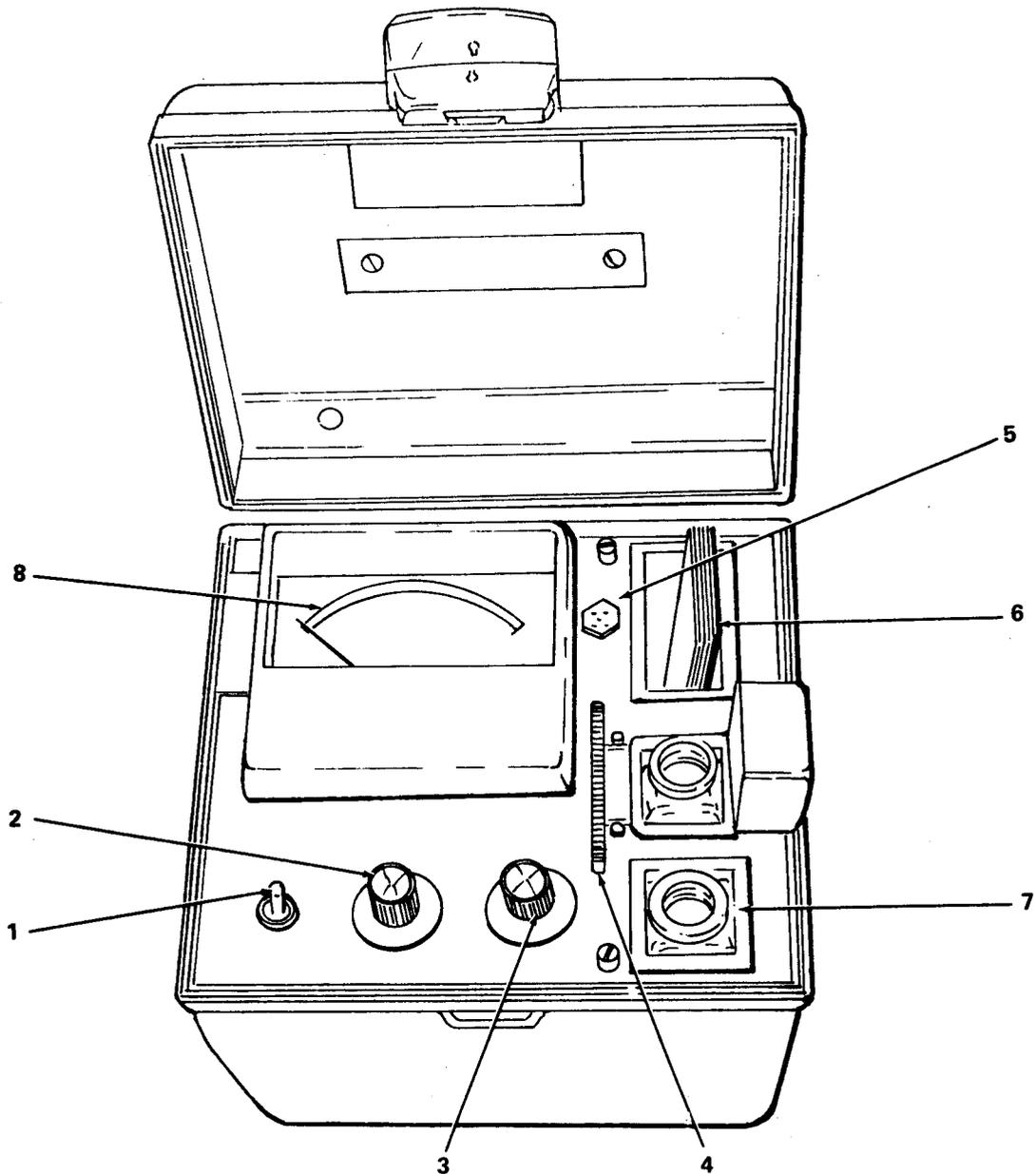


Figure 2-11. Spectrophotometer Control and Indicators

Table 2-6. Spectrophotometer, Controls and Indicators

Key	Control or Indicator	Function
1	Light Switch	Applies electrical power to the instrument when set to the ON position. In the zero check position, the lamp is turned off, allowing the instrument to be electronically zeroed with no power applied to the photocell.

Table 2-6. Spectrophotometer, Controls and Indicators - Continued

Key	Control or Indicator	Function
2	Zero Adjust	Used to zero the meter when the light switch is held in zero check position. This adjustment should be made at the beginning of each series of tests. The light shield must be closed.
3	Light Control	Varies the lamp brightness thus determining the amount of light reaching the photocell. It is used to standardize the instrument before each measurement to compensate for turbidity and/or color in the sample not caused by the substance being measured.
4	Wavelength Dial	Used to select the wavelength appropriate for the particular test. It is adjustable from 400 to 700 nanometers (nm) and contains an individual filter for suspended solids determinations.
5	Range Expander	<p style="text-align: center;"><b>NOTE</b></p> <p style="text-align: center;">The range expander is not issued with the spectrophotometer.</p> <p>Receptacle used to electrically connect the optional Expanded Low-Range Accessory to the spectrophotometer.</p>
6	Meter Scales	Provide direct readouts for all calorimetric tests. The appropriate scale for each test is inserted in the meter while the remaining scales are stored in the meter scale holder. The calibrations are printed on yellow, enamel-coated card stock for easy reading.
7	Sample Cells	Supplied with the spectrophotometer, are borosilicate glass with two sides frosted. The bottles are placed in the instrument cell holder with either clear side toward the light source. Only clean, dry sample cells should be placed in the instrument and when their surfaces become scratched or nicked the cells should be discarded. The 25 ml mark is approximate but adequate for most applications. Greater accuracy will be assured however, if the sample is measured in a graduated cylinder or by pipet.
8	Meter	Used in conjunction with meter scales, meter pointer gives direct readout on meter scale card printed scale.

(c) For battery DC operation the second AC power cable (HC5) must be disconnected from the amplifier board and the battery pack cable (also marked HC5) connected at BC5 in its place as illustrated in figure 2-12. The primary AC cable between the case receptacle and the power supply board and the line voltage plug should not be disturbed.

(3) Sample Preparation. The first task in any calorimetric test is to prepare the water sample. The applicable reagent or reagents are added to provide the color indicator for the substance to be measured. If the standardizing solution to be used requires some special treatment, it too is prepared at this time. Normally in the preparation of the sample, a minimum waiting period must be observed following the addition of the final reagent in order for the color to fully develop. There may also be a maximum time limit after which the color will begin to fade. Therefore, it is important to take the readings within the time period specified in the test to obtain accurate results.

b. Spectrophotometer in Use (fig. 2-11). The next step in the calorimetric test is to set up the spectrophotometer for the particular test. The standardizing solution (usually untreated water sample) is placed in the cell holder and the lid closed, the appropriate meter scale is inserted in the meter and the proper wavelength is dialed. Then the instrument is zeroed and standardized.

(1) To zero the instrument, the light switch is held in the zero check position while the zero adjust control is used to obtain a zero transmittance reading (needle aligned with the mark at the extreme left of the arc). If a % Transmittance-Absorbance meter scale is used, adjust for a % T reading.

#### NOTE

The light shield lid must be closed for this adjustment.

(2) The instrument is standardized by setting the light switch to ON and using the light control to obtain a meter reading equal to value of the standardizing solution. Normally the standardizing solution is untreated sample water and the meter is adjusted for zero mg/l (extreme right mark of the scale arc) reading. The instrument does not need to be zeroed each time this is performed, but frequent checks of the zero adjustment are recommended.

(3) The batteries are in good condition if the instrument can be standardized as performed in each calorimetric test while the instrument is on battery power. If a zero mg/l reading cannot be obtained using the light control, the batteries may need replacing. Before replacing the batteries, change the instrument to operate on AC power and verify that it can be standardized in that mode. A darkened lamp could be the cause of the inability to obtain the zero mg/l reading (table 3-2, item 3, step 3).

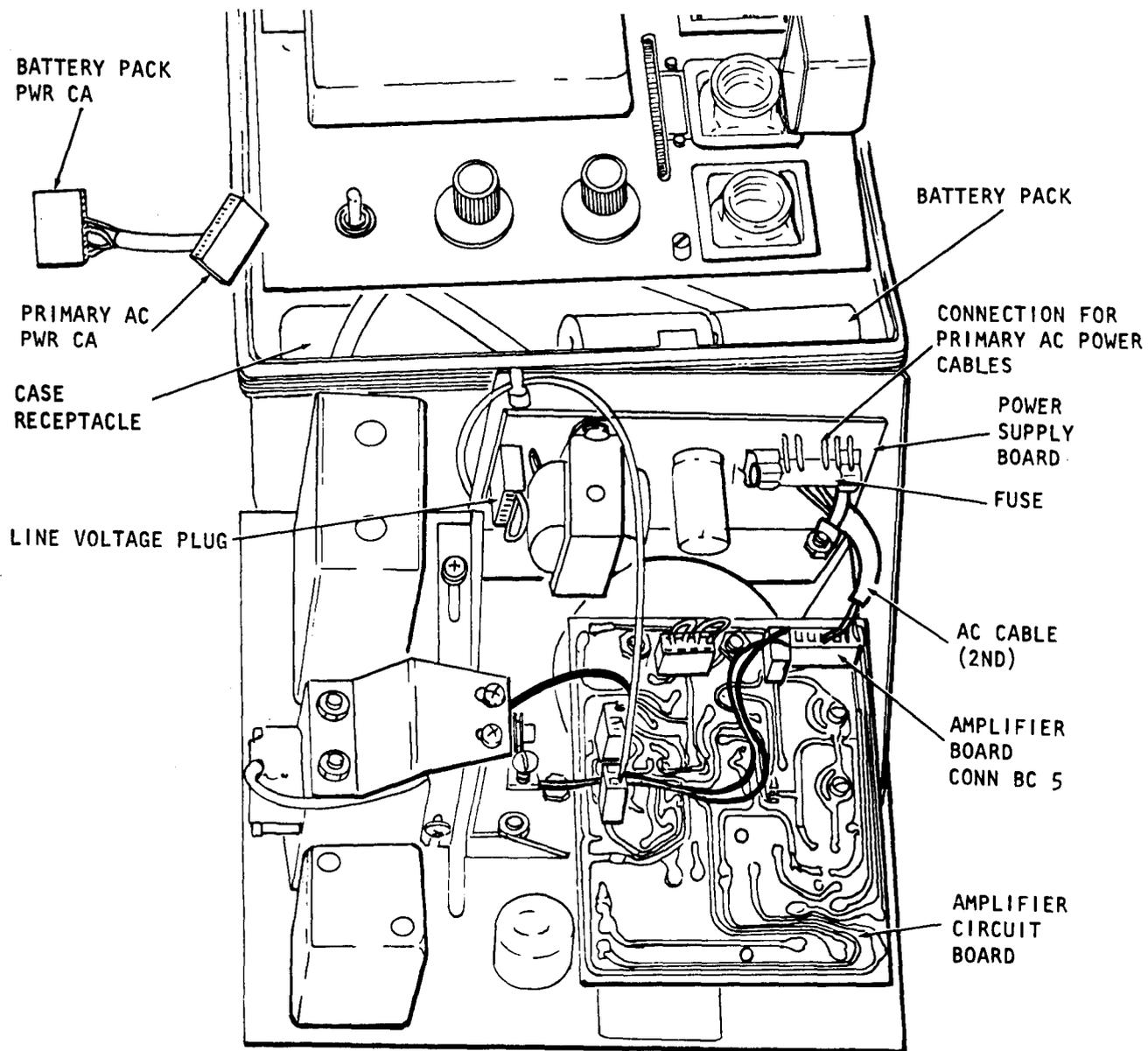


Figure 2-12. Spectrophotometer; Power Conversion

(4) After observing the proper waiting period, the sample color can be measured. The prepared (or reacted) sample is substituted for the standardizing solution in the cell holder and the reading is taken.

NOTE

The light shield lid must be closed whenever a reading is taken.

(5) When operating the instrument on AC power, a 1-minute warm-up period should be observed after the instrument is initially turned ON. When operating on battery power, the most accurate test results will be obtained if the instrument is allowed to warm up for approximately 1 minute before standardization and then left ON only long enough to standardize or take the reading in order to prolong the life of the batteries.

**CAUTION**

When operating the spectrophotometer on AC power, caution is recommended that the instrument be left on continually between measurements with the wavelength dial set to 550 nm and the light control adjusted for approximately 20% transmittance.

(6) It is important that the sample cell used to standardize the instrument be thoroughly rinsed first to ensure contaminants from the previous test are not present. The outside surfaces of the sample cell should be dry when it is placed in the cell holder. Water droplets in the cell holder light slit, on the photocell window or on the sample cell itself will cause error in the instrument reading. The inside of the cell holder should be kept clean and dry at all times.

**CAUTION**

Use extreme care when handling the filter wedge to avoid damaging the filter surfaces or shifting the position of the wavelength scale.

c. After Use. Disconnect the battery pack cable and ensure that the AC voltage plug is connected next to the transformer on the power circuit board (figs. 2-11 and 2-12).

(1) The spectrophotometer, sample cells and instrument case should be kept clean at all times and spills should be wiped up promptly. The photocell window, located in the right-hand side of the cell holder, can be wiped with lense tissue or a soft, lint-free cloth which will not leave an oil film. Sample cells can be cleaned with soap and water or other cleaning solution. They should be rinsed

thoroughly in demineralized water and the outside wiped dry. The filter wedge containing the light filters can best be cleaned by wiping both surfaces with a soft tissue dampened with isopropyl alcohol.

(2) If the instrument is to be placed in storage for a significant length of time, the batteries should be removed to avoid damage that may result from battery leakage. Avoid exposing the variable interference light filter to heavy moisture for extended periods of time. See Chapter 3 for Operator Maintenance and Preventative Maintenance Checks and Services.

d. Sample Cell Matching. Although the sample cells furnished with the spectrophotometer are essentially distortion free optically, nicks and scratches acquired during handling can cause a mismatch between two sample cells and thus introduce error in the test results. This type of error can be minimized by optically matching the sample cells. The following procedure tells how. If the sample cannot be matched within  $+0.5\%T$ , one or both cells should be discarded.

(1) Set the instrument light switch in the "ON" position and allow approximately 2 minutes warm-up.

(2) Insert the % Transmittance-Absorbance Meter scale in the meter and adjust the Wavelength Dial for 510 nm.

(3) Place the light switch in the ZERO CHECK position and adjust the Zero Adjust Control for a reading of 0% transmittance. Return the light switch to the ON position.

(4) Pour exactly 25 ml of demineralized water into each of two clean sample cells.

(5) Place one sample cell in the instrument cell holder and adjust the Light Control for a reading of 95% transmittance.

(6) Place the other sample cell in the cell holder and, note the direction and amount of deviation from the 95% value.

(7) Try to achieve a match within  $+0.5\%T$ . Rotate the cells  $180^\circ$  and recheck the match.

**WARNING**

- Dangerous chemicals are provided in these kits. Death, health hazards or injuries such as severe burns, impaired vision and internal tissue destruction may be experienced if personnel fail to observe precautions.
- Do not allow reagents, buffer solutions or acids to come in contact with skin or eyes.
- Do not ingest solutions, tablets, droplets or spillage from lab ware.
- Do not inhale fumes from products or mixing reactions.
- Cyanide is extremely poisonous. Potassium Cyanide should be stored away from water and acids. Always add cyanide after adding potassium hydroxide and never before. Many products furnished are highly inflammable, some have explosive potential.
- Most acids are corrosive.
- Keep all bottles and containers capped and sealed to prevent accidental spillage and to increase shelf-life. Never pipet chemical reagent solutions or unknown water samples by mouth.
- DO NOT INDUCE VOMITING if any of the following chemicals are ingested:

Alkalinity Titration Reagent (Sulfuric Acid)  
 Alkaline Potassium Iodide Solution  
 Spadns Reagent  
 Hydrochloric Acid  
 Reagent "A" (Potassium Bisulfate and Copper Sulfate Pentahydrate)  
 Reagent "D" (4(Nitrobenzyl) Pyridine and Potassium Perchlorate and Urea)  
 Reagent "E" (Potassium Carbonate)  
 Reagent "G" (Halazone Tablets)  
 Reagent "H" (Dimethoxybenzidine)  
 Reagent "I" (Potassium Carbonate and Sodium Methaphosphate)  
 Reagent "J" (Perdox" (Sodium Borate))  
 Reagent "X" (Orthotolidine Dihydrochloride)  
 Substrate Solution (Ligroine and 2, 6 Dichloroindophenol Acetate)  
 Trihydroxymethylaminomethane (TRIS)

**WARNING**

- INDUCE VOMITING if any of the following chemicals are ingested:

Isopropyl Alcohol  
 DPD (Diethyl -P-Phenylene Diamine)  
 Wide Range pH Indicator Solution  
 Arsenite Solution  
 Nessler's Reagent APHA  
 Sulfaver IV  
 Sodium Hydroxide Standard Solution  
 Chloride Titrant (Silver Nitrate)  
 Phenolphthalein Indicator solution  
 Manganese Sulfate Solution  
 Sodium Thiocyanate Solution  
 Zinc Reagent  
 Standard Barium Chloride Reagent  
 Reagent "K" (Acetone and Zylenes)

IMPORTANT

Refer to the specific "Step-BY-Step" instructions relative to accidents as defined in the paragraphs covering each specific chemical.

2-19. SPECTROPHOTOMETER TESTS (figs. 2-11 and 2-12). The spectrophotometer is used to conduct the tests in Paragraphs 2-19a through 2-19h. Prior to its use the operator should study paragraph 2-18, which describes the instrument and its operation. Accessory support items (lab-ware) for the tests are listed and located on the WQAS - Preventive Medicine Loading Diagram (fig. 1-5). In addition to the chemical precautions given in paragraph 2-18, the following electrical precautions apply.

**WARNING**

- When operating with 110/220 volt power sources, make sure that the power source and equipment are in ground potential. Insure that the power cable connections are correct for the desired voltage prior to connecting to the power source.
- SPADNS Reagent. This reagent contains arsenic and hydrochloric acid. It is poisonous. May be fatal if swallowed. May cause burns. Avoid breathing vapor. Avoid contact with skin, eyes, or clothing. Keep containers well closed. External contact: Wash with soap and water. Eye contact: irrigate with water for 15 minutes, call physician. Inhalation: Remove from exposure. Ingestion: Give plenty of milk or water. Follow with dose of milk of magnesia. Induce vomiting only under medical supervision.

a. Fluoride Test - SPADNS Method, 0-2.0 mg/l range (para 2-18 and figs. 2-11 and 2-12).

(1) Fluoride occurs naturally in some ground waters and a 1 mg/l level is normally maintained in public drinking water supplies for the prevention of dental cavities. Excessive amounts of fluoride cause an objectional discoloration of tooth enamel called fluorosis, though levels up to 8 mg/l have not been found to be physiologically harmful.

(a) The SPADNS methods for fluoride analysis involves the reaction of fluoride with a dark red zirconium-dye lake. The fluoride combines with part of the zirconium to form a colorless zirconium-fluoride complex with the net effect of bleaching the color in an amount proportional to the fluoride concentration. The SPADNS method is the preferable calorimetric method due to its instantaneous reaction with fluoride and the stability of the SPADNS reagent.

(2) Fluoride Test Procedure.

#### NOTE

- The fluoride test is sensitive to small amounts of interference (table 2-7). Glassware must be absolutely clean and it is advisable to mark the sample cells and graduated cylinders so that they do not become mixed. Repeating the test using the same cylinders and sample cells is recommended to insure they are free of interferences and the results are accurate.
- Polyethylene bottles are preferred for collecting and storing water samples for fluoride analyses. Rinse the bottle several times with portions of the sample before collecting the test sample.
- It is important that the water sample and the fluoride standard solution be at the same temperature (+ or - 1°C) for test. The temperature of the standard solution and the water sample should be 20°C + or - 1° (68°F) for best results. Temperature adjustments should be made after the addition of the SPADNS reagent in step (c), below.
- Volume measurements of the sample and the SPADNS reagent are extremely critical and should be made very carefully. For greater accuracy, the sample and the fluoride standard solution should be measured with 25-ml volumetric flask.

NOTE (Continued)

- A simple method of checking for interference by aluminum is to read the concentration one minute after mixing with the SPADNS reagent, wait 15 minutes, and read it again. An appreciable increase in concentration indicates the presence of aluminum as an interference. At this point, allowing the reacted sample to stand undisturbed for two hours before making the final reading will eliminate the effect of up to 3.0 mg/l aluminum.

Table 2-7. SPADNS Method Errors Due to Interference

Interference Substance	Concentration	Error
Alkalinity (asCaCO <sub>3</sub> )	5000 mg/l	-0.1 mg/l F
Aluminum	0.1 mg/l	-0.1 mg/l F
Chloride	7000 mg/l	+0.1 mg/l F
Iron, ferric	10 mg/l	-0.1 mg/l F
Sodium Hexametaphosphate	1.0 mg/l	+0.1 mg/l F
Phosphate, ortho	16 mg/l	+0.1 mg/l F
Sulfate	200 mg/l	+0.1 mg/l F

(a) Take a water sample by accurately filling a clean graduated cylinder to the 25.0-ml mark. Pour the sample into a clean, dry sample cell.

(b) Accurately measure 25 ml of fluoride standard solution, (1.00 mg/l of fluoride (F)), by filling another graduated cylinder to the 25.0-ml mark. Pour the standard into the other sample cell.



The SPADNS reagent is a very strong acid.

(c) Using a pipet filler, pipet 5.00 ml of SPADNS reagent into each sample cell and swirl to mix immediately. Allow one minute for the color to fully develop and proceed with step (d).

(d) Place the sample cell containing the Fluoride Standard Solution into the cell holder. Insert the Fluoride (SPADNS method) Meter Scale into the meter and adjust the wavelength dial to 580 nm. Adjust the LIGHT CONTROL for a meter reading of 1.0 mg/l Fluoride.

(e) Replace the standard blank with the prepared sample in the cell holder and read the mg/l fluoride.

b. Iron, Ferrous (Fe<sup>++</sup>) Test - 1,10-Phenanthroline Method (figs. 2-11 and 2-12, and para 2-18).

(1) Iron in Water. Natural water contain variable but minor amounts of iron. Iron in ground waters is normally present in the ferrous (Fe<sup>++</sup>) state which is easily oxidized to ferric (Fe<sup>+++</sup>) on exposure to air. Iron can enter a water system by leaching natural deposits from iron-bearing industrial wastes, effluents from pickling operations, or acidic mine drainage.

(a) Iron in domestic water supply systems stains laundry and porcelain, causing more of a nuisance than a potential health hazard. Taste thresholds of iron in water are 0.1 mg/l ferrous iron and 0.2 mg/l ferric iron, giving a bitter or astringent taste. Water used in industrial processes usually contain less than 0.2 mg/l total iron. Domestic water supplies containing more than 0.3 mg/l total iron are objectionable due to staining and taste considerations.

(b) The Iron, Ferrous, (Fe<sup>++</sup>) test 1, 10-Phenanthroline Method is the most well-known test for ferrous and total iron. The 1, 10-phenanthroline reagent gives an orange color with ferrous iron and is free from common interferences. The indicator is combined with a reducing agent for total iron analysis in a single powder formulation. The amount of ferric iron present can be determined as the difference between the amount of ferrous iron and the results of a total iron test paragraph 2-19.c. The Iron reagent converts all iron present in the sample to the ferrous state, including precipitated or suspended iron such as rust, where it reacts with the 1, 10-phenanthroline to give the orange color necessary for the determination.

(2) Ferrous Iron (Fe<sup>++</sup>) Test Procedure.

#### NOTE

- Samples should be analyzed as soon as possible after collection to prevent air oxidation of ferrous iron (Fe<sup>++</sup>) to ferric iron (Fe<sup>+++</sup>).
- Iron reagent powder pillows are stable up to 24 months depending on storage and handling conditions. A cool, dry atmosphere is recommended for longest shelf life. The iron reagent powder can be checked by adding the contents of one pillow to about 25 ml of water containing visual rust. If the characteristic orange color does not develop, then the reagent has deteriorated beyond use and should be discarded and reordered.
- A large excess of iron will inhibit full color development. A diluted sample should be tested if there is any doubt about the validity of a result. To extend the range of the test, a sample dilution is necessary (para 2-10a, table 2-1).

(a) Fill a graduated cylinder with the water to be analyzed to the 25 ml mark. Pour into a sample cell.

(b) To the contents of this cell add one ferrous iron test reagent powder pillow and swirl to mix.

(c) Allow the solution to stand 2 minutes. If iron is present, an orange color will develop. Proceed to step (d) while waiting.

(d) Fill the second clean sample with the original sample water and place it into the cell holder. Insert the Iron (Ferrover Method) Metal Scale into the meter and adjust the wavelength dial to 510 nm. Adjust the light control for a meter reading of 0 mg/l.

(e) Replace this blank sample with the prepared sample (step (c)) in the cell holder and read the mg/l ferrous (Fe++) iron on the meter scale.

c. Iron, total and Ferric (Fe+++ ) - 1, 10-Phenanthroline Method (fig. 2-11, 2-12 and para 2-18).

(1) Iron in Water (para 2-19b).

(2) Iron, total. Test Procedure.

(a) Fill a graduated cylinder with the water to be analyzed to the 25 ml mark. Pour into a clean sample cell.

(b) Add the contents of one Ferrover reagent test powder pillow to the sample, swirl and mix. Let the sample stand 2 minutes and more than 10 minutes to allow the color to develop.

(c) Fill a clean sample cell with original sample water (step (a)) and place it in the cell holder. Insert the Iron (Ferrover method) meter scale in the meter and adjust the wavelength dial to 510 nm. Adjust the light control for a meter reading of 0 mg/l.

(d) Replace this blank sample with the prepared sample (step (c)) in the cell holder and read the Total Iron (in mg/l) on the meter scale.

(3) Iron, Ferric (Fe+++ ) - by subtracting the Ferrous (Fe++) Iron Value from the total Iron Value, the Ferric (Fe+++ ) Iron Value in mg/L is obtained.

#### NOTE

To extend the range of the test a sample dilution is necessary (para 2-10a and table 2-1).

b. Iron, Ferrous ( $\text{Fe}^{++}$ ) Test - 1,10-Phenanthroline Method (figs. 2-11 and 2-12, and para 2-18).

(1) Iron in Water. Natural water contain variable but minor amounts of iron. Iron in ground waters is normally present in the ferrous ( $\text{Fe}^{++}$ ) state which is easily oxidized to ferric ( $\text{Fe}^{+++}$ ) on exposure to air. Iron can enter a water system by leaching natural deposits from iron-bearing industrial wastes, effluents from pickling operations, or acidic mine drainage.

(a) Iron in domestic water supply systems stains laundry and procelain, causing more of a nuisance than a potential health hazard. Taste thresholds of iron in water are 0.1 mg/l ferrous iron and 0.2 mg/l ferric iron, giving a bitter or astringent taste. Water used in industrial processes usually contain less than 0.2 mg/l total iron. Domestic water supplies containing more than 0.3 mg/l total iron are objectionable due to staining and taste considerations.

(b) The Iron, Ferrous, ( $\text{Fe}^{++}$ ) test 1, 10-Phenanthroline Method is the most well-known test for ferrous and total iron. The 1, 10-phenanthroline reagent gives an orange color with ferrous iron and is free from common interferences. The indicator is combined with a reducing agent for total iron analysis in a single powder formulation. The amount of ferric iron present can be determined as the difference between the amount of ferrous iron and the results of a total iron test paragraph 2-19.c. The Iron reagent converts all iron present in the sample to the ferrous state, including precipitated or suspended iron such as rust, where it reacts with the 1, 10-phenanthroline to give the orange color necessary for the determination.

(2) Ferrous Iron ( $\text{Fe}^{++}$ ) Test Procedure.

#### NOTE

- Samples should be analyzed as soon as possible after collection to prevent air oxidation of ferrous iron ( $\text{Fe}^{++}$ ) to ferric iron ( $\text{Fe}^{+++}$ ).
- Iron reagent powder pillows are stable up to 12 months depending on storage and handling conditions. A cool, dry atmosphere is recommended for longest shelf life. The iron reagent powder can be checked by adding the contents of one pillow to about 25 ml of water containing visual rust. If the characteristic orange color does not develop, then the reagent has deteriorated beyond use and should be discarded and reordered.
- A large excess of iron will inhibit full color development. A diluted sample should be tested if there is any doubt about the validity of a result. To extend the range of the test, sample dilution is necessary (para 2-10a, table 2-1).

(a) Fill a graduated cylinder with the water to be analyzed to the 25 ml mark. Pour into a sample cell.

(b) To the contents of this cell add one ferrous iron test reagent powder pillow DWG No. 13222E0715 and swirl to mix.

(c) Allow the solution to stand 2 minutes. If iron is present, an orange color will develop. Proceed to step (d) while waiting.

(d) Fill the second clean sample with the original sample water and place it into the cell holder. Insert the Iron (Ferrover Method) Metal Scale into the meter and adjust the wavelength dial to 510 nm. Adjust the light control for a meter reading of 0 mg/l.

(e) Replace this blank sample with the prepared sample (step (c)) in the cell holder and read the mg/l ferrous (Fe++) iron on the meter scale.

c. Iron, total and Ferric (Fe+++) - 1, 10-Phenanthroline Method (fig. 2-11, 2-12 and para 2-18).

(1) Iron in Water (para 2-19b).

(2) Iron, total. Test procedure.

(a) Fill a graduated cylinder with the water to be analyzed to the 25 ml mark. Pour into a clean sample cell.

(b) Add the contents of one Ferrover reagent test powder pillow (Dwg No. 13222E0657) to the sample, swirl and mix. Let the sample stand 2 minutes and more than 10 minutes to allow the color to develop.

(c) Fill a clean sample cell with original sample water (step (a)) and place it in the cell holder. Insert the Iron (Ferrover method) meter scale in the meter and adjust the wavelength dial to 510 nm. Adjust the light control for a meter reading of 0 mg/l.

(d) Replace this blank sample with the prepared sample (step (c)) in the cell holder and read the Total Iron (in mg/l) on the meter scale.

(3) Iron, Ferric (Fe+++) - by subtracting the Ferrous (Fe++) Iron Valve from the total Iron Valve, the Ferric (Fe++) Iron Valve in mg/L is obtained.

#### NOTE

To extend the range of the test a sample dilution is necessary (para 2-10a and table 2-1).

**WARNING**

Nessler's Reagent APHA. Contains mercuric compound and sodium hydroxide. External or eye contact: Flush with water. Ingestion: give plenty of water or milk. Follow with citrus juice or dilute vinegar. Table vinegar is approximately 4% acetic acid. Induce vomiting.

d. Nitrogen Ammonia 0-2 mg/l range (figs. 2-11 and 2-12, and para 2-18).

(1) Ammonia nitrogen is a product of the microbiological decay of plant and animal protein. It can be reused directly by plants and is commonly used in commercial fertilizers. Its presence in raw surface waters is uncommon and indicates domestic pollution. The Nessler method for ammonia nitrogen testing is a sensitive, single-reagent test, free from most common interferences. Distillation is not required for most samples and the Nessler reagent is stable for over one year.

## NOTE

- The temperature of the demineralized water and the water sample should be  $20^{\circ} +$  or  $-1^{\circ}\text{C}$  ( $68^{\circ}\text{F}$ ) for best results. Higher temperature will cause high readings and lower temperatures will cause low results.
- If the Nessler reagent becomes dark brown it should be discarded and a fresh supply ordered. A precipitate in the bottom of the reagent bottle is normal. These solids must not be disturbed in transferring the reagent to either solution or erratic answers may result.
- The results may be expressed as mg/l ammonia ( $\text{NH}_3$ ) or mg/l ammonium ( $\text{NH}_4$ ) by multiplying the mg/l ammonia nitrogen (N) by 1.22 or by 1.29, respectively.
- When testing water samples containing greater than 100 mg/l hardness (about 6 grains per gallon) (para 2-22g) a positive interference may result due to the precipitation of magnesium hydroxide. To eliminate this interference, add one drop of Rochelle Salt reagent (6, fig. 1-5) to the demineralized water and to the water sample before adding the Nessler reagent in step (c).

NOTE (Continued)

- Iron and sulfide will interfere by causing a turbidity with the Nessler reagent. Less common interferences such as hydrazine, glycine, various aliphatic and aromatic amines, organic chloramines, acetone, aldehydes, and alcohols may cause greenish or other off colors or turbidity in the prepared sample.

(a) Measure 25 ml demineralized water by filling a clean graduated cylinder to the 25 ml mark. Pour into a clean sample cell

(b) Take a water sample by filling a second graduated cylinder to the 25 ml mark. Pour into another sample cell

(c) Add 1.0 ml of Nessler reagent to both sample cells by using the 1.0 ml calibrated dropper (or 1 ml transfer pipet). Swirl to mix. A yellow color will develop in the water sample if ammonia nitrogen is present. Allow at least 10 minutes for the color to develop but do not wait more than 25 minutes before completing steps (d) and (e).

(d) Place the sample cell containing the prepared demineralized water solution into the cell holder (as a blank). Insert the Nitrogen. Ammonia (Nessler method) meter scale into the meter and adjust the wavelength dial to 425 nm. Adjust the light control for a meter reading of zero mg/l.

(e) Replace the cell containing the prepared demineralized water with the prepared water sample in the cell holder and read the mg/l ammonia nitrogen (N).

e. Nitrogen, Nitrate, High range 0-30 mg/l/(figs. 2-11 and 2-12, and para 2-18).

(1) Nitrate represents the most completely oxidized state of nitrogen commonly found in water. Nitrate-forming bacteria convert nitrites into nitrates under aerobic conditions and lightning converts large amounts of atmospheric nitrogen ( $N_2$ ) directly to nitrates. Many granular commercial fertilizers contain nitrogen in the form of nitrates.

(a) High levels of nitrate in water indicate biological wastes in the final stages of stabilization or run-off from heavily fertilized fields. Nitrate-rich effluents discharged into receiving waters can degrade water quality by encouraging excessive growth of algae. Drinking waters containing excessive amounts of nitrates can cause infant methemoglobinemia (blue babies). For this reason, a level of 45 mg/l nitrate nitrogen has been established as the maximum allowable concentration of nitrates in public drinking water supplies.

(b) The method of analysis used in the high range test is a modification of the cadmium reduction method using gentisic acid in place of 1-naphthyl amine. The test registers both nitrates and nitrites present in the water sample and eliminates the need for dilutions by operating in the most useful range. All the necessary reagents have been combined into a single stable powder called the nitrate reagent.

(2) Nitrogen, Nitrate, Range 0-30 mg/l (figs. 2-11 and 2-12, and para 2-18).

#### NOTE

- The Nitrate reagent is slightly temperature sensitive. For best results, the test should be performed with a sample temperature of 20° - 25°C (68° - 75°F).
- A deposit of unoxidized metal will remain after the Nitrate reagent powder has dissolved. This will have no effect on test results.
- The extent of color development in the nitrate nitrogen test using Nitrate reagent powder is partially affected by the shaking time and technique of the analyst. For most accurate results, the analyst should make successive tests on a solution containing a known amount of nitrate and adjust shaking time to obtain the most accurate results.

(a) Take a water sample by filling a clean sample cell to the 25 ml mark.

(b) Add the contents of one nitrate reagent powder pillow to the sample cell, stopper, and shake vigorously for exactly one minute. An amber color will develop if nitrate nitrogen is present. Allow at least 5 minutes for proper color development but do not wait more than 15 minutes before completing steps (c) and (d).

(c) Fill another sample cell to the 25 mark with original water sample and place it into the cell holder. Insert the Nitrogen, Nitrate meter scale into the meter and adjust the wavelength dial to 500 nm. Adjust the light control for a meter reading of zero mg/l.

(d) Replace the blank sample, step (c) with the prepared sample in the cell holder and read the mg/l nitrate nitrogen (N).

(e) The results can be expressed as mg/l nitrate ( $\text{NO}_3$ ) by multiplying the mg/l nitrate nitrogen (N) by 4.4.

f. pH, Wide Range (figs. 2-11 and 2-12, and para 2-18).

(1) pH is defined as the logarithm of the reciprocal of the hydrogen ion activity expressed in moles per liter. More simply, the pH value of water sample expresses its tendency to accept or donate hydrogen ions on a scale of 0 (very acidic) to 14 (very basic). Pure water at 25°C (77°F) is neutral and has a defined pH value of 7. The pH value represents the instantaneous hydrogen ion activity rather than the buffering capacity or the total reserve as in acidity and alkalinity tests.

(a) Most natural waters range from pH 4 to pH9 and are often slightly basic due to the presence of carbonates and bicarbonates. A major deviation from the normal pH for a given water indicates the intrusion of strongly acidic or strongly basic industrial wastes. pH adjustment is a common practice in water treatment processes and is used to control corrosion within the distribution system. Ground waters in the United States have pH values ranging from around 6.0 to 8.5, while surface waters vary between 6.5 to 8.5 pH units. The pH of some waters is held at lower levels by redox reactions, such as the oxidation of sulfur and ferrous iron.

(b) The importance of pH in virtually every phase of water supply and waste treatment is well established. The 5.8 and 8.2 values are minimum and maximum aesthetic limits, respectively, specified by the U.S. Army for short-term consumption.

(c) The pH of water can be determined calorimetrically by choosing indicators whose colors are highly pH dependent. It is recommended the Wide Range pH test below be performed on the sample initially to determine the approximate pH value, followed by a second test using a more specific range and indicator.

(2) pH, Wide Range Test Procedure.

**WARNING**

Wide Range pH Indicator. Contains Methanol.  
Poison. Vapors harmful. May cause permanent blindness. Keep well closed and in a cool place.  
Flammable. External contact: flush with water.  
Inhalation: remove from exposure. Ingestion: induce vomiting (salt in warm water). Fire: use "smothering" foam. Water may be ineffective.

## NOTE

- The amount of indicator added is critical to the accuracy of the test and should be measured as carefully as possible.
- The strength of the indicator solution should be checked occasionally in the range normally being tested. Substitute: The indicator solution may be checked by running the test on a prepared buffer solution of a known PH. If the meter reading is too high the indicator has become too concentrated through evaporation of the solvent. If meter reading is too low, the indicator has deteriorated and should be replaced.

(a) Take a water sample by accurately filling a clean graduated cylinder to the 25.0 ml mark. Pour the sample into a clean, dry sample cell.

(b) Add exactly 1.0 ml of wide range pH indicator solution using the 1.0 ml transfer pipet and swirl to mix.

(c) Fill another sample cell with about 25 ml of original water sample and place it into the cell holder. Insert the pH, wide range meter scale into the meter and adjust the wavelength dial to 520 nm. Adjust the light control so the meter needle rests at the far right end of the arc.

(d) Replace the blank sample (step (c)) with the prepared sample in the cell holder and read the pH value from the center or lower scale, according to the developed color. If the color does not correspond to those indicated on the center or lower scales, and/or the meter reading does not fall within the ranges indicated, proceed with step (e).

(e) Adjust the wavelength dial to 615 nm and standardize the instrument as described in step (c). Place the prepared sample in the cell holder and read the pH value on the upper scale.

g. Sulfate, Range: 0-150 mg/l, Turbidimetric Method (para 2-18 and figs. 2-11 and 2-12).

(1) Sulfate appears in natural waters in a wide range of concentrations. Mine waters and industrial effluents frequently contain large amounts of sulfate from pyrite oxidation and the use of sulfuric acid.

(a) Public Health Service drinking water standards call for not more than 250 mg/l of sulfate because of its cathartic action. The taste threshold of magnesium sulfate is 400 to 600 mg/l and for calcium sulfate is 250 to 800 mg/l. Sulfate may be either beneficial or detrimental in water used for manufacturing and domestic supply.

In domestic water systems, sulfates do not appear to cause any increased corrosion on brass fittings but concentrations above 200 mg/l do increase the amount of lead dissolved from lead pipes.

(b) The procedure for determining sulfate is a modification of the Barium Sulfate Turbidimetric Method. A single, dry powder reagent called sulfate reagent will cause a milky precipitate to form if sulfate is present. The sulfate reagent also contains a stabilizing agent to hold the precipitate in suspension for turbidimetric analysis. The amount of turbidity formed is directly proportional to the amount of sulfate present.

(2) Sulfate Test Procedure.

NOTE

- Filtering (para 2-22j) is recommended for highly colored and/or turbid water samples. Large amount of color or turbidity will interfere and cause high readings. The filtered water is then used in steps (a) and (c).
- The results will not be affected if the reagent powder does not completely dissolve.
- After each test the sample cells should be cleaned with soap and a brush. A white film will deposit on the inside of the cells and lead to errors in future determinations if this is not done soon after each test.
- Silica in excess of 500 mg/l will interfere.
- To extend the range of the test, a sample dilution is necessary (para 2-10a and table 2-1).

(a) Fill a clean graduated cylinder to the 25 ml mark, then pour into a sample cell.

(b) Add the contents of one sulfate reagent powder pillow and swirl to mix. A white turbidity will develop if sulfate is present. Allow the sample to stand 5 minutes but not more than 10 minutes before step (c) and (d).

(c) Fill another sample cell to the 25 ml mark with original water sample and place it in the cell holder. Insert the sulfate meter scale into the meter and adjust the wavelength dial to 450 nm. Adjust the light control for a meter reading of zero mg/l.

(d) Replace the blank sample (step (c)) with the prepared sample in the cell holder and read the mg/l ( $\text{SO}_4$ ).

h. Turbidity, 0-500 FTU Range (fig. 2-11 and 2-12 para 2-18h).

(1) Turbidity occurs in most surface waters as the result of suspended clay, silt, finely divided organic and inorganic matter, plankton and other micro-organisms. Turbidity measurement of water is important to those industries where the product is destined for human consumption, such as the food and beverage industries, and municipal water treatment plants.

(a) The turbidity test measures an optical property of the water sample which results from the scattering and absorbing of light by the particulate matter present. The amount of turbidity registered is dependent on such variables as the size, shape, and refractive indices of the particles. No direct relationship exists between the turbidity of a water sample and the weight concentration of the matter present, as is determined in the suspended solids test.

(b) Turbidity calibrations were originally based on the Jackson candle turbidimeter with results expressed in Jackson Turbidity Units (JTU). As the Jackson equipment lacks sensitivity below 25 JTU (most treated water ranges from 0 to 5 JTU, the meter scale calibrations have been based on a uniform milky polymer called formazin, which allows accurate calibrations over a wide range. The results are expressed as Formazin Turbidity Units (FTU) and are equivalent to the Jackson units.

(2) Turbidity Test Procedure.

#### NOTE

Filtering (para 2-22) is recommended for highly colored samples. The filtered water is then used in place of the clear, colorless water called for in step (b).

(a) Take a water sample by filling a clean sample cell to the 25 ml mark.

(b) Fill another sample cell to the 25 ml mark with clear, colorless water and place it into the cell holder. Insert the Turbidity (Absorptometric Method) Meter Scale into the meter and adjust the wavelength dial to 450 nm. Adjust the light control for a meter reading of zero FTU.

((c) Replace the blank sample (step (c)) with the sample (step (a) in the cell holder and read the formazin turbidity units (FTU).

2-20. WATER QUALITY ANALYSIS SET - ENGINEER.

2-21. INTRODUCTION. The operator should read the general water test information (para 2-1), prior to using the WQAS. (See fig. 1-2.)

a. Instructions for using the kits are arranged alphabetically by test kit title and are designed to be conducted with the following principal equipment within the ranges specified.

(1) Alkalinity Test Kit Range 0 mg/l to 500 mg/l.

(2) Low range Chloride Test Kit Range 0 to 1500 mg/l.

(3) Color Test Ranges. Low: 0 to 100 APHA platinum cobalt units. High: 0 to 500 APHA platinum cobalt units.

(4) Comparator. Color, Hydrogen Ion and Residual Chlorine - Chlorine Test - 0.1 to 10.0 ppm Wide range pH indicator - 3.0 to 11.0.

(5) Conductivity Meter: Total Dissolved Solids (TDS) Determination, 0-50-500-5000 ppm. Range Extension 5000 to 50,000 ppm TDS.

(6) Hardness Test Kit, Total Magnesium and Calcium, 0 to 9000 mg/l.

(7) Refill Kit Chemical Detectors, NSN 6665-00-909-3647, (for Water Testing Kit, NSN 6665-00-171-9747). (Used in buys 1 and 2.)

(8) Sulfate Test Kit - Range 0 to 3000 mg/l.

(9) Turbidity Test Kit - Range of 5 to 100 JTU units in increments of 5 units and 10 to 200 JTU units in increments of 10 units.

(10) Water Testing Kit, Chemical agents, AN-M2, NSN 6665-00-171-9747. (Used in buys 1 and 2.)

(11) Water Testing Kit, Chemical Agents - M272, NSN 6665-01-134-0885. (Not used in buys 1 and 2.)

b. Accessory support items (lab-ware) for the kits are identified in the test procedures with the stored location item member as given on the WQAS - Engineer Loading Diagram (fig. 1-6).

c. See the Index under Test Procedures - Engineer for a complete listing. Each procedure is introduced with a brief chemical discussion to familiarize the operator with the causes of the condition followed by a step-by-step procedure to accomplish measurement, with the pertinent kit, of the degree of the condition.

d. Instructions for determination of chemical dosage requirements are stored within the set.

e. A summary of the maximum allowable raw water constituents for use when determining the preliminary type of process or processes in the treatment of the raw water source is contained in table 2-8.

**Table 2-8. Maximum Allowable Raw Water Constituents**

Test Paragraph	Constituent	Coagulation	Ion Exchange	Distillation
2-21a	Alkalinity	No Limit	No Limit	No Limit
2-21b	Chlorides	250 mg/l	3000 mg/l	No Limit
2-21h(4)	Chloride, Demand	No Limit	No Limit	No Limit
2-21c	Color	No Limit	No Limit	No Limit
2-21e	Hardness, Total	250 mg/l	2000 mg/l	No Limit
2-21e(1)	Calcium	250 mg/l	2000 mg/l	No Limit
2-21g(6)	Magnesium	125 mg/l	125 mg/l	No Limit
2-21d	pH	No Limit	No Limit	No Limit
2-21h	Sulfate	250 mg/l	1500 mg/l	No Limit
2-21f	Total Dissolved Solids	500 mg/l	3000 mg/l	No Limit
2-21i	Turbidity	No Limit	*5 Units	No Limit

\*If the turbidity exceeds 5 units, the raw water source must be pretreated using the coagulation process 2-21a(2).

**WARNING**

- Dangerous chemicals are provided in these kits. Death, health hazards or injuries such as severe burns, impaired vision and internal tissue destruction may be experienced if personnel fail to observe precautions.
- Do not allow reagents, buffer solutions or acids to come in contact with skin or eyes. Do not ingest solutions, tablets, droplets or spillage from lab-ware.
- Do not inhale fumes from products or mixing reactions. Cyanide is extremely poisonous. Potassium cyanide should be stored away from water and acids. Always add Cyanide AFTER ADDING Potassium Hydroxide and NEVER BEFORE.
- Many products furnished are highly inflammable, some have explosive potential. Most acids are corrosive.

**WARNING**

- Keep all bottles and containers capped and sealed to prevent accidental spillage and to increase shelf-life.
- Never pipet chemical reagent solutions or unknown water samples by mouth.
- DO NOT INDUCE VOMITING if any of the following chemicals are ingested:

Alkalinity Titration Reagent (Sulfuric Acid)  
 Alkaline Potassium Iodide Solution  
 Spadns Reagent  
 Hydrochloric Acid  
 Reagent "A" (Potassium Bisulfate and Copper Sulfate Pentahydrate)  
 Reagent "D" (4(Nitrobenzyl) Pyridine and Potassium Perchlorate and Urea)  
 Reagent "E" (Potassium Carbonate)  
 Reagent "G" (Halazone Tablets)  
 Reagent "H" (Dimethoxybenzidine)  
 Reagent "I" (Potassium Carbonate and Sodium Methaphosphate)  
 Reagent "J" (Perdox" (Sodium Borate))  
 Reagent "X" (Orthotolidine Dihydrochloride)  
 Substrate Solution (Ligroine and 2, 6 Dichloroindophenol Acetate)  
 Trihydroxymethylaminomethane (TRIS)

- INDUCE VOMITING if any of the following chemicals are ingested:

Isopropyl Alcohol  
 DPD (Diethyl-P-Phenylene Diamine)  
 Wide Range pH Indicator Solution  
 Arsenite Solution  
 Nessler's Reagent APHA  
 Sulfaver IV  
 Sodium Hydroxide Standard Solution  
 Chloride Titrant (Silver Nitrate)  
 Phenolphthalein Indicator solution  
 Manganese Sulfate Solution  
 Sodium Thiocyanate Solution  
 Zinc Reagent  
 Standard Barium Chloride Reagent  
 Reagent "K" (Acetone and Zylenes)

IMPORTANT

Refer to the specific "Step-BY-Step" instructions relative to accidents as defined in the paragraphs covering each specific chemical.

## 2-22. PROCEDURES.

## a. Alkalinity Test Kit (fig. 2-13).

(1) Alkalinity refers to the capability of water to neutralize acids. The presence of carbonates, bicarbonates, and hydroxides of calcium, magnesium, and sodium metals are the most common causes of alkalinity in natural waters.

(a) The levels and types of alkalinity are directly dependent on the source of water. Natural surface and well waters usually contain less alkalinity than sewage or wastewater samples. High levels of alkalinity indicate the presence of a strongly alkaline industrial waste.

(b) Alkalinity is expressed as "P" (phenolphthalein) alkalinity or as "T" (total) alkalinity. Both types are determined by titration with sulfuric acid standard solution 0.020 N, to an end point evidenced by the color change of standard solution.

(c) The "P" alkalinity is determined by titration to a pH of 8.3 (the phenolphthalein end point) and registers the total hydroxide and one half the carbonate present. The "T" alkalinity is determined by titration to a pH of 5.1, 4.8, or 4.5, depending on the amount of carbon dioxide present as described in para 2-22a(3) below. The total alkalinity includes all carbonate, bicarbonate and hydroxide alkalinity.



**WARNING**

- Total Alkalinity Indicator: For test purposes only. Not for internal use. Keep away from children.
- Alkalinity Titration Reagent (Sulfuric Acid). For test purposes only. Not for internal use. Keep away from children. May cause burns. Avoid breathing vapors. In case of contact with skin or eyes, flush well with water, for eyes get medical attention. If swallowed, call a physician at once. DO NOT INDUCE VOMITING. Give milk of magnesia with large amounts of water. Follow with milk or raw egg whites beaten in water.
- Phenolphthalein Indicator. For test purposes only. Flammable. Keep away from sparks or open flame. Not for internal use - contains toxic material. If swallowed, call a physician at once. Induce vomiting by giving a tablespoonful of salt in a glass of warm water, repeating until vomit is clear. KEEP OUT OF REACH OF CHILDREN.

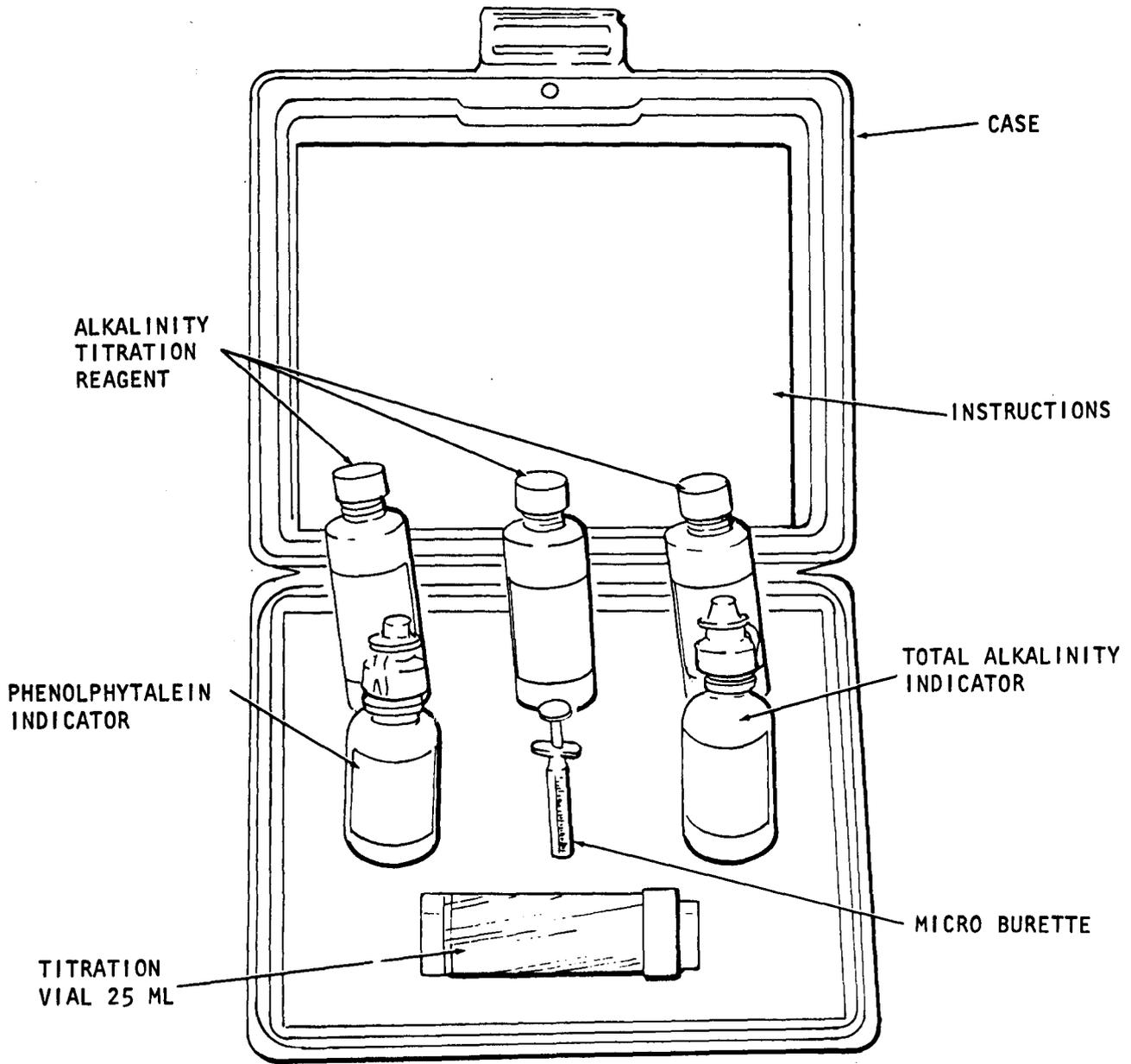


Figure 2-13. Alkalinity Test Kit

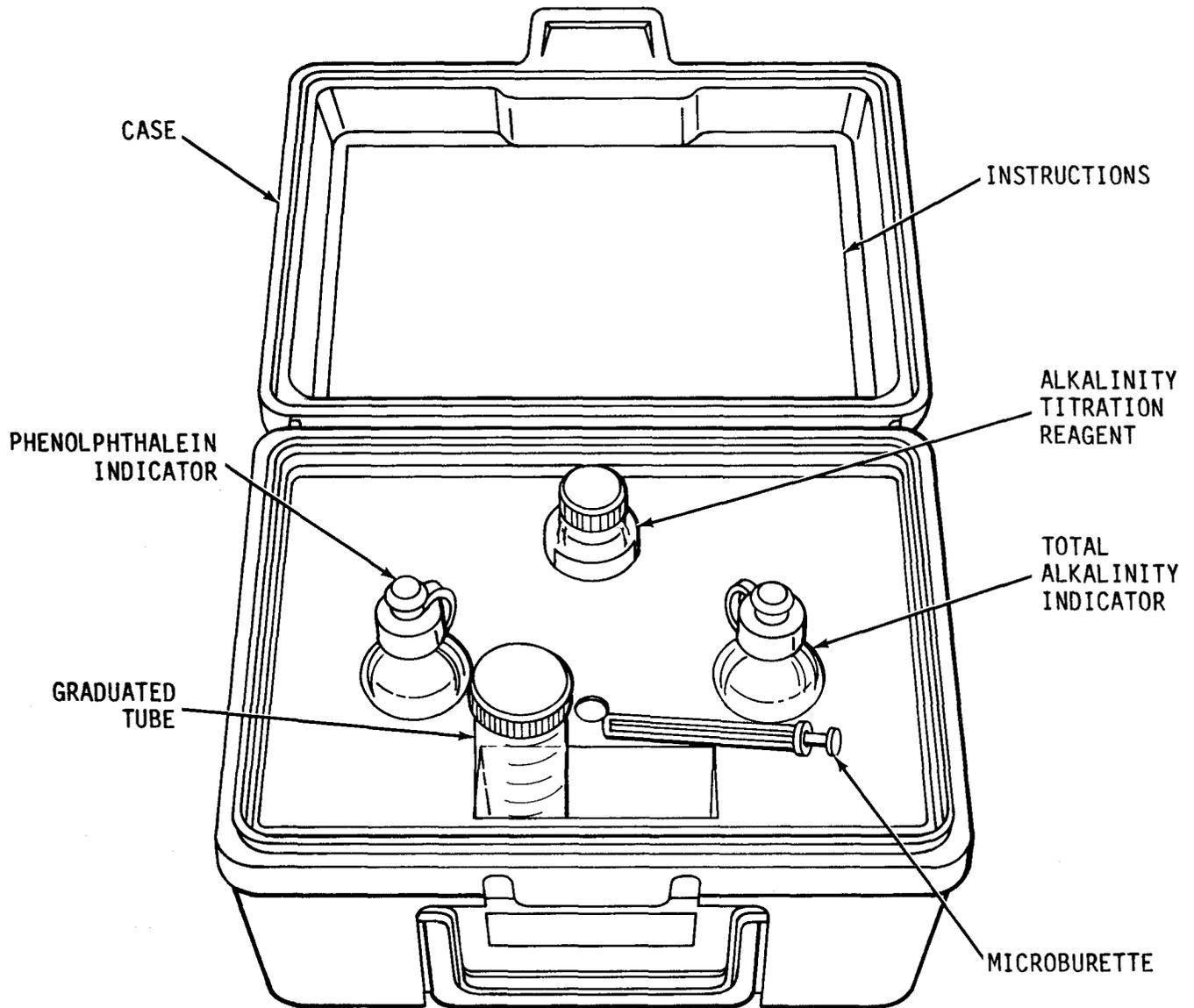


Figure 2-13.1. Alkalinity Test Kit (Not Used in Buys 1 and 2)



## (2) Method for Phenolphthalein "P" Alkalinity Test (0-500 mg/l).

(a) Add sample water to the line in the titration vial.

(b) Add 1 drop of phenolphthalein indicator to the vial and mix. If the sample does not turn pink, the phenolphthalein alkalinity is zero. Proceed to total Alkalinity Test.

(c) If the sample does turn pink, fill the micro burette (para 2-11) with alkalinity titration reagent.

(d) Titrate the sample slowly with the alkalinity titration reagent. Swirl the vial gently during each addition. When the sample changes from pink to colorless, stop titrating and record the scale reading from the micro burette barrel. Multiply the number of major micro burette divisions used by 10 to obtain the "P" alkalinity as mg/l calcium carbonate ( $\text{CaCO}_3$ ).

## NOTE

Save the sample for the Total Alkalinity test. Do not refill the micro burette at this point.

## (3) Total "T" Alkalinity Test (0-500 mg/l).

(a) Add to the sample on which the phenolphthalein alkalinity has just been determined, 1 drop of total alkalinity indicator and mix. The color of the sample should be green at this point.

(b) Continue to slowly add alkalinity titration reagent left in the micro burette after the phenolphthalein test to the titration vial with swirling, until the green color of the sample changes to a permanent pale purple.

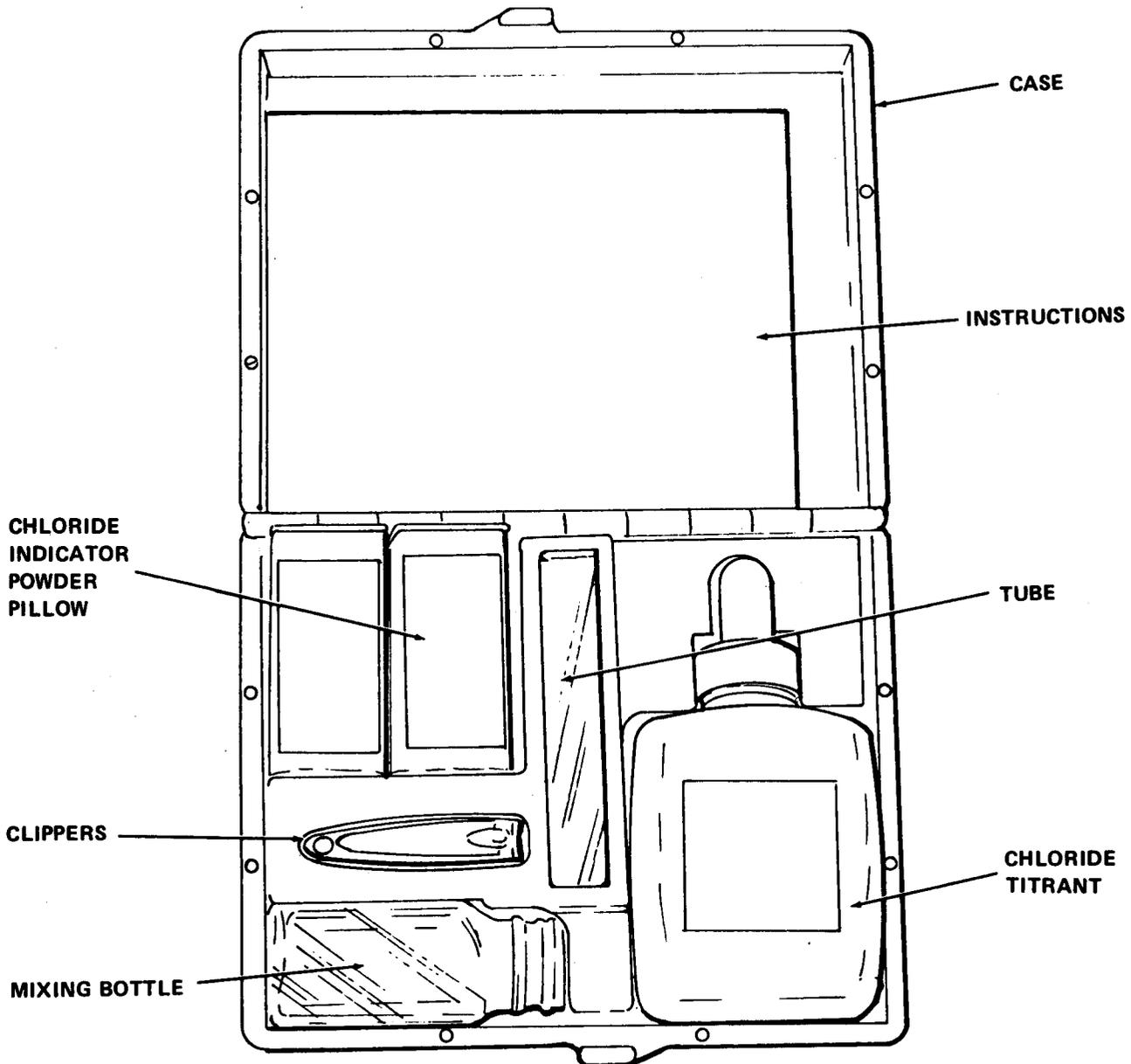
(c) Record the total number of micro burette divisions used. Multiply the total number of micro burette divisions used by 10 to obtain the total "T" alkalinity concentration as mg/l ( $\text{CaCO}_3$ ).

## b. Low Range Chloride Test Kit Instructions (fig 2-14).

(1) Chlorides are present in all potable water supplies and in sewage, usually as a metallic salt. When sodium is present in drinking water, chloride concentrations in excess of 250 mg/l give a salty taste. If the chloride is present as a calcium or magnesium salt, the taste detection level may be as high as 1000 mg/l chloride.

(a) Chloride is essential in the diet and passes through the digestive system unchanged to become one of the major components of raw sewage. The wide use of zeolite in water softeners also contributes a large amount of chloride in sewage and wastewaters.

(b) High chloride concentrations in water are not known to have toxic effects on man, though large amounts may act corrosively on metal pipes and be harmful to plant life. The maximum allowable



*Figure 2-14. Low Range Chloride Test Kit*

chloride concentration of 250 mg/l in drinking water has been established for reasons of taste rather than as a safeguard against physical hazard.

(c) This test set provides a quantitative method for determining the concentration of chlorides in water. When used in reconnaissance of raw water sources, a determination can be made as to the type of process required; i.e., coagulation, ion exchange or distillation. When used for analysis of product from a distillation unit, the results should indicate 15 mg/l or less. If the chloride content exceeds 15 mg/l, this is an indication of possible foam carryover or leakage in the heat exchanger.

**WARNING**

- Keep all bottles tightly capped. Do not allow reagent chemicals to come in contact with the skin or eyes. Do not ingest. Most chemical reagents are either corrosive or poisonous or both.
- Chloride Titrant. Poison, may be fatal if swallowed. May cause permanent blindness. Cannot be made nonpoisonous. For test purposes only. Contains silver nitrate and methanol. Avoid contact with skin and eyes. Keep well closed in cool place. External contact: Flush with Water. Ingestion: Induce vomiting by giving a tablespoon of salt in a glass of warm water. Call physician immediately. Keep away from children.
- Chloride Indicator. For test purposes only. Not for internal use. Keep away from children.

(2) Chloride Test - 0 -1500 mg/l Range.

(a) Fill the plastic measuring tube level with the water sample and pour it into the mixing bottle.

(b) Add the contents of one chloride indicator powder pillow. Swirl to mix.

(c) Add the chloride titrant dropwise (counting the number of drops) until the solution changes to an orange color. Be sure to mix thoroughly after each drop and to hold the dropper vertically.

(d) The chloride content of the test water in mg chloride/l is found by multiplying the number of drops added by 30.3.

NOTE

To extend the range of the test, a sample dilution is necessary (para 2-10a, table 2-1).

(3) Chloride Test - 0-500 mg/l Range.

(a) Fill the mixing bottle to the 23 ml mark with the water sample.

(b) Add the contents of one chloride indicator powder pillow. Swirl to mix.

(c) Add the chloride titrant dropwise (counting the number of drops) until the solution changes to an orange color. Be sure to mix thoroughly after each drop and to hold the dropper vertically.

(d) The chloride content of the test water in mg chloride/l is found by multiplying the number of drops added by 7.58.

c. Color Test Kit - Apparent Color (fig. 2-15).

(1) Color in natural waters results from metallic salts, organic matter, and other dissolved or suspended materials present.

(a) Industrial wastes contribute specific colors to wastewater which are dependent, as are most color forming materials, on the pH of the water. Color removal is necessary for some industrial processes and is practiced for water intended for general domestic purposes.

(b) Color may be expressed as "apparent" or "true" color. The apparent color includes that from dissolved materials plus that from suspended matter. By filtering or centrifuging out the suspended materials, the true color can be determined.

(2) Color Test - Low Range, 0-100 APHA platinum cobalt units.

(a) Fill one of the color viewing tubes to within 1/16 inch of the top with the water sample. Insert the stopper in a manner so as to expel any air bubbles.

(b) Place the lengthwise viewing adapter in the comparator.

(c) Insert the tube with the water sample into the back side of the comparator in the opening nearest the middle.

(d) Fill the other sample tube with clear water and stopper in a manner so as to expel air bubbles. Insert this tube in the comparator in the other opening in the back of the comparator.

(e) Hold the comparator up to a light such as a window, the sky, or a lamp and view through the openings of the comparator. Rotate the disc until a color match is obtained. The reading obtained through the scale window is the apparent color in APHA platinum cobalt units.

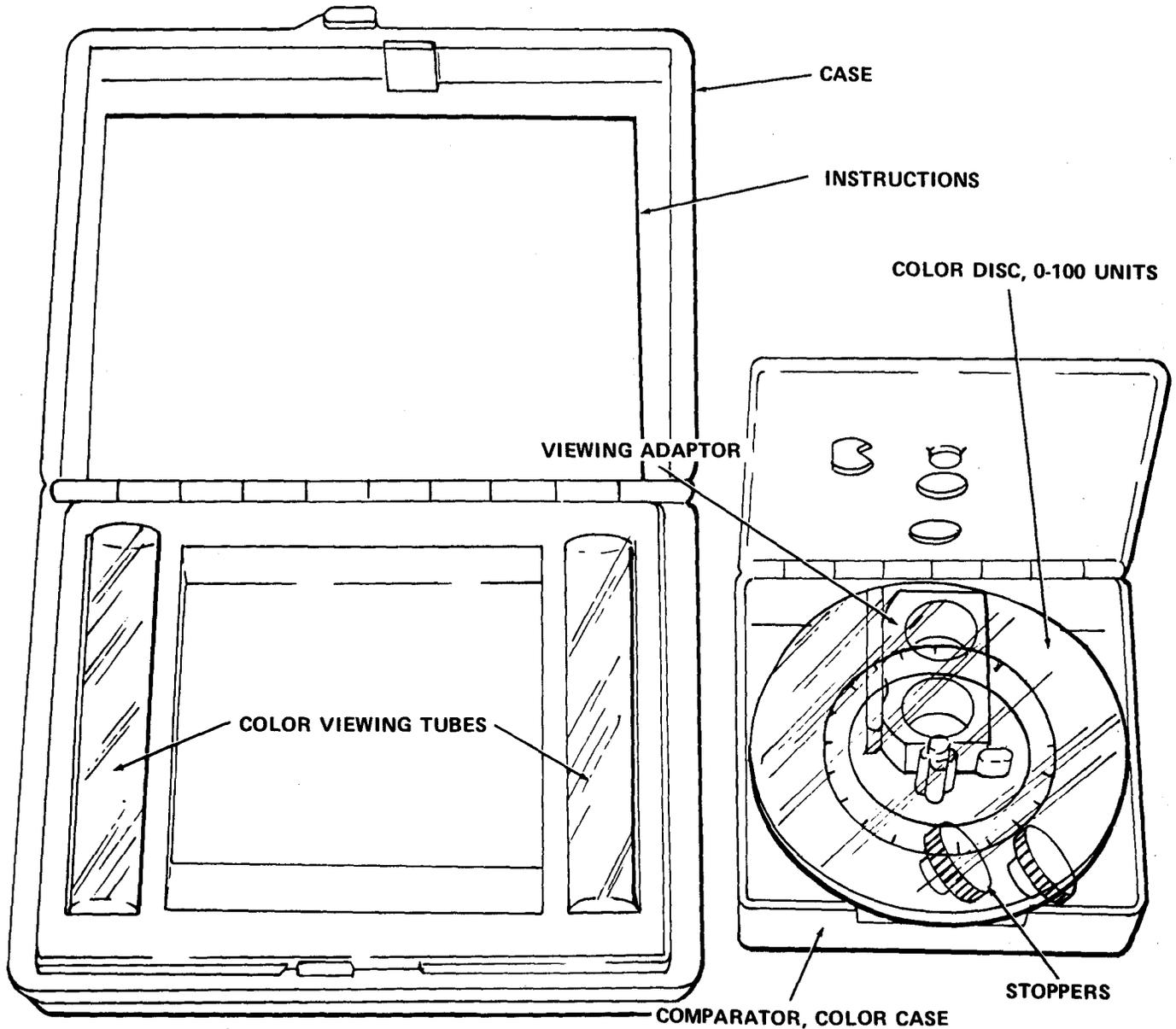
(3) Color Test - High range, 0-500 APHA platinum cobalt units.

(a) If the lengthwise viewing adapter is in place, remove it.

(b) Fill one of the tubes to the 5-ml mark with the water sample.

(c) Insert the tube in the right top opening of the comparator.

(d) Fill the other tube to the mark with clear water and insert this tube in the left opening of the comparator.



*Figure 2-15. Color Test Kit (Diet Installed)*

(e) Hold the comparator up to a light such as a window, the sky, or a light and view through the openings in the comparator. Rotate the disc until and color match is obtained. The reading obtained through the scale window is multiplied by 5 to obtain the apparent color in APHA platinum cobalt units.

NOTE

Color discs are developed to withstand fading due to ultraviolet light, but to prolong the life of the discs, avoid leaving in direct sunlight for any extended period of time.

d. Comparator, Color, Hydrogen Ion and Residual Chlorine, (Determination of pH) (fig. 2-16).

(1) pH Values. In determining pH values, this comparator measures them as simple numbers conforming to the hydrogen ion scale. The sample cells have a 26 mm viewing depth and hold 15 ml of samples when filled to the mark on the cells. The pH color disc furnished with the comparator contains nine permanent values. The reagent bottle has a color coded (white) label and cap to indicate the pH indicator solution. The pH color disc being used in the comparator is also marked to show the solution to be used. A prism eyepiece is provided for accurate comparison.

**WARNING**

- Orthotolidine. Danger, contains acid. Can cause severe burns. Avoid contact the skin and eyes. Avoid breathing vapors. Antidote: External, flush with water. If in eyes, wash for 15 minutes. Get medical attention. Internal - call physician at once. Do not induce vomiting or use carbonates. Give large amounts of water containing milk of magnesia. Follow with raw white of eggs beaten with water. Keep away from children.
- Wide Range D pH Indicator. Danger, poison. May be harmful, fatal, or cause blindness if swallowed. Cannot be made non-poisonous. Keep container closed. Avoid prolonged or repeated breathing of vapor. Inflammable keep away from sparks or open flame. Antidote: If swallowed, call a physician immediately. First Aid: Give tablespoon of salt in a glass of warm water and repeat until vomit fluid is clear. Give two teaspoonfuls of baking soda in a glass of water. Have patient lie down and keep warm. Cover eyes to exclude light. Keep away from children.
- Arsenite Solution. Danger. Poison. May be fatal if swallowed or absorbed through skin. Do not get in eyes, on skin, or on clothing. Wash thoroughly after handling. Do not pipet by mouth. Use automatic pipet. Antidote: If swallowed, induce vomiting by sticking finger down throat or by giving soapy or strong salty water to drink. Repeat until vomit is clear. Never give anything by mouth to an unconscious person. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before re-use. (Discard contaminated shoes.) Keep away from children.

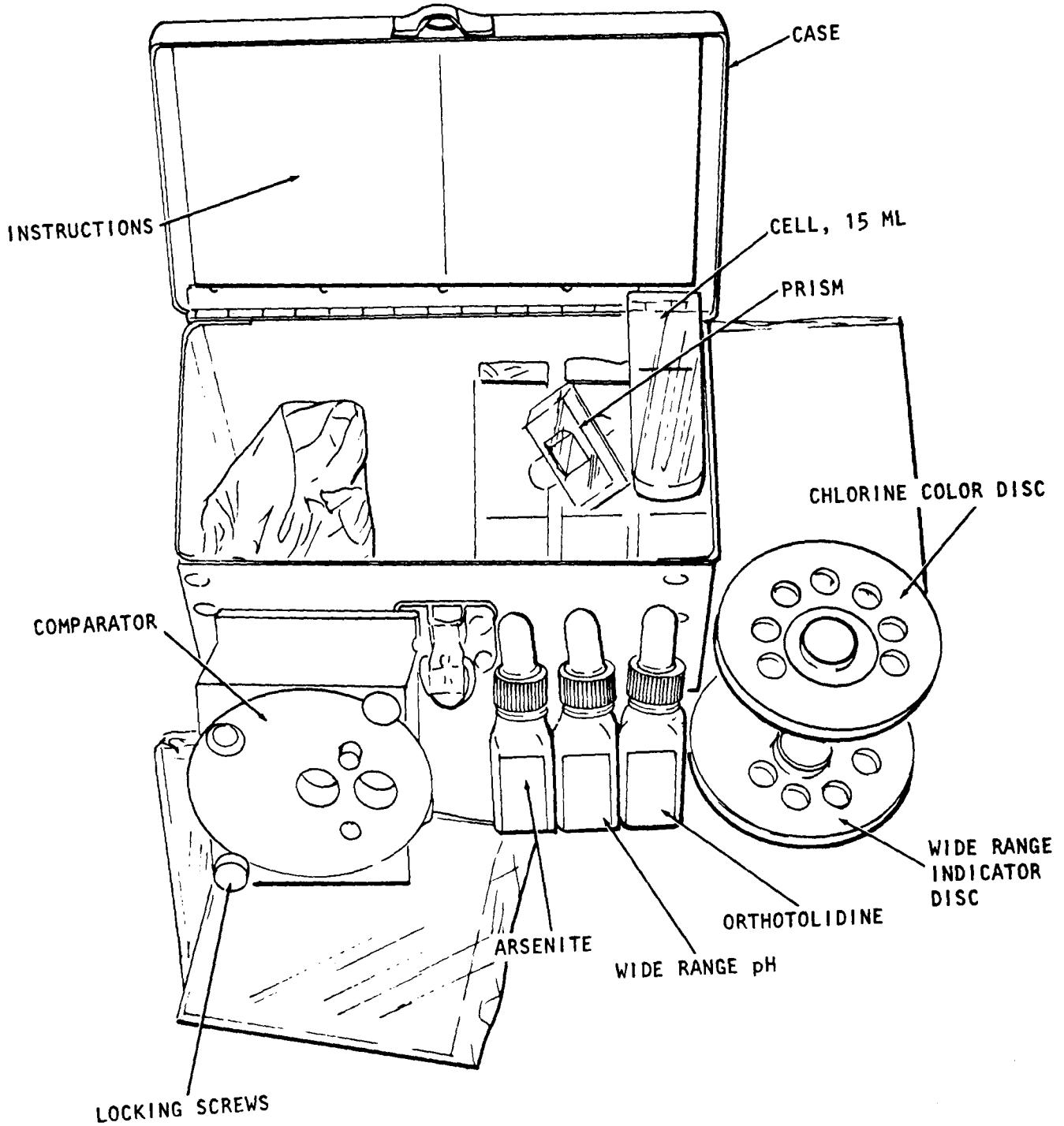
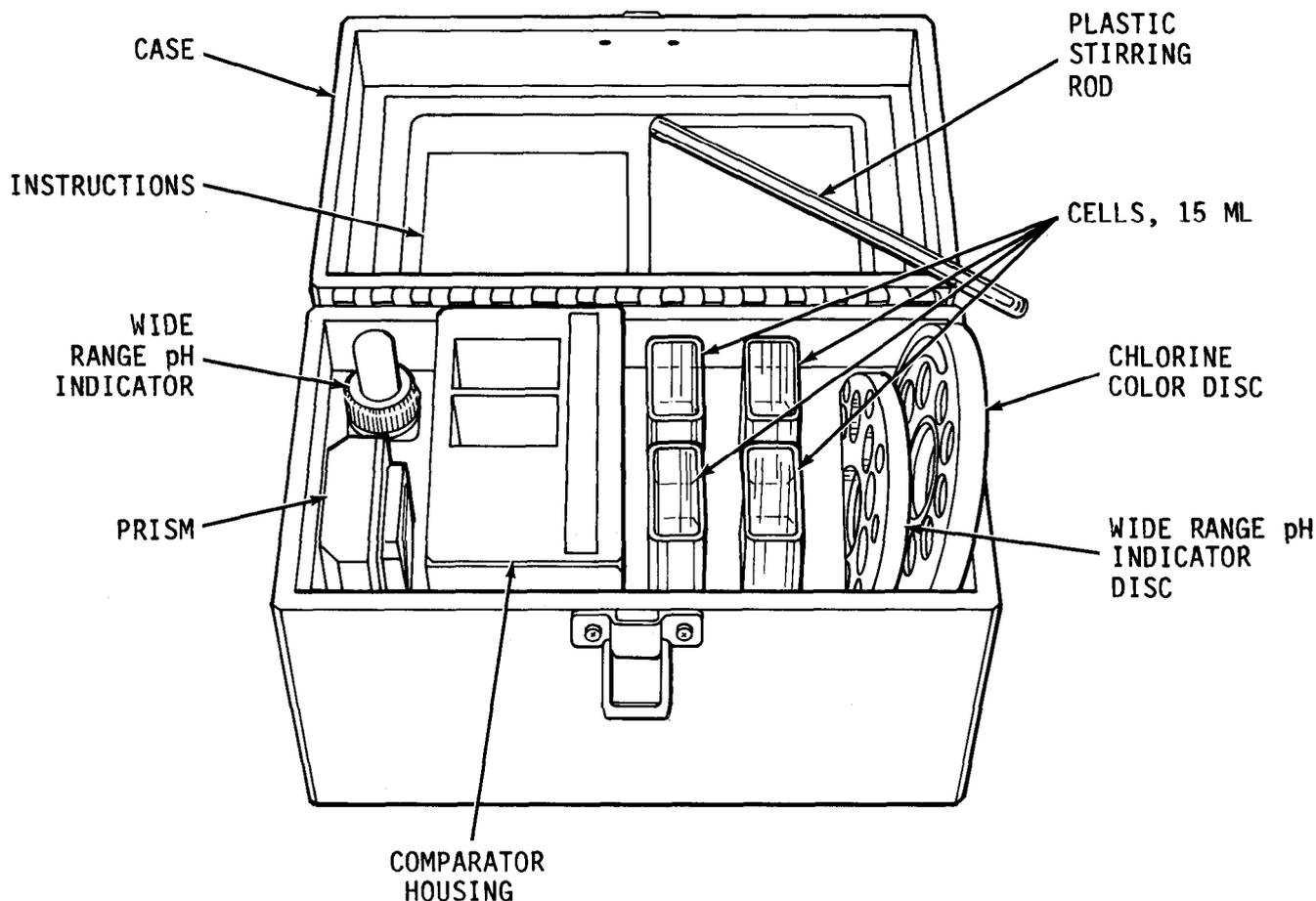


Figure 2-16. Hydrogen-Ion and Chlorine Residual Color Comparator Test Kit



*Figure 2-16.1. Hydrogen-Ion and Chlorine Residual Color Comparator Test Kit (Not Used in Buy 1)*

NOTE

- Never place the pH dropper down on an object or permit it to touch the sample or the sample cell because the adherence of the slightest amount of acid or alkali to it will produce erroneous results. Always replace the dropper on proper reagent bottle.

Dropper bottles for solutions used in this kit shall be filled prior to testing from larger containers (11, 12, and 13, fig. 1-6 or 11, Fig 1-6.1) as indicated:

Arsenite (Used in Buy 1 Only)	- (12)	Sodium Arsenite S.
Wide Range pH 1	- (11)	Wide Range 1 "D".
Orthotolidine (Used in Buy 1 Only)	- (13)	Orthotolidine S.

(2) Determination for pH.

(a) Insert the pH color disc into the comparator.

(b) Select two clean comparator cells.

(c) Fill one cell to the 15 ml graduation mark with water under test. This cell, when filled to the mark with the water under test, compensates for color and turbidity. The omission of this step may cause serious errors.

(d) Insert this cell in the right-hand space of the comparator.

(e) Add 0.5 ml of the wide range pH indicator solution (white cap) to the other cell by means of the dropper.

(f) Fill this cell to the mark with the water under test.

(g) Insert this cell containing the water and indicator solution in the left-side of the comparator. Position the prism eyepiece on the two bosses.

NOTE

Determinations made without the prism installed are subject to error.

(h) Hold comparator with the eyepiece about 10 inches from the eye facing a good light source, preferably daylight, but avoid direct sunlight. Rotate the disc until the color on the disc matches the color of the left-hand cell. The reading can be made directly from the round window in front of the comparator. The value is expressed as the pH number.

(i) If the color in the left-hand cell appears between two color standards, the value may be estimated.

(j) When the test has been completed, empty the samples and wash the cells with clean water.



## NOTE

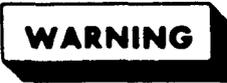
The presence of chlorine residuals in excess of 1 mg/l will cause fading of the developed color and thus result in error in reading. This can be overcome to a large degree by adding a small grain of sodium thiosulphate to the cell prior to the introduction of the pH indicator solution.

e. Comparator, Color, Hydrogen Ion and Residual Chlorine (fig. 2-16).

## NOTE

Figure 2-16 and paragraph 2-22 e (1) apply to kits of 1st buy only. Refer to Figure 2-16.1 and paragraph 2-22 e (2) for kits other than buy 1.

(1) Determination of Chlorine Residual. In determining these values, this comparator measures them as simple numbers in the reading window. The arsenite (red) and orthotolidine (yellow) bottles are color coded. A prism eyepiece is furnished and must be positioned on the bosses in order to insure accuracy.


**WARNING**

- Orthotolidine. Danger, contains acid. Can cause severe burns. Avoid contact with skin and eyes. Avoid breathing vapors. Antidote: External, flush with water. If in eyes, wash for 15 minutes. Get medical attention. Internal, call physician at once. Do not induce vomiting or use carbonates. Give large amounts of water containing milk of magnesia. Follow with raw white of eggs beaten with water. Keep away from children.
- Wide Range D pH Indicator. Danger, poison. May be harmful, fatal, or cause blindness if swallowed. Cannot be made non-poisonous. Keep container closed. Avoid prolonged or repeated breathing of vapor. Inflammable keep away from sparks or open flame. Antidote: If swallowed, call physician immediately. First Aid: Give a tablespoon of salt in a glass of warm water and repeat until vomit fluid is clear. Give two teaspoonfuls of baking soda in a glass of water. Have patient lie down and keep warm. Cover eyes to exclude light. Keep away from children.

**WARNING**

Arsenite Solution. Danger, poison. May be fatal if swallowed or absorbed through skin. Do not get in eyes, on skin, or on clothing. Wash thoroughly after handling. Do not pipet by mouth. Use automatic pipet. Antidote: If swallowed, induce vomiting by sticking finger down throat or by giving soapy or strong salty water to drink. Repeat until vomit is clear. Never give anything by mouth to an unconscious person. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before re-use. (Discard contaminated shoes.) Keep away from children.

(a) Place a chlorine color comparator disc in the comparator.

(b) Thoroughly rinse two rectangular comparator cells and fill both cells with the water sample to the etched mark (15 ml) on the tubes.

(c) Position the prism eyepiece. Hold the comparator in one hand with the eyepiece facing you, and place the two water-filled cells into the openings at the top of the comparator. Hold the arsenite and orthotolidine bottles between the index and middle fingers of the hand holding the comparator.

(d) Fill the droppers in the caps of the arsenite and orthotolidine bottles and let the dropper caps sit loosely in the bottles. Do not screw the caps back on the bottles.

(e) Expel, with force, one dropper full (not less than 0.75 ml) of arsenite (red cap) into the cell in the right-hand opening of the comparator. The forceful addition of the orthotolidine and arsenite to the cells is very important in order to get good mixing of the chemicals in the water. Then expel, with force, one dropper full (not less than 0.75 ml) of orthotolidine (yellow cap) into the same cell.

(f) Refill the arsenite and orthotolidine droppers, and let the droppers sit loosely in the bottles.

**CAUTION**

Reading (step (g)) must be made within one minute of adding the chemicals to the indicator cell. It is absolutely essential that the chemicals be introduced in their proper order.

(g) Expel, with force, the dropper full of orthotolidine (yellow cap) into the cell in the left opening of the comparator. Immediately expel, with force, the dropper of arsenite (red cap) into the same cell. The immediate addition of the arsenite is important to make a correct residual reading. This solution in the left opening is the indicator.

(h) Hold the comparator to your eye, and face a good light source (daylight but not the direct rays of the sun, daylight illuminator, or artificial light reflected from a white surface). Be sure your fingers do not cover the light window in the back of the comparator. Rotate the chlorine color comparator disc until a color on the disc matches the color of the indicator cell (left hand). The reading can be made directly from the round window in front of the comparator. The value is expressed in milligrams per liter (mg/l).

(i) If the color of the indicator (left hand) cell is between two colors on the chlorine color comparator disc, the value must be estimated between the readings.

(j) When test has been completed, remove both sample cells from the comparator, empty the samples and wash the cells with clean water.

#### NOTE

In the event that your WQAS-ENGR is received equipped with Color Comparator NSN6630-01-044-0334 (Fig. 2-16.1) the test for free chlorine residual is as para. 22 e (2).

#### (2) Color Comparator, Hydrogen Ion and Residual Chlorine

(a) Determination of free Chlorine Residual - In determining these values, the Comparator measures them in simple numbers in the reading window. A prism eyepiece is furnished and must be positioned on the bosses in order to insure accuracy.

#### **WARNING**

DPD (Diethyl -P-Phenylene Diamine) poison -- may be fatal -- induce vomiting.

Wide range DpH Indicator Solution -- poison -- may be fatal or cause blindness if swallowed. Cannot be made nonpoisonous. Flammable -- keep away from sparks. If swallowed -- call a physician immediately. Induce vomiting by giving a tablespoon of salt in a glass of warm water. Give two (2) tablespoons of soda in a glass of warm water. Have patient lie down and cover the eyes to exclude light.

(b) The Free Chlorine Residual Test is conducted as follows:

(1) Select two (2) Clean Comparator Sample Cells.

(2) Fill one cell to the 15 ml mark with test water.

(3) Insert the cell into the right hand cell compartment of the comparator.

NOTE

This cell, when filled to the mark, compensates for color and turbidity. The omission of this step may cause serious errors.

(4) Collect just enough test water to cover the bottom of the 2nd sample cell.

(5) Add two DPD Tablets No. 1 to the 2nd sample cell and crush it with the stirring rod. Fill the sample cell to the 15 ml mark with test water and insert it into the left hand cell compartment of the comparator. Compare the sample with the color standard of the appropriate disc as rapidly as possible. Record the result which is the closest match at the value of the Free Residual Chlorine level of the test sample. Interpolation between the two values may be necessary.

(6) When the test has been completed, remove both sample cells from the comparator, empty the samples and wash the cells with clean water.

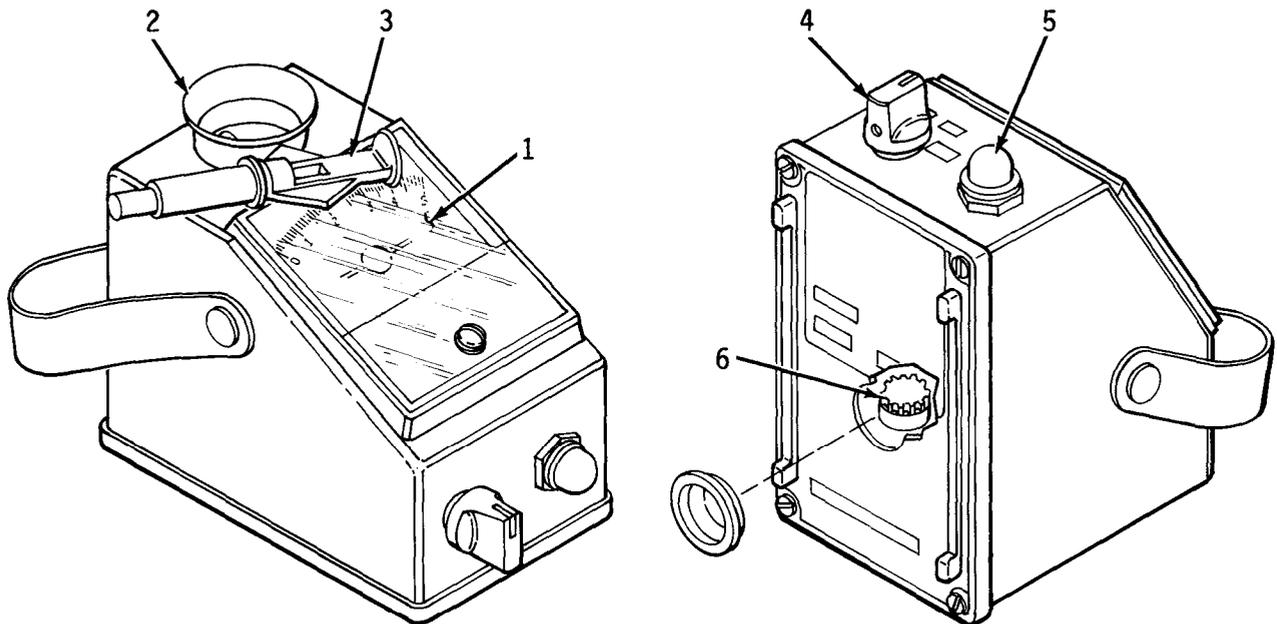
f. Conductivity Meter - Total Dissolved Solids (fig. 2-17 and table 2-9).

(1) The Total Dissolved Solids (Conductivity) Meter is a compact meter operating on an electrical conductivity principle and reads directly in parts per million from 1 to 5000 on three ranges 0-50, 0-500 and 0-5000 (to 50,000 or more with the RE 10 range extension accessory). See figure 2-17 and table 2-9 for location and function of controls and indicators. It is self-contained, calibrated against a standard sodium chloride solution, and has a permanent built-in cell with fully automatic temperature compensation from 10° - 71°C (50° - 160°F) and is powered for 1000 or more tests by a 9 volt transistor battery.

(a) The built-in electrode conditioning feature automatically operates each time the button is pushed with a sample in the cell, thus insuring consistent results every time. A small initial downward swing of the meter pointer with some samples is a result of this conditioning action. This action is powerful and removes normal films of oil and dirt but if dirty samples, particularly scaling types, are allowed to repeatedly dry in the cell, a film will build up that reduces accuracy. Wherever visible films of oil, dirt or scale

accumulate in the cell, scrub lightly with a small brush and household type cleanser. Make sure any accumulation is removed from the silvery metal electrode disc in the cell cup.

(b) Internal Standard: A factory determined value for the internal standard reading appears on the calibration label located on the bottom of each instrument. To check instruments calibration, set the selector switch to "S" and press the button. If the reading on the "S" position does not correspond with the internal standard value on the label, adjust the master calibration control. It is housed within the case for protection but easily accessible through a finger-hole in the bottom.



**Figure 2-17. Conductivity Meter, Total Dissolved Solids, with RE10 Range Extender**

Table 2-9. Conductivity Meter, Controls and Indicators

Key	Control or Indicator	Function
1	Meter	Gives direct pointer reading in parts per million (PPM) in ranges of 0-50, 0-500 and 0-5000 (to 50,000 or more with the use of RE10 range extension accessory).
2	Cell	Used to hold sample to be tested.
3	Range Extender	Range extender is a small insert which can be pushed into the sample filled cell cup, and can temporarily increase the range by 10 times reducing the effective cell size.
4	Range Selector	A switch used to select the range (PPM) required on the meter.
5	Pushbutton	When the pushbutton is pushed a built-in electrode conditioning feature is automatically operated, which compensates temperatures from 10°- 71°C (50° - 160°F).
6	Finger/Access Calibration Dial	Used to calibrate the system if the meter reading in the "S" position does not correspond to the internal standard value printed on the label.

**CAUTION**

- Do not spill lacquer thinner, acetone, benzene or chlorinated solvents on case.
- Do not try to turn or remove the build-in cell cup. Do not dip meter into water.
- Do not use with samples hotter than 71° C (160°F).
- Do not attempt service or modification.

(2) To Double the Range (Conductivity Meter) - The master calibration control adjusts all ranges simultaneously and may be used to temporarily recalibrate any range. For example, all ranges can be approximately doubled by adjusting the master calibration control so that the meter reads one-half the normal value of the internal standard "S". After making this change, be sure to multiply by two the reading of the water tested.

(3) RE10 Range Extender - The RE10 Range Extender is a small insert which can be pushed into the sample filled cell cup. Its purpose is to temporarily increase the range by 10 times. Reducing the effective cell size.

(4) Procedure - Total Dissolved Solids - 0.50, 0-500 and 0-5000 ppm.

(a) Rinse the built-in cell cup three times with the water to be tested and then fill with the water to be tested.

(b) Select the desired range.

(c) Push the button on the front of the instrument, the meter will indicate the total dissolved solids in parts per million.

(5) Procedure - Total Dissolve Solids 0 0-50,000 ppm. Whenever the meter reading is off scale (pointer contacts high stop) on the maximum range:

(a) Thoroughly rinse the range extender three times by inserting the extender into the cell cup which is refilled with a fresh sample each time. Push the extender into a fresh sample filled cell cup seating the o-ring seal.

(b) Operate the instrument as in steps (b) and (c) above. Multiply the meter reading by 10 to obtain the total dissolved solids in the sample.

(c) For maximum accuracy, repeat the complete test with fresh test water.

(d) Upon completion of tests, remove the range extender and thoroughly rinse the cell cup and extender with deionized water. This is extremely important when the instrument is also used to test high purity water.

g. Hardness Test Kit (Range 0 mg/l to 9000 mg/l) (fig. 2-18).

(1) Hardness is defined as a total characteristic of water which represents the total concentration of calcium and magnesium expressed as their calcium carbonate equivalent. When other polyvalent metal ions are present in significant amounts they are also determined and reported as hardness.

(a) The hardness of water was originally defined in terms of its ability to precipitate soap. Calcium and magnesium ions are the principle causes though iron, aluminum, manganese, strontium, zinc, and hydrogen ions are capable of producing the same effect. High concentrations of the latter ions are not commonly found in natural waters. Hardness concentrations were originally expressed as grains per gallon but are not commonly reported as milligrams per liter (1 gr/gal. = 17.16 gm/l).

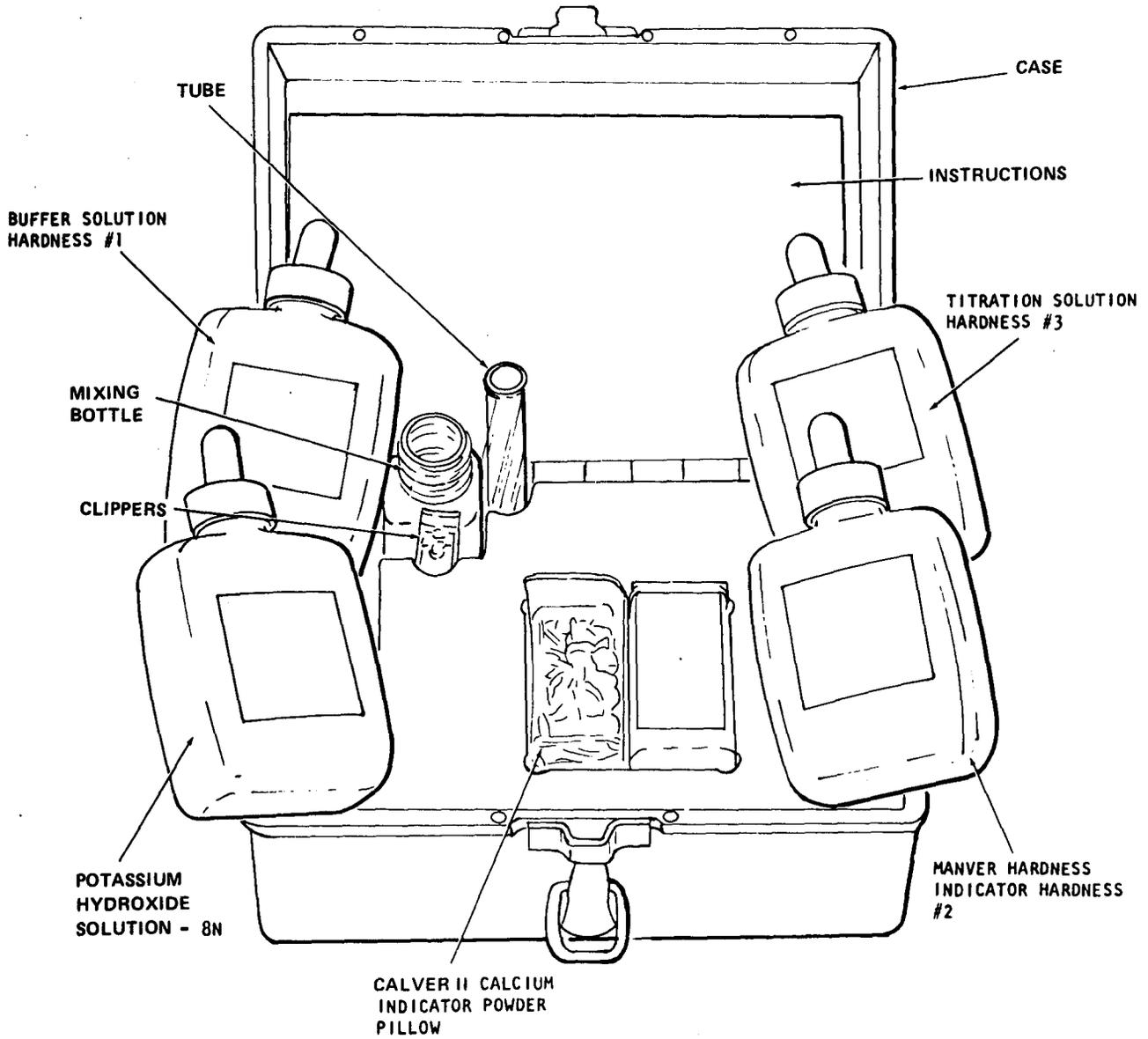


Figure 2-18. Hardness Test Kit

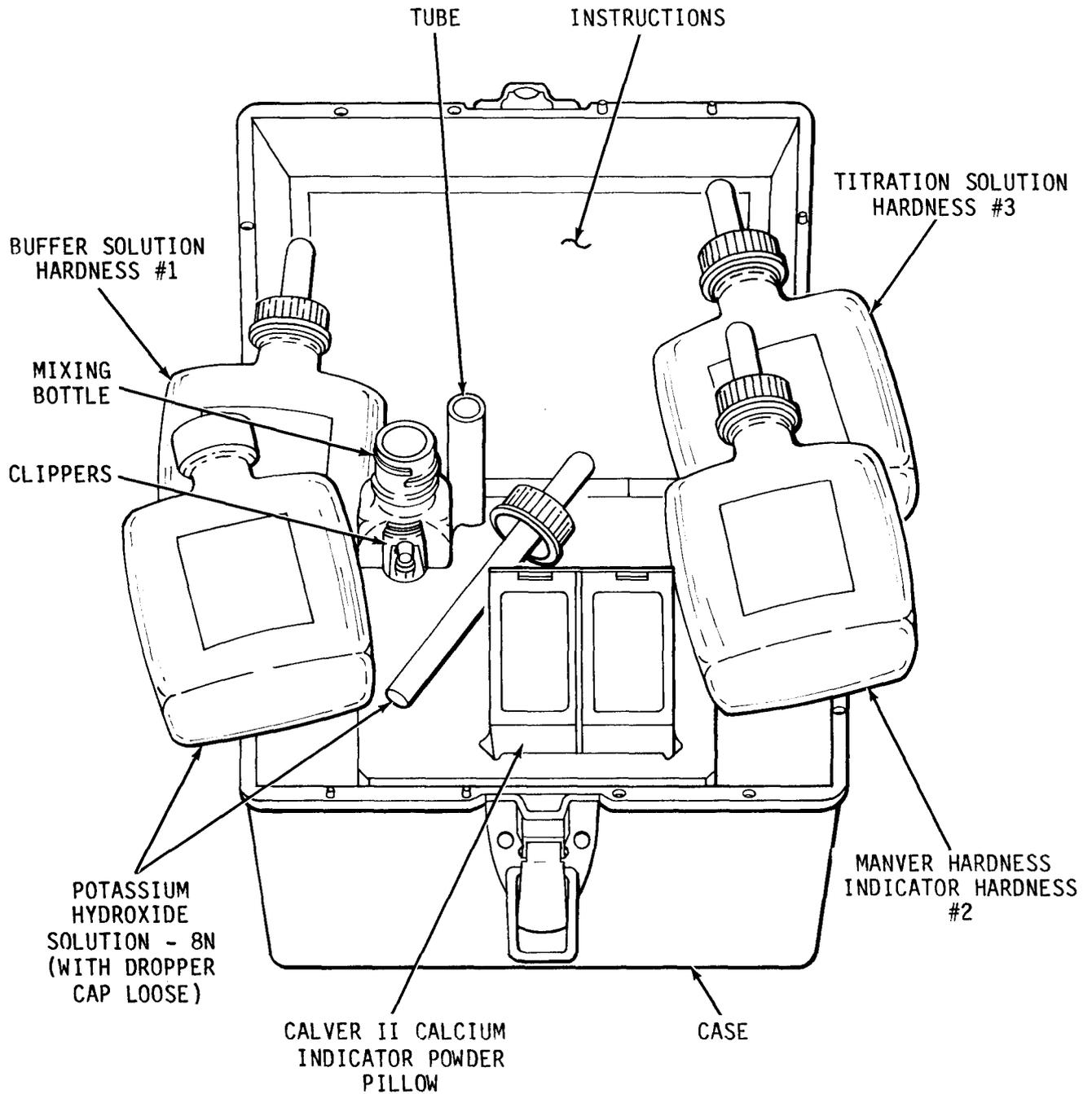


Figure 2-18.1. Hardness Test Kit (Not Used in Buy 1)



(b) The hardness test is the most frequently performed analysis in the water industry. Large amounts of hardness are undesirable for aesthetic and economic reasons in many industries and must be removed before the water is suitable for use; e.g., the beverage, food, laundry, metal finishing, dyeing and textiles, and pulp and paper industries. Levels about 500 mg/l hardness are undesirable for domestic use and most drinking water supplies average about 250 mg/l.

### **WARNING**

- Keep all bottles tightly closed. Do not allow chemical reagents to come in contact with eyes. Most chemical reagents are corrosive or poisonous or both.
- Buffer Solution Hardness No. 1. For test purposes only. Cause irritation. Avoid contact with skin and eyes. Keep well closed. External contact: flush with water. Ingestion: give plenty of water or milk. Follow with a dose of milk of magnesia. DO NOT induce vomiting. Call physician. For laboratory use only. Keep away from children.
- Manver Hardness Indicator Hardness No. 2. May cause irritation. For test purposes only. Avoid prolonged and repeated contact with skin. Keep well closed. External contact: flush with water. Ingestion: give plenty of water or milk. Induce vomiting. Call physician. For laboratory use only. Keep away from children.
- Titration Solution Hardness No. 3. Harmful or fatal if swallowed. Contains ethylene glycol. Avoid prolonged and repeated contact with skin. Keep well closed in cool place. External contact: flush with water. Ingestion: give plenty of water or milk. Induce vomiting. Call physician. For laboratory use only. Keep away from children.
- Potassium Hydroxide Solution 8N. Poison. May cause burns. Contains potassium hydroxide. Avoid contact with skin, eyes, and clothing. Keep well closed. External contact: flush with water. Eye contact: Irrigate with water for 10 minutes. Call physician. Ingestion: give plenty of water or milk. Follow with citrus juice or diluted vinegar. Induce vomiting. Call physician. For laboratory use only. Keep away from children.

NOTE

- The titrant reagent dropper should be held in a vertical manner, and the drops should be dispensed at a rate not faster than one drop per second. The dropper should be held slightly above the top of the mixing bottle so that it never comes into contact with the side of the mixing bottle.
- Table 2-4 lists conversion factors for different units of measure common to ours and other nations use.

(2) Calcium Hardness Test - (0-500 mg/l range).

(a) Fill plastic measuring tube level full of test water and pour it into the mixing bottle.

(b) Add 2 drops of 8N potassium hydroxide solution.

(c) Add the contents of one Calver II Calcium Indicator Powder Pillow.

(d) Add titrant reagent hardness 3 dropwise (counting the number of drops) until the color changes from pink to blue. Mix the solution swirling after each drop addition.

(e) The calcium hardness in mg/l (as Calcium Carbonate,  $\text{CaCO}_3$ ) is equal to 17.2 times the number of drops of titrant reagent hardness 3 added.

(3) Calcium Hardness Test - (500-9000 mg/l range).

(a) Dilute the test water by pipetting 1 ml (use 1cc/1 ml dropper) of the test water into a 25 ml graduated cylinder and invert several times to mix.

(b) Fill the plastic measuring tube level full of diluted test water and put it into the mixing bottle.

(c) Add 2 drops of 8N potassium hydroxide solution.

(d) Add the contents of one Calver II Calcium Indicator Powder Pillow.

(e) Add titrant reagent hardness 3 dropwise (counting the number of drops) until the color changes from pink to blue. Mix the solution by swirling after each drop addition.

(f) The calcium hardness in mg/l (as Calcium Carbonate,  $\text{CaCO}_3$ ) is equal to 430 times the number of drops of titrant reagent hardness 3 added.

## (4) Total Hardness Test - (0-500 mg/l).

(a) Fill the plastic measuring tube level full of test water and pour it into the mixing bottle.

(b) Add 3 drops of buffer solution hardness 1 and swirl to mix.

(c) Add 1 drop of Manver hardness indicator solution, hardness 2.

(d) Add titrant reagent hardness 3 dropwise (counting the number of drops) until the color changes from pink to blue. Mix the solution by swirling after each drop addition.

(e) The total hardness in mg/l is equal to 17.2 times the number of drops of titrant reagent hardness 3 added.

## (5) Total Hardness Test - (500-9000 mg/l range).

(a) Dilute the test water by pipetting 1 ml (using 1 cc/l ml dropper) of the test water into a 25 ml graduated cylinder and adding 24 ml of distilled water. Stopper the graduated cylinder and invert several times to mix.

(b) Fill the plastic measuring tube level full of diluted test water and pour it into the mixing bottle.

(c) Add 3 drops of buffer solution hardness 1 and swirl to mix.

(d) Add 1 drop of Manver hardness indicator solution, hardness 2.

(e) Add titrant reagent hardness 3 dropwise (counting the number of drops) until the color changes from pink to blue. Mix the solution by swirling after each drop addition.

(f) The total hardness in mg/l is equal to 430 times the number of drops of titrant reagent hardness 3 added.

(6) Magnesium Hardness. The magnesium hardness in mg/l is found by subtracting the calcium hardness value (in mg/l) from the total hardness value (in mg/l).

## h. Sulfate Test Kit - 0-3000 mg/l (fig. 2-19).

(1) Sulfate appears in natural waters in a wide range of concentrations. Mine waters and industrial effluents frequently contain large amounts of sulfate from pyrite oxidation and the use of sulfuric acid.

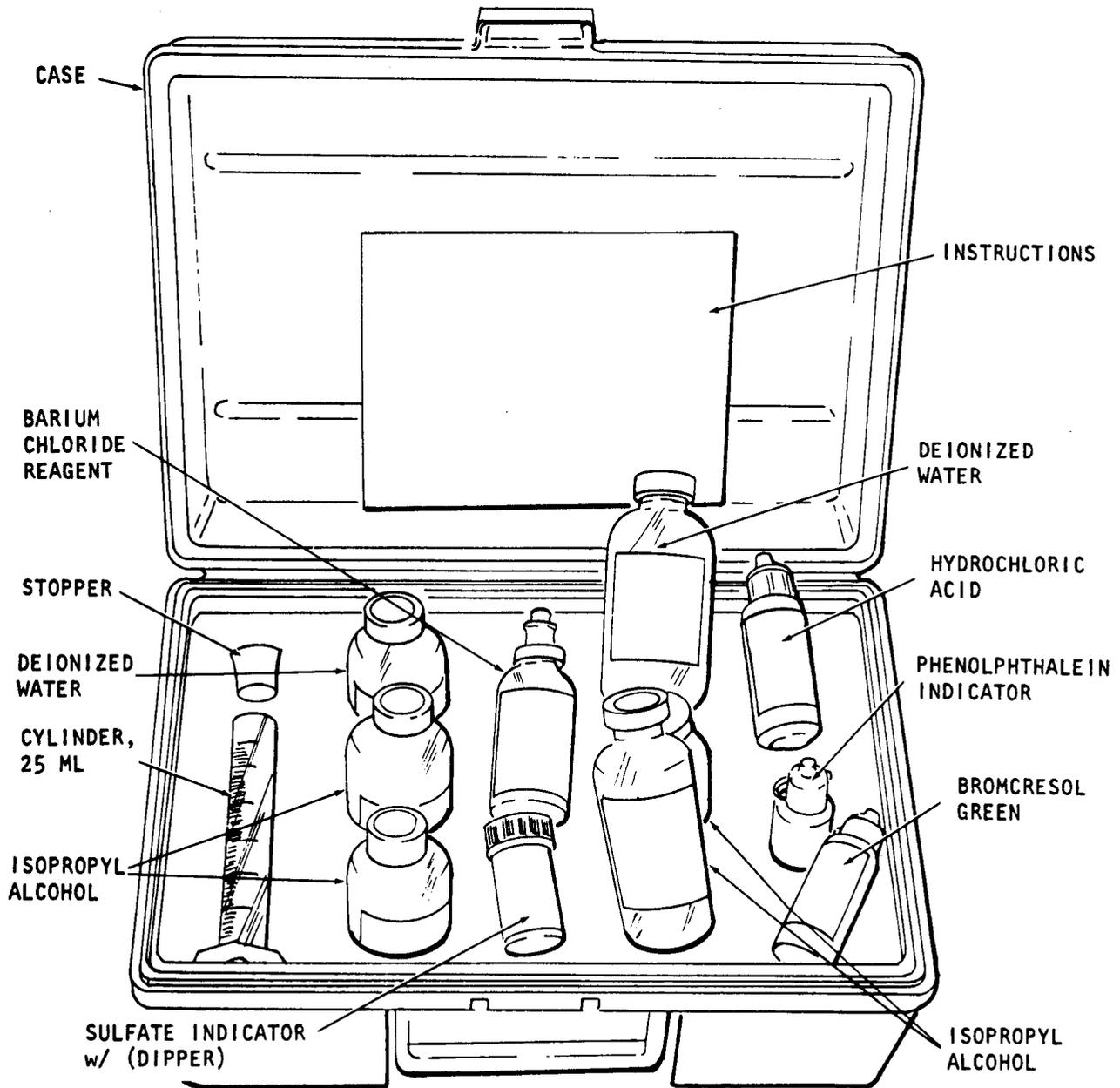


Figure 2-19. Sulfate Test Kit

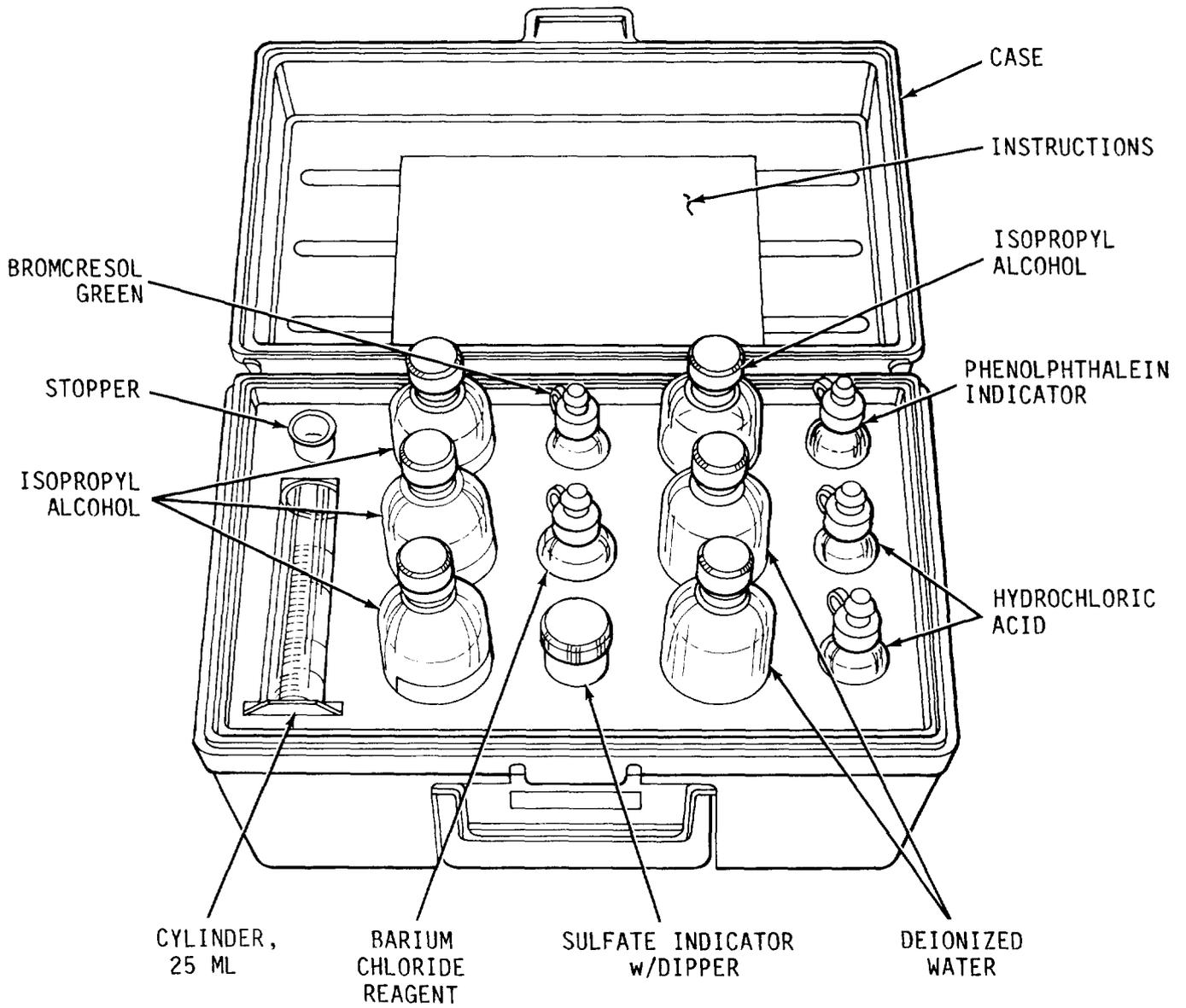


Figure 2-19.1. Sulfate Test Kit (Not Used in Buy 1)



(a) Public Health Service drinking water standards call for not more than 250 mg/l of sulfate because of its cathartic action. The taste threshold of magnesium sulfate is 400 to 600 mg/l and for calcium sulfate is 250 to 800 mg/l. Sulfate may be either beneficial or detrimental in water used for manufacturing the domestic supply. In domestic water systems, sulfates do not appear to cause any increased corrosion on brass fittings but - concentrations above 200 mg/l do increase the amount of lead dissolved from lead pipes.

(b) This kit provides a quantitative method for determining the concentration of sulfate in water. When used in reconnaissance of raw water sources, a determination can be made as to the type of process required; i.e., coagulation, or distillation. As sulfate concentration approaches 3000 mg/l and calcium hardness exceeds 250 mg/l, (para 2-22g) a scale insoluble in citric acid will form in the tubes of distillation unit.

### **WARNING**

- Keep all containers tightly capped. Do not allow reagent chemicals to come in contact with skin or eyes. Do not ingest. Most chemical reagents are either corrosive or poisonous or both.
- Hydrochloric Acid. For test purposes only. Keep away from children. May cause severe burns - avoid breathing vapors. Not for internal use. In case of contact with skin or eyes, flush well with water, for eyes get medical attention. If swallowed call a physician at once. Do not induce vomiting. Give milk of magnesia with large amounts of water. Follow with milk or raw egg whites beaten in water.
- Isopropyl Alcohol. For test purposes only. Flammable. Keep away from sparks or open flame. Not for internal use. Contains toxic material. Symptoms, vomiting, abdominal pain, depressed respiration. Antidote: if swallowed, call a physician at once, induce vomiting by giving a tablespoonful of salt in a glass of warm water, repeating until vomit is clear.
- Phenolphthalein Indicator. Keep out of reach of children. For test purposes only. Flammable. Keep away from sparks or open flame. Not for internal use, contains toxic material. If swallowed, call a physician at once. Induce vomiting by giving a tablespoon of salt in a glass of warm water, repeating until vomit is clear.

**WARNING**

- Barium Chloride Reagent. Keep away from children. For test purposes only, poison. If swallowed, call a physician at once. Give patient a tablespoonful of Epsom Salts in a glass of water. Induce vomiting with plenty of warm salt water. (1 tablespoon of salt per glass). Repeat until vomit is clear.
- Sulfate Indicator Powder. Caution, for test purposes only. Not for internal use. Keep away from children.

**CAUTION**

Phosphates react similarly to sulfates in the Procedure A test which follows, therefore if present, would cause an erroneous result. Use Procedure A if it is known that phosphates are not present (rain water in a cistern complex, etc.). If phosphate presence is unknown or suspected, use Procedure B which nullifies the phosphate interference. As a check or if there is a need for phosphate determination, run both procedures. Both results should be similar if phosphates are not present. If Procedure A reads higher than B, phosphates are present in the amount of difference.

NOTE

Hold dropper vertical in use and do not allow dropper to touch container when adding droplets.

(2) 0-750 mg/l range. Procedure A - for waters that do not contain phosphate.

(a) Rinse the 25 ml graduated cylinder with the water being tested and fill to the 10 ml mark.

(b) Add one drop of phenolphthalein indicator solution. If the sample turns red, add hydrochloric acid dropwise until the red color disappears. If the sample remains colorless when phenolphthalein is added, do not add hydrochloric acid.

(c) Add a level dipper full of sulfate indicator powder to the above sample and allow to dissolve.

(d) Add isopropyl alcohol to the graduated cylinder until it is full to the 20 ml mark. Cap and mix.

(e) Add standard barium chloride solution dropwise with mixing after each drop addition until the color changes from yellow to a dull red or orange. Keep count of the number of drops added.

(f) The sulfate content of the water in mg/l is found by multiplying the number of drops of barium chloride solution by 25.

(3) 0-750 mg/l range. Procedure B - for waters that contain phosphate.

(a) Rinse the 25 ml graduated cylinder with the water being tested and fill to the 10 ml mark.

(b) Add 3 drops of bromocresol green indicator solution. Add hydrochloric acid dropwise until the color changes from blue to yellow.

(c) Add level dipper full of Sulfate Indicator Powder to the above sample and allow to dissolve.

(d) Add Isopropyl Alcohol to the graduated cylinder until it is full to the 20 ml mark. Cap and mix.

(e) Add Standard Barium Chloride Solution dropwise and mix after each drop addition until the color changes from yellow to dull red or orange. Keep count of the number of drops added.

(f) The sulfate content of the water in mg/L is found by multiplying the number of drops of Barium Chloride Solution by 25.

(4) 0-3000 mg/l range - with and without phosphate.

(a) Dilute the sample water by adding 6 ml of test water to the 25 ml graduated cylinder and filling to the 24 ml mark with de-ionized water. Stopper and mix thoroughly.

(b) Pour off 14 ml of the diluted sample so that exactly 10 ml remains in the graduated cylinder.

(c) For water not containing phosphate, continue as in steps (b) thru (f) of Procedure A. For water containing phosphate, continue as in step (b) of Procedure B.

(d) The sulfate content of the water in mg/l is found by multiplying the number of drops of barium chloride solution by 100.

i. Turbidity Test Kit (fig. 2-20).

(1) Turbidity interferes with color analysis. This test is made by comparing the turbidity of measured amount of the sample being analyzed with an identical amount of turbidity-free water to which an accurately measured amount of standardized turbidity reagent has been added. The readings are made by looking down through the column of liquid. If turbidity is present, it will interfere with the passage of light through the column of liquid. Small amounts of turbidity will cause a "blurring" of the black dot in the bottom of the tube. Large amounts of turbidity may provide sufficient "cloudiness" so that it is not possible to see the black dot when looking down through the column. Any color that may be present in the sample should be disregarded. This determination is concerned only with the haziness or cloudy nature of the sample.

**WARNING**

Do not allow reagents to come in contact with skin or eyes. Do not ingest. Most chemical reagents are corrosive or poisonous.

NOTE

Store reagent in a cool, dark place away from direct sunlight. Shake reagent vigorously before using.

(2) Turbidity Test Procedure.

(a) Fill one turbidity tube to the 50 ml graduation (top line) with the water to be tested. If the black dot in the bottom of the tube is not visible when looking down through the column of liquid, pour out a sufficient amount of the test sample so the tube is filled to the 25 ml graduation (top line). Most determinations are made with a 50 ml sample.

(b) Fill the second turbidity tube with an amount of turbidity-free water that is equal to the amount of sample being measured (25 or 50 ml). See instructions for turbidity-free water which follows in para 2-22j.

(c) Place the two tubes side-by-side and note the difference of clarity.

(d) Add 0.5 ml of the standard turbidity reagent to the "clear water" turbidity tube. Seal with thumb or other stopper, invert both tubes to get equal distribution of the turbid particles. Inspect as in step (a). If the turbidity in the sample being tested is greater than the turbidity in the treated mixture in the second turbidity tube, continue to add the standard turbidity reagent in increments of 0.5 ml

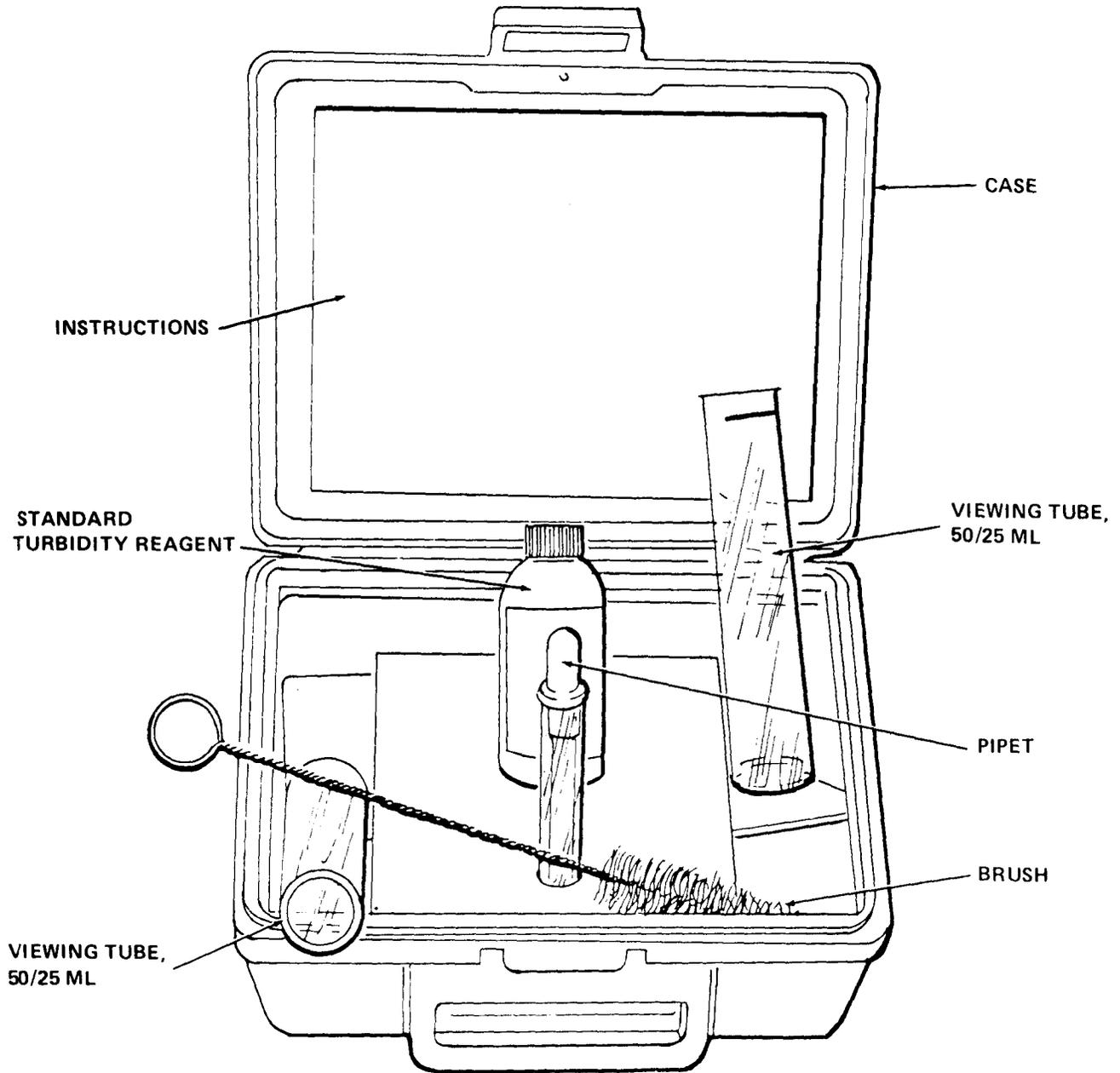


Figure 2-20. Turbidity Test Kit

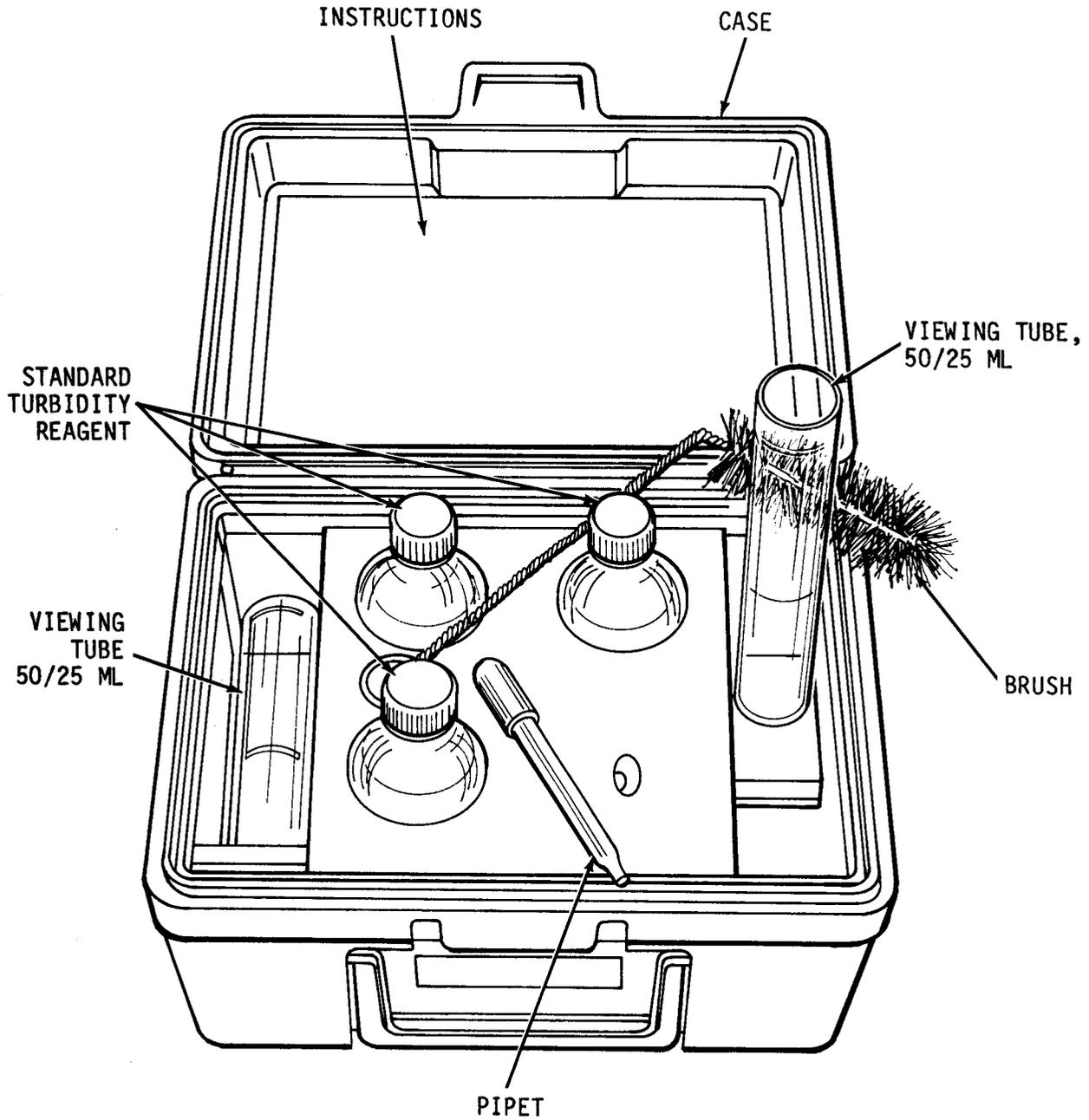


Figure 2-20.1. Turbidity Test Kit (Not Used in Buy 1)

until the amounts of turbidity in each column are equal. Count each 0.5 ml addition of the reagent added. Mix the contents of the tube after each addition of the turbidity reagent. Each 0.5 ml addition to the 50 ml size is equal to (5) Jackson Turbidity Units (JTU). If a 25 ml size sample is used, each 0.5 ml addition of the standard turbidity reagent is equal to (10) Jackson Turbidity Units (JTU). See the compilation below (table 2-10). Rinse both tubes carefully after each determination.

j. Turbidity-Free Water Filter Equipment.

(1) Equipment (location as shown in fig. 1-6 and assembled for use in fig. 2-21).

(2) Preparation of Turbidity-Free Water and De-Ionized Water.

(a) Assemble equipment as shown. Make sure the suction end of bulb is attached to suction flask.

NOTE

Treated and filtered water may be used in lieu of water obtained by steps (b) thru (e); however, steps (f) and (g) should be completed.

**Table 2-10. Turbidity Calculations**

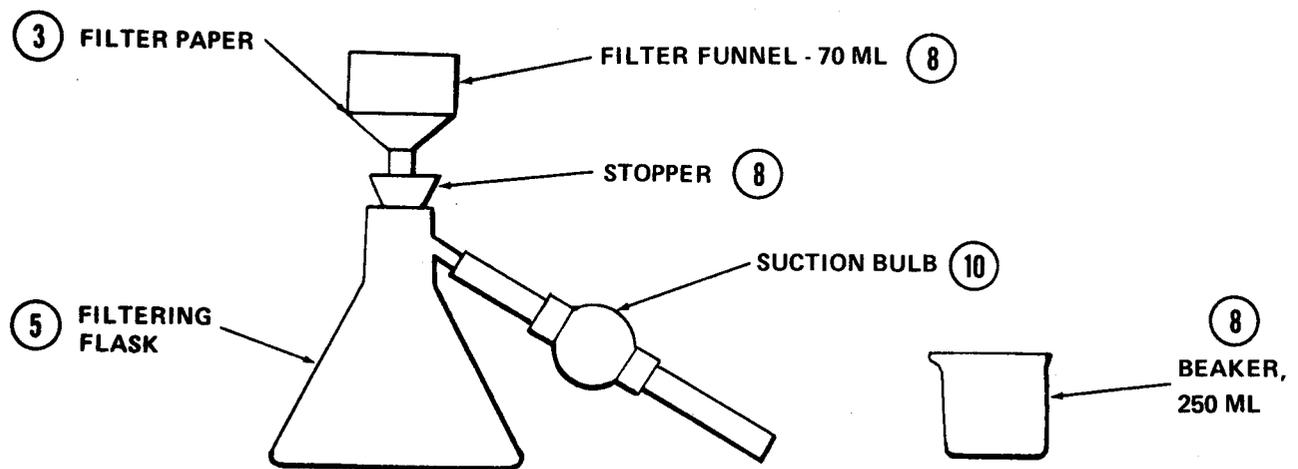
No. of Measured Additions	Amount of Ml	50 ml Graduation	25 ml Graduation
1	0.5	5 JTU	10 JTU
2	1.0	10 JTU	20 JTU
3	1.5	15 JTU	30 JTU
4	2.0	20 JTU	40 JTU
5	2.5	25 JTU	50 JTU
6	3.0	30 JTU	60 JTU
7	3.5	35 JTU	70 JTU
8	4.0	40 JTU	80 JTU
9	4.5	45 JTU	90 JTU
10	5.0	50 JTU	100 JTU
15	7.5	75 JTU	150 JTU
20	10.0	100 JTU	200 JTU

(b) Using equipment and procedure furnished with Chlorine Demand and Coagulation Kit coagulate some raw water. (Jar Test Kit, para 2-22k).

(c) Allow floc in jars to settle.

(d) Place a piece of filter paper on top of perforated plate in filter funnel.





*Figure 2-21. Water Filter Kit*

(e) Using the jar having the clearest water, slowly pour the water from this jar into the filter funnel until funnel is full. Do not pour floc into filter funnel.

(f) Squeeze the suction bulb to create a vacuum in the suction flask. Seal end and release bulb. Water should flow into flask from funnel. Continue creating a vacuum until all the water in the funnel has been filtered.

(g) Pour this water into a clean beaker and refilter using a new filter paper and the vacuum process in step (f).

(h) With care, water obtained by the above steps will have a turbidity of less than 0.5 units.

(i) This filtered water is to be used in the turbidity test para 2-22i or for a similar requirement. Pour this turbidity free water into the plastic wash bottle containing the ION Exchange Resin (fig. C-1, WOAS-PM) for use in diluting samples, when required.

k. Chlorine Demand and Coagulation Test Assembly (fig. 2-22).

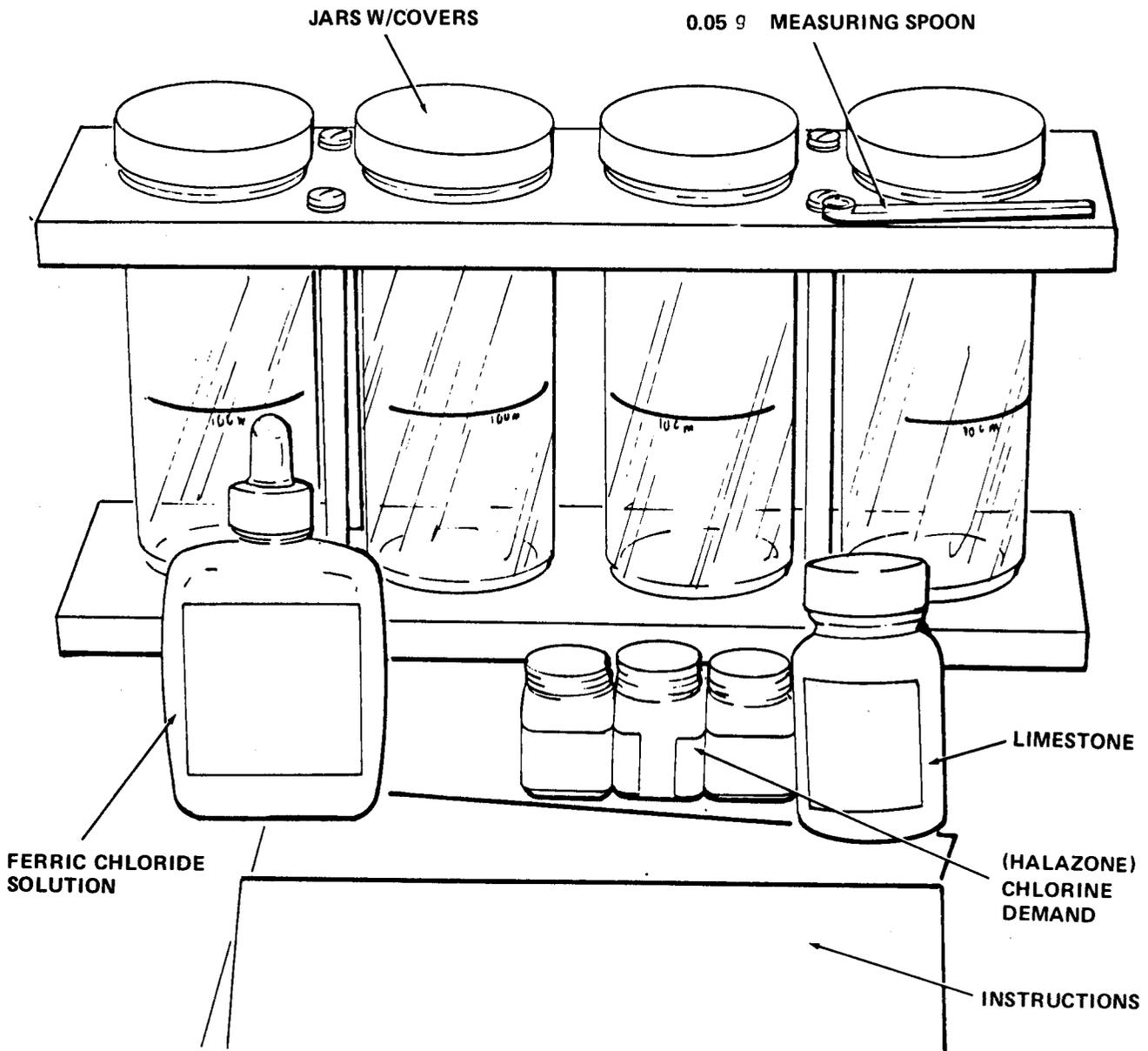
(1) Equipment. The test assembly consists of the following items located as indicated in the loading diagram (fig. 1-6).

(a) Jars, 200 ml capacity, 4 ea. with frame.

(b) Limestone, powdered 1-oz bottle.

(c) Measuring spoon, 0.05 g.

(d) Halazone (Chlorine demand reagent tablets) (100 tablets per bottle).



**Figure 2-22. Chlorine Demand and Coagulation Test Assembly**

- (e) Ferric chloride solution, 4-oz bottle (2 each).
- (f) Comparator, Color, Hydrogen Ion and Residual Chlorine.
- (g) Card, chemical dosage.

This kit provides a quantitative method for determining the dosages of ferric chloride and limestone required for coagulation and the dosage of calcium hypochlorite required to produce a desired chlorine residual in the treated water.

**WARNING**

Ferric chloride solution and Halazone tablets.  
Keep away from children. Not for internal  
use.

(2) Chlorine Demand Test.

(a) Fill one of the jars to the 200 ml mark with the water to be tested.

(b) Add one Halazone tablet to the jar. Cap the jar tightly and shake until the Halazone tablet is completely dissolved. Each tablet is equivalent to 5 mg/l available chlorine.

(c) Wait 5 minutes.

(d) Use the color comparator (fig. 2-16) and conduct the Residual Chlorine Test (para 2-221) to determine the residual chlorine in the sample. Subtract the residual chlorine value from 5 to obtain the Chlorine Demand of the sample water.

(e) If the residual chlorine in step (d) is zero, fill one of the jars to the 100 ml mark with the water to be tested.

(f) Repeat steps (b) and (c).

(g) Determine the residual chlorine in the sample and subtract it from 10 to obtain the chlorine demand of the sample water.

(h) If the residual chlorine in step (g) is zero, fill one of the test jars to the 200 ml mark with the water to be tested.

(i) Repeat step (b), but add 3 Halazone tablets.

(j) Repeat step (c).

(k) Determine the residual chlorine in the sample and subtract it from 15 to obtain chlorine demand of the sample water.

(3) Coagulation Test.

(a) Fill each of the four jars to the 200 ml mark with the water to be tested.

(b) Add 1 drop of ferric chloride solution to the first jar (marked No. 1), 2 drops to the second, 3 drops to the third and 4 drops to the fourth test jar.

(c) Add one measuring spoonful (0.05 g) of pulverized limestone to each of the jars. Cap the jars and shake vigorously for 30 seconds.

(d) Shake the jars slowly by inverting and returning to the upright position for 5 minutes.

NOTE

Keep bottles tightly capped.

(e) Allow the jars to stand undisturbed. Note the setting rate of the floc and the clarity of the water above the flocculent layer. The sample that yields the fastest flock settling rate with clear water above the flocculent layer, contains the best coagulant concentration to be used for the water being treated.

(f) Each drop of ferric chloride is equivalent to 10 ppm.

(g) If, after 15 minutes, none of the jars have clear water above the flocculent layer, the test must be repeated.

(h) Repeat step (a).

(i) Repeat step (b), but add 5 drops of ferric chloride solution to the first jar, 6 drops to the second, 7 drops to the third, and 8 drops to the fourth test jar.

(j) Repeat step (c) thru (e).

2-23. REFILL KIT, CHEMICAL AGENT DETECTOR, V-G COMPONENTS

(Used for Buys 1 and 2 Only, Fig. 2-23).

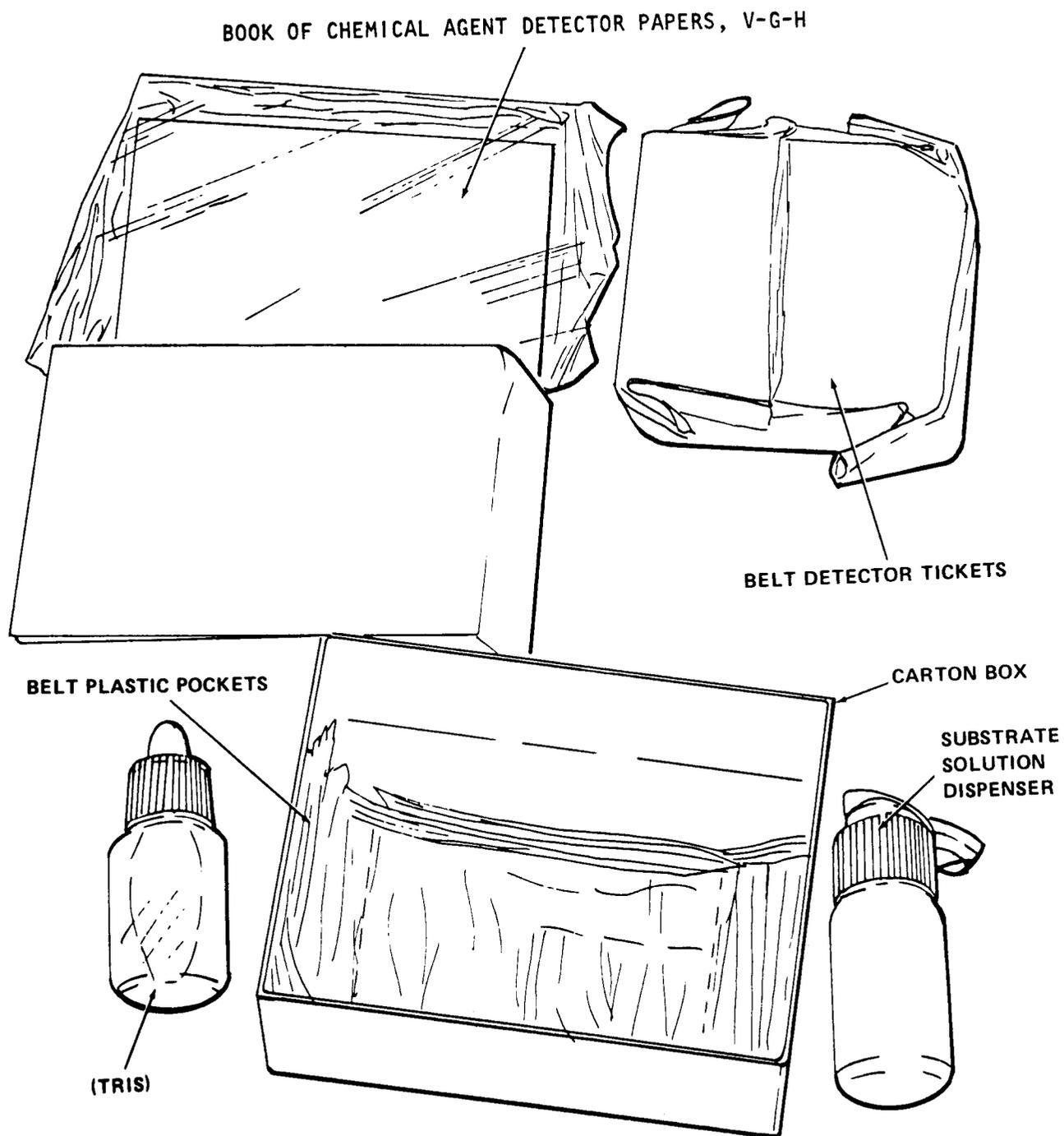
The tickets and paper contained in this refill kit are designed to indicate whether V or G contaminants are present. V-G contaminants can affect the central nervous system. Their presence indicates pollution by toxic industrial wastes or agricultural pesticide, herbicide and fungicide residues. They have somewhat identical, persistent and nonpersistent, toxicity properties as chemical warfare agents. If the water is contaminated, then proceed with the procedures for the Water Testing Kit, Chemical Agents, AN-M2 (para 2-24).

a. Contents

- (1) Belt of 40 plastic pockets.
- (2) Belt of 40 detector tickets.
- (3) Book of chemical agent detector, V-G-H paper.
- (4) Bottle of trihydroxymethyl aminomethane (TRIS) (white lined).
- (5) Substrate solution dispenser (red dot on cap).

b. Procedure for Water Contamination Determination.

- (1) Remove detector ticket from plastic package and save package.
- (2) Add 1 or 2 drops of suspected water to square end of the ticket by any convenient means, dropper, stirring rod, twig, etc., or by dipping the ticket into the water.



*Figure 2-23. Refill Kit, Chemical Agent Detector, V-G Components*

(3) Place the ticket in the plastic bag and gently knead until the paper disc is thoroughly wetted as shown by the darker appearance. (To knead, gently press bag between thumb and forefinger 20-30 times. This is done after each addition of a liquid to the ticket.)

(4) Add 1 or 2 drops of solution in white lined squeeze bottle, (TRIS).

(5) Add 2 or 3 drops of solution in red dotted dispenser (substrate).

(6) Continue kneading and after one minute, examine the ticket. The appearance of a blue color indicates NO AGENT. If the ticket is colorless to orange, G or V agent is PRESENT.

(7) Compare the color to a blank (see paragraph below). If in doubt, allow to stand an additional three minutes and compare color to blank.

(8) For the blank, use the round end of ticket and continue with step (2) using uncontaminated water. This should produce a blue color on the round end of the ticket.

c. Procedure for Surface Contamination.

(1) Add 1 or 2 drops of solution from white lined squeeze bottle to square end of ticket and knead in bag until paper is wetted.

(2) Smear or touch wet end of ticket to suspected surface, replace in plastic bag and proceed with step (5) above.

d. Procedure for Liquid Contamination.

(1) Detach a sheet of paper from the booklet.

(2) Place the paper in contact with the suspect surface.

(3) Note whether a color change takes place. Compare with the color change on the inside cover of the booklet.

(4) A color change similar to that shown indicates the presence of chemical agents (contamination).

NOTE

Certain G-agents give a red-brown color response which is intermediate between the typical H & G colors.

2-24. WATER TESTING KIT, CHEMICAL AGENTS (Used for Buys 1 and 2 Only) (fig. 2-24). This kit is designed to determine the toxicological characteristics of drinking water. It is a reconnaissance field kit for water testing and screening raw water sources so contaminated with chemical agents that they cannot be rendered potable with customary field Lyster Bag filtering or similar treatment. A preliminary screening using the chemical agents detector procedure (para 2-23) should be made prior to these tests to indicate whether the water is contaminated.

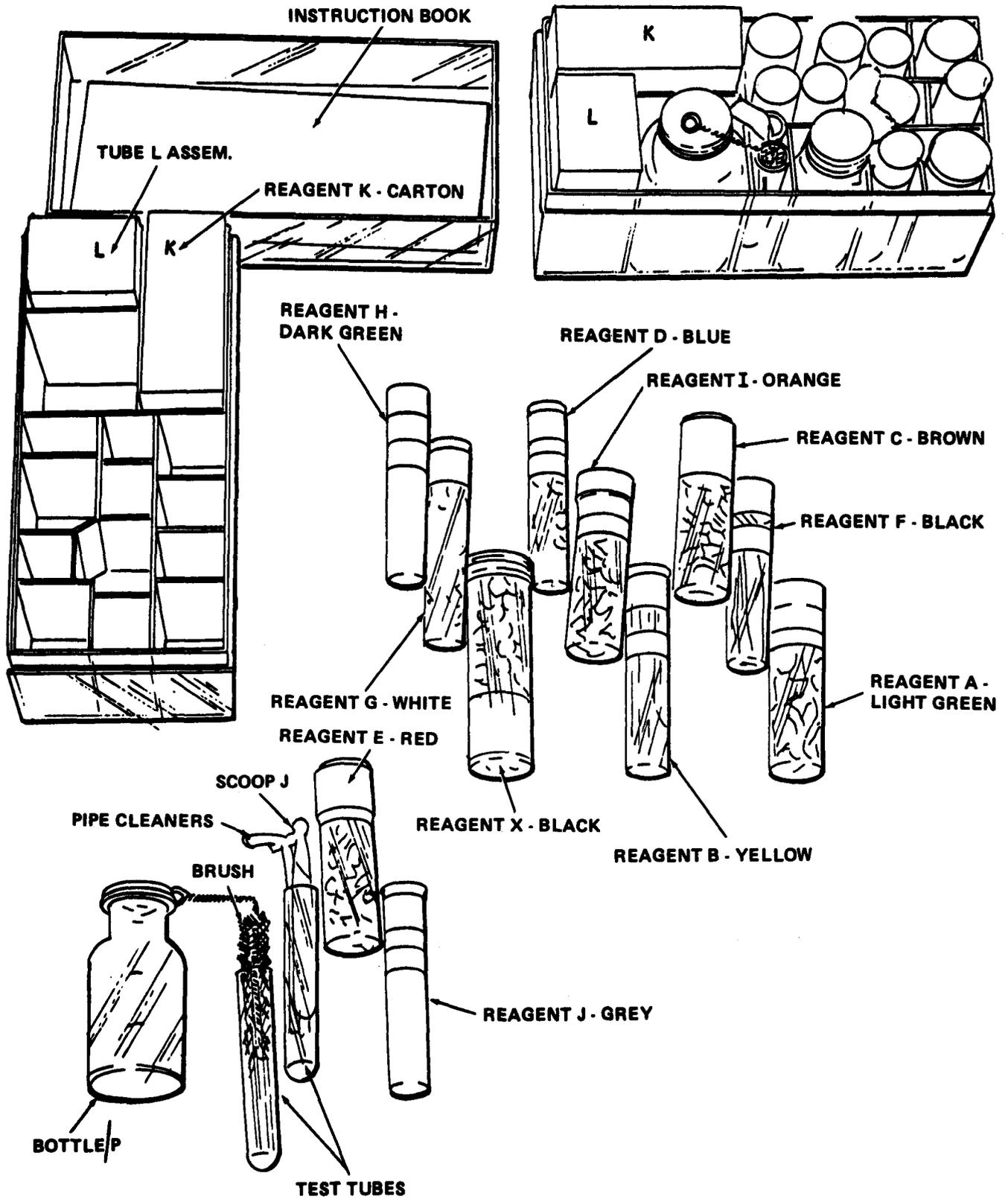


Figure 2-24. Water Testing Kit, M272

**WARNING**

- Dangerous and poisonous chemicals are provided in these kits. Death, health hazards or injuries such as severe burns, impaired vision and internal tissue destruction may be experienced if personnel fail to observe precautions.
- Do not allow reagents, buffer solutions or acids to come in contact with skin or eyes.
- Do not ingest solutions, tablets, droplets or spillage from lab-ware.
- Do not inhale fumes from products or mixing reactions.
- Many products furnished are highly inflammable, some have explosive potential.
- Most acids are corrosive.
- Keep all bottles and containers capped and sealed to prevent accidental spillage and to increase shelf-life. Never pipet chemical reagent solutions or unknown water samples by mouth.

**CAUTION**

After using any of the tablets or reagents, be sure to immediately close the vial with the matching colored cap.

NOTE

- Negative test results, and if the pH is above 6, indicate that the water may be used sparingly by troops for a period not exceeding one week after customary field treatment.
- Positive test results, and if the pH is below 6, indicate that the water should not be used.
- This kit is not designed for use in the control of treated water.

a. Contents. A description of the principal reagents in the chemical agents water testing kit is as follows:

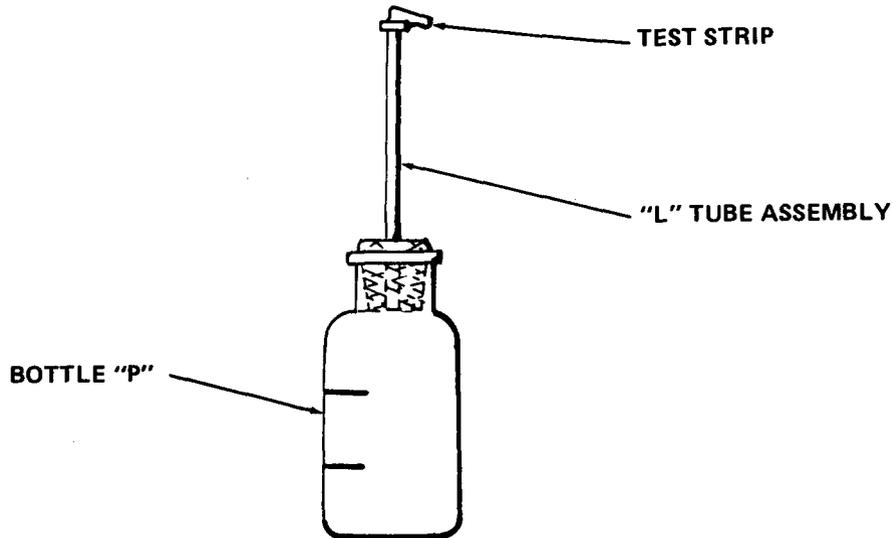
(a) Reagent A - White tablets wrapped in green foil consisting of 99 parts Potassium Bisulfate and 1 part Copper Sulfate Pentahydrate (light green cap).

- (b) Reagent B - Arsenic Test Paper Strips (yellow cap)
- (c) Reagent C - Zinc Pellets (brown cap)
- (d) Reagent D - White tablets composed of 92% Urea, 5% Potassium Perchlorate and 3% 4 - (Nitrobenzyl Pyridine (blue cap))
- (e) Reagent E - White tablets wrapped in red foil composed of 0.250g of Anhydrous Potassium Carbonate, 0.0172g of Magnesium Stearate and Talcium Powder (red cap)
- (f) Reagent F - pH test Litmus Paper (black cap)
- (g) Reagent G - White Halazone Tablets (white cap)
- (h) Reagent H - Light brown tablets composed of Lactose, Orthodiani sine Dihydrochloride, Acacia, and Glycol (dark green cap)
- (i) Reagent I - White tablets wrapped in gold foil composed of Potassium Carbonate, Sodium Chloride, Magnesium Stearate and Sodium Hexametaphosphate (orange cap)
- (j) Reagent J - Contains white Dupont "Perdiox" powder (grey cap)
- (k) Reagent K - Blue stripped ampule form containing 25% Acetone and 75% Xylene (carton)
- (x) Reagent X - White tablet consisting of Potassium Bisulfate, Orthotolidine Dihydrochloride and Sodium Chloride (black cap)

b. Test Instructions. All steps must be performed in the order given. Obtain a water sample in a canteen cup without excessive disturbance of the water source. The specimen sample should be taken as nearly as possible at the point and depth from which the water is to be taken. This water will be used for all tests except the chlorine demand test.

(1) Arsenic Test (fig. 2-25).

- (a) Pour the specimen water into the bottle (P) to the 10 ml mark nearer the bottom of the bottle.
- (b) Place 2 tablets from the light green capped vial A into the bottle. Swirl to dissolve.
- (c) Take 1 test strip from the yellow capped vial B and carefully insert it into the tube L, bending the strip near the top so it will remain upright in the tube. Touch only the top end of the strip. Keep test strip dry.
- (d) When the tablets from the light green capped vial A have dissolved, add 5 pellets from the brown capped vial C to the contents of bottle P, and promptly fit the tube L assembly into the bottle.



*Figure 2-25. "L" Tube Assembly*

(e) Let react for 20 minutes. If the solution is cold, warm the bottle in your hands.

NOTE

While the arsenic test is developing, perform other tests.

(f) Remove the test strip from the tube L and note the length of the yellow to brown stain. A stain 1/4 inch or more indicates a positive test; a stain less than 1/4 inch indicates a negative test.

(2) Mustard Test (Including Nitrogen Mustards and Cyanogen Chloride).

(a) Rinse a test tube with the water specimen, and carefully fill the tube about 1/2 inch deep with the specimen water.

(b) Add 1 table from the blue capped vial D and agitate for 3 minutes. Bring the solution to a boil with a match, lighter, or other source of heat. (The test carried out without the flame is less sensitive but will detect amounts of nitrogen mustard.) Allow the solution to stand for 5 minutes. During cold weather keep the tube warm in hand or inside pocket for an additional 5 minutes. A yellow color in the solution is positive for cyanogen chloride.

(c) Add 2 tablets from the red capped vial E to the test tube. Agitate the test tube gently, observing against a white background for any change of color in the sample (or in the curd) from white to red or blue. Any visible color change, even if it fades quickly indicates a positive test for mustard or nitrogen mustards. A yellow color indicates cyanogen chloride. A white color indicates a negative test.

## (3) Chlorine Demand Test.

(a) Fill a canteen with the water specimen to within 1 inch of the top, add 3 tablets from the white capped vial G, screw on the cap, and shake vigorously for 5 minutes. Allow solution to stand for 5 minutes.

(b) Fill the outer plastic tube, containing reagent X, to the bottom of the yellow band with water from the canteen. Add 1 tablet from the black capped vial (Reagent X), swirl until it is completely dissolved and compare the color of the solution with that of the yellow band on the tube.

(c) A positive test is indicated by no color or color lighter than the yellow band. A negative test is indicated by an orange color or a color darker than the yellow band.

(4) pH Test. Dip 1 strip of test paper from vial F into the suspected water. Remove and compare the resulting color of the test paper with the color chart on the following page. pH of less than 6 indicates possible contamination.

## (5) G Agents (Toxic Insecticides).

**CAUTION**

Do not perform this test in direct sunlight.

(a) Rinse bottle "P" 3 times with the water specimen, fill the bottle to the second mark (25 ml) with the water, and add 1 table from the dark green capped vial H. Swirl the solution to dissolve the tablet. If a yellow or green color appears, discard the solution and test as described in step (g). If no yellow or green color is formed, continue as follows:

(b) Rinse one test tube 3 times with the water specimen from the canteen cup, and fill the test tube 1/2 full with the suspected water specimen. Add two tablets from the orange capped vial I to the test tube and shake to dissolve.

(c) With scoop J add 1 level measure of powder from gray capped vial J to the test tube and shake for 2 minutes.

(d) Pour the contents of the test tube into the bottle "P", place the plastic cap on the bottle and shake well for 2 minutes.

(e) Break the tip on one of the ampules in carton "K", add the contents to the bottle. Replace the plastic cap and shake for an additional 2 minutes. Add enough water from the canteen cup to bring the top level of the solution into the neck of the bottle just below the yellow band and let stand for 5 minutes.

(f). A yellow color in the upper layer equal to or darker than the yellow band on the bottle is a positive test for G agents and for certain toxic insecticides. A yellow color in the lower water layer indicates very dangerous concentrations of G agents. With time, the yellow band on the bottle may fade, in this case, a comparison may be made with the yellow band on the Reagent X plastic tube used for the chlorine demand test.

(g) Rinse the bottle "P" (fig. 2-25) and fill to the 25 ml mark on the bottle. Add 2 tablets from the orange capped vial I and shake to dissolve. Add 1 level scoop of powder from the gray capped vial J followed immediately by 1 tablet from the dark green capped vial H. Place the plastic capon the bottle and shake well for 2 minutes. Continue as specified in steps (e) and (f).

(h) In the absence of a highly positive chlorine demand test, no color or a color lighter than the yellow band indicates a negative agent.

(6) Taste and Odor Test.

(a) If the arsenic test, para 2-24b(1) mustard test (2) above, chlorine demand test 2-22K(2) and G-agents test 2-24b(1) are negative and if the pH test (4) above is 6 or above, carefully smell and taste a sample of the water specimen.

(b) A positive test is indicated by:

A lacrimatory or chlorine odor.

A biting and/or peppery chlorine taste.

Any taste or odor of a known war gas.

(c) Absence of all tastes and odors will indicate a negative result, but not necessarily a safe water. A negative test is also indicated by the presence of only those odors and/or tastes normally characteristic of natural waters.

**2-24.1 WATER TESTING KIT CHEMICAL AGENTS-M272 (Not Used in Buys 1 and 2).**

Refer to TM 3-6665-315-10 (Non-Supportable)

**Section II. OPERATION OF AUXILIARY EQUIPMENT**

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Water Testing Kit-Bacteriological	2-94
Scope	2-94
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Operation	2-96

**2-25. WATER TESTING KIT-BACTERIOLOGICAL. (Fig. 2-26.)**

**2-26 SCOPE.**

The Water Testing Kit-Bacteriological is used in conjunction with the WOAS-Preventive Medicine.

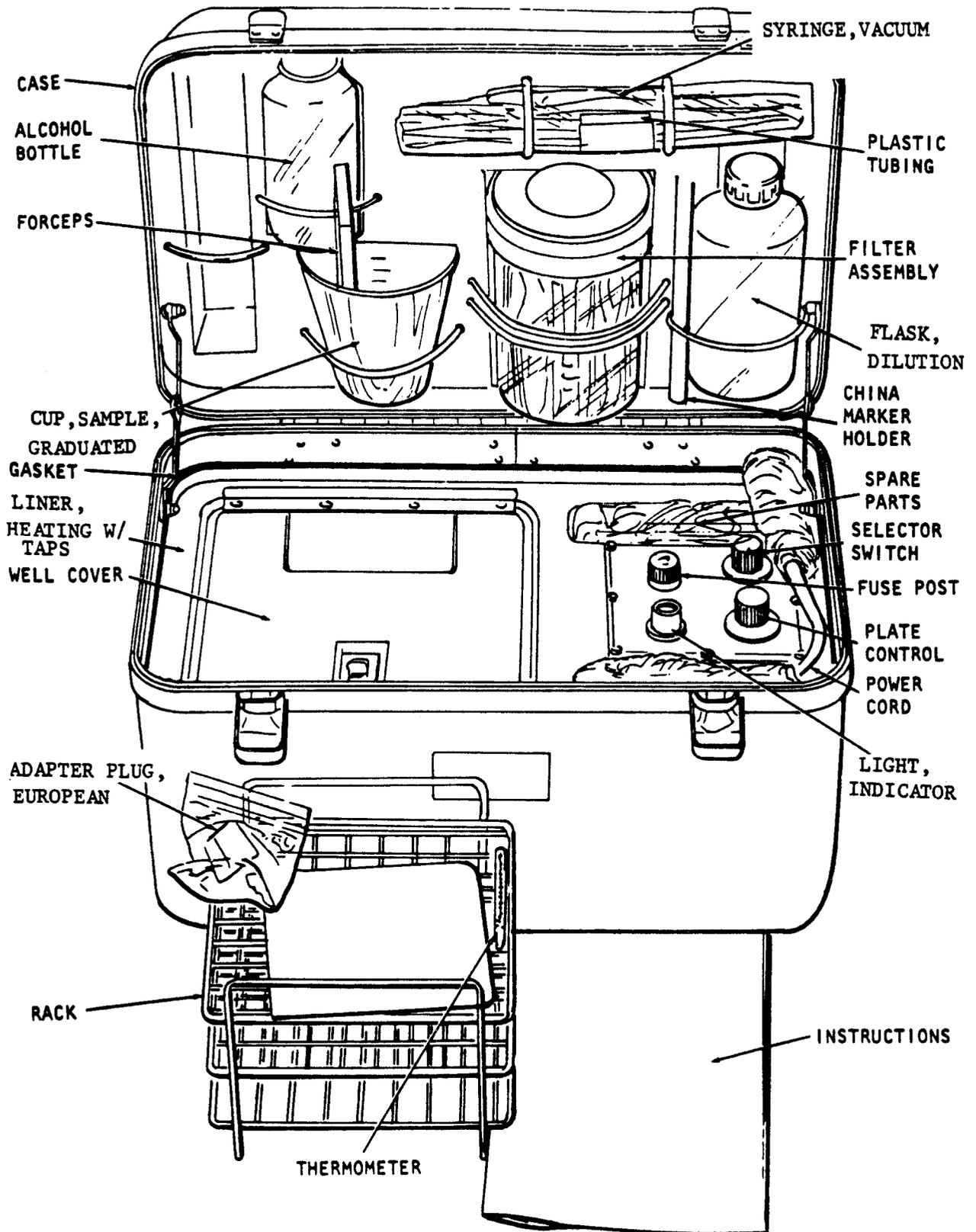


Figure 2-26. Water Testing Kit-Bacteriological

**2-27. CONTENTS.** A brief description of the principal units comprising the kit follows:

- a.** A carrying case of blue fiberglass which can be easily carried by one man in the field and contains all components of the kit except the plastic microporous petri dishes, bacterial filtering discs and medium culture ampules which are packaged separately. The carrying case cover is not removable.
- b.** An incubator capable of maintaining a temperature of 36°C (97°F) with 6, 12, 24 volt DC and 110/220 volts, 50/60 cycles AC under outside temperature conditions varying from 0°C (32°F) to 37°C (98.6°F).
- c.** Incubator Rack capable of accommodating 24 petriculture dishes.
- d.** Filter Holder Assembly composed of a funnel assembly, a support with removable screen and a vacuum filter flask, all of corrosive resisting steel.
- e.** Clear Plastic Cylinder containing 12 lengths of polyvinylchloride tubing.
- f.** Plastic Container holding:
  - (1) Two-way valve inlet luer taper and outlet serrated hose adapter (2 each).
  - (2) Indicator lamp (red).
- g.** Metal Syringe.
- h.** Booklet of operating instructions.
- i.** One box of Endo-Broth holding 24 ampules, each containing 2 ml of broth, to be used for culturing coliform bacteria, is packed separately.

<b>WARNING</b>
----------------

**Coliform bacteria is of a type found in the large intestine of man and animal. It is indicative of fecal water pollution. Sterile conditions must be strictly enforced when incubating nutrient-saturated filter disks or when dealing with suspect water.**

**2-28. OPERATION.** Test procedures and operation of this accessory unit are described in the Instruction Booklet enclosed in its case.

**Section III. OPERATION UNDER UNUSUAL CONDITIONS**

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Operation Below Freezing	2-97
Plastic Containers	2-97
Sample Water	2-97
Below -35°C (-30°F)	2-97
Operating Above 25°C (77°F) Temperature	2-97
WQAS	2-97
Incubator	2-98
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**2-29. OPERATING BELOW FREEZING.**

**a.** 0°C (32°F) to -35°C (-30°F). Precautions should be taken to allow for the expansion property of water and chemical solutions (water solubles) under freezing conditions. Acids retain their fluid state as lower temperatures than water, depending upon the percentage inclusion. Insure that there is an approximate 10% void in all liquid containers.

**b.** Plastic Containers. Plastic ampules and containers have a slight expansion capability, but may exhibit leakage due to fractures. Extreme cold may cause brittleness. Be alert for cracks and leakage. Handle components carefully.

**c.** Sample Water. Water must be changed from the frozen state to a liquid state in order to mix with reagents and indicators.

**NOTE**

For best results, tests should be performed between 20°C (68°F) and 25°C (77°F) for optimum water chemistry results.

**d.** Below -35°C (-30°F). This is below the designed lower operating limit of the incubator. (Water testing kit-Bacteriological).

**2-30. OPERATING ABOVE 25°C (77°F) TEMPERATURE.**

**a.** WQAS. Water chemistry is not at optimum testing conditions. Higher temperatures result in progressively more saturated solutions. Temperature serves as a catalyst in most reactions. Indicator solutions usually react faster.

**b. Incubator.** The incubator's designed higher limit is 37°C (98°F). Above this temperature, incubation of cultures will be less effective.

**CAUTION**

**Fumes from open or cracked containers will create a potential health and fire hazard. Insure adequate ventilation.**

**c. Volatile Kit Inclusions.** Rising temperatures will affect alcohol, acetone and other similar kit inclusions. There will be a tendency to change from a liquid to a gaseous state with a resultant expansion pressure on closed containers.

**d. Shelf-Life.** Chemical solutions and powder pillow reagents will have their shelf-life expectancy shortened directly proportional to the temperature increase.

CHAPTER 3

OPERATOR MAINTENANCE INSTRUCTIONS

**OVERVIEW**

This chapter contains Lubrication, Preventive Maintenance Checks and Services (PMCS) and troubleshooting procedures that must be accomplished by the operator.

Section I. LUBRICATION

	Page
General	3-1
Instructions	3-1

3-1. GENERAL.

a. Instructions. There are essentially no working wear parts incorporated in the Water Quality Analysis Sets. Cover hinges, latches and similar minor items should be given a minimum application of graphite, dry silicone or similar lubricant material. Oils and greases should be avoided; if used to prevent corrosion - apply sparingly.

b. (DELETED)

Section II. PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS)

	Page
General	3-1
Item Number Column	3-2
Interval Columns	3-2
Item to be Inspected Column	3-2
For Readiness Reporting, Equipment is Not Ready/Available if: Column	3-2
Checks With Assistance	3-12
General	3-12
Instrument Linearity Check	3-12
Instrument Wavelength Accuracy Check	3-12

3-2. GENERAL

To insure that the Water Quality analysis Set is ready for operation at all times, it must be inspected systematically so that the defects may be discovered and corrected before they result in serious damage or failure. Defects discovered during operation of the unit

shall be noted for future corrections, to be made as soon as an operation has ceased. Stop an operation which would damage the equipment if the operation were to continue. All deficiencies and shortcomings shall be recorded together with the corrective action taken on DA Form 2404, "Equipment Inspection and Maintenance Worksheet", at the earliest opportunity. When performing your "Before Operation" (B) and "During Operation" (D) PMCS, always keep in mind the CAUTIONS and WARNINGS. After an operation, be sure to perform your (A) PMCS. If your equipment fails to operate, troubleshoot with proper equipment. Report any deficiencies using the proper forms, see TM 38-750.

### 3-3. PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS). (Table 3-1.)

a. Item Number Column. Checks and services are numbered in chronological order regardless of interval. This column will be used as a source of item numbers for the "TM Item Number" column on DA Form 2404 in recording results of PMCS.

b. Interval Columns. The columns headed "B", "D", "A", "W", and "M", will contain a dot (o) opposite the appropriate check indicating it is to be performed Before, During, After, Weekly, or Monthly.

c. Item to be Inspected Column. The items listed in this column are divided into groups and identify the items to be inspected.

d. Procedures Column. This column contains a brief description of the procedure by which the check is to be performed.

e. For Readiness Reporting, Equipment is Not Ready/Available If: Column. This column will contain the criteria which will cause the equipment to be classified as not Ready/Available because of inability to perform its primary mission.

#### NOTE

If the equipment must be kept in continuous operation, check and service only those items that can be checked and serviced without disturbing operation. Make the complete checks and services when the equipment can be shut down.

Table 3-1. Operator Preventive Maintenance Checks and Services

NOTE: Within designated interval, these checks are to be performed in the order listed.

Item No.	Interval					Item to be Inspected	Procedures Check for and have repaired or adjusted as necessary	For Readiness Reporting Equipment is Not Ready Available If
	B	D	A	W	M			
1			•		•	<b>WATER QUALITY ANALYSIS SET, PREVENTIVE MEDICINE:</b> (fig. 1-1) Case Inserts Fittings Manual (In Engineer Kit)	Visual Inspection of: 1 - Cases, fittings & inserts for function. Patch or replace. 2 - Lab-ware. Broken units are to be replaced. 3 - Shelf-life. If expired, retain for identification only. Replace. 4 - Containers for leakage and function. Clean up. Tighten caps. Replace.	1 - Less than the quantity of any type of reagent listed in Appendix C, required to perform function; or, not of effective shelf life. 2 - Leakage of any container is evident (until cleaned up and replaced). 3 - Lab-ware is broken or missing to an extent that accurate measurements cannot be made. 4 - Environmental exposure has been such that containers or contents are unreliable.
2			•		•			
3			•		•			
4				•				
5			•		•	<b>ACIDITY TEST KIT</b> (fig. 2-5) Case Inserts Lab-ware Instructions Indicator Pillows, Bromcresol Green-Methyl Red		
6			•		•			
7			•	•				
8					•			
9			•	•				
10			•	•		<b>Indicator Solution - Phenolphthalein</b> <b>Sodium Hydroxide Standard Solution</b>		
11			•	•				
12			•		•	<b>CHLORIDE TEST KIT (HIGH RANGE)</b> (fig. 2-6) Case Insert Instructions Lab-ware Chloride Titrant (Silver Nitrate)		
13			•		•			
14				•				
15			•	•				
16			•	•		<b>Chloride Indicator Pillows</b>		
17			•	•				
18			•		•	<b>DISSOLVED OXYGEN TEST KIT</b> (fig. 2-9) Case Insert		
19			•		•			

Table 3-1. Operator Preventive Maintenance Checks and Services - Continued

NOTE: Within designated interval, these checks are to be performed in the order listed.

B - Before                      D - During                      A - After                      W - Weekly                      M - Monthly

Item No.	Interval					Item to be Inspected	Procedures Check for and have repaired or adjusted as necessary	For Readiness Reporting Equipment is Not Ready Available If
	B	D	A	W	M			
20			•	•		Lab-ware	Visual Inspection of: 1 - Cases, fittings & inserts for function. Patch or replace. 2 - Lab-ware. Broken units are to be replaced. 3 - Shelf-life. If expired, retain for identification only. Replace. 4 - Containers for leakage and function. Clean up. Tighten caps. Replace.	1 - Less than the quantity of any type of reagent listed in Appendix C, required to perform function; or, not of effective shelf life. 2 - Leakage of any container is evident (until cleaned up and replaced). 3 - Lab-ware is broken or missing to an extent that accurate measurements cannot be made. 4 - Environmental exposure has been such that containers or contents are unreliable.
21				•	Instructions			
22			•	•	Sulfuric Acid			
23			•	•	Manganese, Sulfate Solution			
24			•	•	Alkaline Potassium Iodide Solution			
25			•	•	Starch Solution			
26			•	•	Sodium Thiosulfate Solution			
					FERRIC IRON TEST KIT (fig. 2-7)			
27			•		Case			
28			•	•	Insert			
29			•	•	Lab-ware			
30			•	•	Instructions			
31			•	•	Ferover (For 25 ml Samples) Test Reagent			
32			•	•	Ferover (For 5 ml Samples) Test Reagent			
					ZINC TEST KIT (fig. 2-10)			
33			•		Case			
34			•	•	Insert			
35			•	•	Lab-ware			
36			•	•	Instructions			
37			•	•	Zinc, Conditioning Reagent			
38			•	•	Zinc, Reagent			
39			•	•	Water, De-ionized			

Table 3-1. Operator Preventive Maintenance Checks and Services - Continued

NOTE: Within designated interval, these checks are to be performed in the order listed.

Item No.	Interval					Item to be Inspected	Procedures Check for and have repaired or adjusted as necessary	For Readiness Reporting Equipment is Not Ready Available If
	B	D	A	W	M			
40			•	•		OTHER REAGENT IN WQAS - P.M. (fig. 1-5)	Visual Inspection of 1 - Cases, fittings & inserts for function. Patch or replace. 2 - Lab-ware. Broken units are to be replaced. 3 - Shelf life. If expired, retain for identification only. Replace. 4 - Containers for leakage and function. Clean up. Tighten caps. Replace.	1 - Less than the quantity of any type of reagent listed in Appendix C, required to perform function; or, not of effective shelf life. 2 - Leakage of any container is evident (until cleaned up and replaced). 3 - Lab-ware is broken or missing to an extent that accurate measurements cannot be made. 4 - Environmental exposure has been such that containers or contents are unreliable.
41			•	•	Fluoride Solution, Standard			
42			•	•	SPADNS Reagent			
43			•	•	Ferrous Iron Reagent Powder Pillows			
44			•	•	Indicator, Solution, pH Wide Range			
45			•	•	Nitrate Test Reagent Powder Pillows			
46			•	•	Nessler's APHA Test Solution			
47			•	•	Salt, Solution, Rochelle			
48			•	•	Sulfate Test Powder Pillows			
49			•	•	Thermometer			
50			•	•	Micro Pipet, glass			
51			•	•	Volumetric Transfer Pipet (2)			
52			•	•	Flask, glass 25 ml			
53			•	•	Cylinder, Grad, 25 ml (2)			
54			•	•	Brush, Test Tube	Visual inspection	1 - Meter is not intact. 2 - Batteries not sealed, batteries deteriorated. 3 - Scales: there is not at least 1 good scale of each type (scales must not be marred or damaged) 4 - Meter not operative.	
55			•	•	SPECTROPHOTOMETER, MULTI-PURPOSE (figs. 2-11 and 2-12)			
56			•	•	Case			
57			•	•	Battery, Dry Cell. 1.5V, Size D			
58			•	•	Scale, pH, Wide Range			

Table 3-1. Operator Preventive Maintenance Checks and Services - Continued

**NOTE:** Within designated interval, these checks are to be performed in the order listed.

B - Before          D - During          A - After          W - Weekly          M - Monthly

Item No.	Interval					Item to be Inspected	Procedures Check for and Have Repaired or Adjusted as Necessary	For Readiness Reporting Equipment is Not Ready Available If
	B	D	A	W	M			
59			•	•		Scale, Nitrogen Ammonia	Visual Inspection	1 - Meter is not intact. 2 - Batteries not sealed, batteries deteriorated. 3 - Scales: there is not at least 1 good scale of each type (scales must not be marred or damaged). 4 - Meter not operative.
60			•	•		Scale, Nitrogen Nitrate		
61			•	•		Scale, Sulfate		
62			•	•		Scale, Turbidity		
63			•	•		Scale % Transmittance - Absorbance		
						WATER TESTING KIT-BACTERIOLOGICAL (packaged separately from WQAS - Preventive Medicine) (fig. 2-26)		
64			•	•		Inserts	Visual Inspection of 1 - Cases, fittings & inserts for function. Patch or replace. 2 - Lab-ware. Broken units are to be replaced. 3 - Shelf life. If expired, retain for identification only. Replace. 4 - Containers for leakage and function. Clean up, tighten caps. Replace.	1 - Less than the quantity of any type of reagent listed in Appendix C, required to perform function; or, not of effective shelf life. 2 - Leakage of any container is evident (until cleaned up and replaced). 3 - Lab-ware is broken or missing 4 - Environmental exposure has been such that containers or contents are unreliable.
65			•	•		Instructions		
66			•	•		Case, Carrying, Reinforced Fiberglass		
67			•	•		Container, Parts, Spare		
68			•	•		Cord, Power, Electrical		
69			•	•		Cover, Incubator Well		
70			•	•		Cup, Sample, Graduated		
71			•	•		Disc, Bacterial Filtering		
72			•	•		Filter, Holder Assembly		
73			•	•		Gasket, Sealing		
74			•	•		Light, Indicator		
75			•	•		Liner. Reinforce Fiberglass with Wiring and Tape		
76			•	•		Medium Culture, Ampouled		

Table 3-1. Operator Preventive Maintenance Checks and Services - Continued

**NOTE:** Within designated interval, these checks are to be performed in the order listed.

B - Before                  D - During                  A - After                  W - Weekly                  M - Monthly

Item No.	Interval					Item to be Inspected	Procedures Check for and Have Repaired or Adjusted as Necessary	For Readiness Reporting Equipment is Not Ready Available If
	B	D	A	W	M			
77			•	•		Petri Dishes, Plastic	Visual Inspection of: 1 - Cases, fittings & inserts for function. Patch or replace. 2 - Lab-ware. Broken units are to be replaced. 3 - Shelf life. If expired, retain for identification only. Replace. 4 - Containers for leakage and function. Clean up, tighten caps. Replace.	1 - Less than the quantity of any type of reagent listed in Appendix C, required to perform function; or, not of effective shelf life. 2 - Leakage of any container is evident (until cleaned up and replaced). 3 - Lab-ware is broken or missing. 4 - Environmental exposure has been such that containers or contents are unreliable.
78			•	•		Plate, Control		
79			•		•	Rack Incubator		
80			•	•		Syringe, Metal		
81			•	•		Switch, Selector, Voltage		
82			•	•		Thermometer, Assembly		
83			•	•		Thermostat		
84			•	•		Valve, Two-Way, Syringe		
85			•	•		Bottle, Alcohol, Polyethylene		
86			•	•		Bottle, Polyethylene, Dilution Water		
						WATER QUALITY ANALYSIS SET ENGINEER (fig. 1-2)		
87			•		•	Case		
88			•	•		Inserts		
89			•	•		Manual (WQAS-P.M./E)		
						ALKALINITY TEST KIT (fig. 2-13)		
90			•		•	Case		
91			•		•	Insert		
92			•	•		Lab-ware		
93			•	•		Instructions		
94			•	•		Alkalinity Titration Reagent		
95			•	•		Indicator, Total Alkalinity		
96			•	•		Indicator, Phenolphthalein		

Table 3-1. Operator Preventive Maintenance Checks and Services - Continued

NOTE: Within designated interval, these checks are to be performed in the order listed.

B - Before                      D - During                      A - After                      W - Weekly                      M - Monthly

Item No.	Interval					Item to be Inspected	Procedures Check for and have repaired or adjusted as necessary	For Readiness Reporting Equipment is Not Ready Available If
	B	D	A	W	M			
97			•		•	CHLORIDE TEST KIT (LOW RANGE) (fig. 2-14)	Visual Inspection of: 1 - Cases, fittings & inserts for function. Patch or replace. 2 - Lab-ware. Broken units are to be replaced. 3 - Shelf life. If expired, retain for identification only. Replace. 4 - Containers for leakage and function. Clean up, tighten caps. Replace.	1 - Less than the quantity of any type of reagent listed in Appendix C, required to perform function; or, not of effective shelf life. 2 - Leakage of any container is evident (until cleaned up and replaced). 3 - Lab-ware is broken or missing to the extent that accurate measurement cannot be made. 4 - Environmental exposure has been such that containers or contents are unreliable.
98			•		•	Case		
99			•		•	Insert		
100			•	•		Lab-ware		
101			•	•		Instructions		
102			•	•		Chloride Titrant (Silver Nitrate)		
			•	•		Chloride Indicator Powder Pillows		
						HARDNESS, TEST KIT (fig. 2-18)		
103			•		•	Case		
104			•		•	Insert		
105			•	•		Lab-ware		
106			•	•		Instructions		
107			•	•		Buffer Solution - Hardness #1		
108			•	•		Manver Hardness Indicator - Hardness #2		
109			•	•		Titration Solution - Hardness #3		
110			•	•		Potassium Hydroxide Solution Calver II, Powder Pillows		
						SULFATE, TEST KIT (fig. 2-19)		
111			•		•	Case		
112			•		•	Insert		
113			•	•		Instructions		
114			•	•		Lab-ware		
115			•	•		Alcohol, Isopropyl		
116			•	•		Standard Barium Chloride Reagent		

Table 3-1. Operator Preventive Maintenance Checks and Services - Continued

NOTE: Within designated interval, these checks are to be performed in the order listed.

B - Before                      D - During                      A - After                      W - Weekly                      M - Monthly

Item No.	Interval					Item to be Inspected	Procedures Check for and have repaired or adjusted as necessary	For Readiness Reporting Equipment is Not Ready Available If
	B	D	A	W	M			
117			•	•		Bromcresol Green Indicator Solution	Visual Inspection of: 1 - Cases, fittings & inserts for function. Patch or replace. 2 - Lab-ware. Broken units are to be replaced. 3 - Shelf life. If expired, retain for identification only. Replace. 4 - Containers for leakage and function. Clean up, tighten caps. Replace.	1 - Less than the quantity of any type of reagent listed in Appendix C, required to perform function; or, not of effective shelf life. 2 - Leakage of any container is evident (until cleaned up and replaced). 3 - Lab-ware is broken or missing to the extent that accurate measurements cannot be made. 4 - Environmental exposure has been such that containers or contents are unreliable.
118			•	•		Hydrochloric Acid, N/50		
119			•	•		Phenolphthalein Indicator Solution		
120			•	•		Sulfate Indicator Powder		
						TURBIDITY, TEST KIT (fig. 2-20)		
121			•		•	Case		
122			•		•	Insert		
123			•	•		Instructions		
124			•		•	Lab-ware		
125			•	•		Standard Turbidity Reagent		
						COLOR TEST KIT (fig. 2-15)		
126			•	•		Instructions		
127			•	•		Color Disc, 0-100 units		
128			•	•		Color viewing tubes, w/5 ml mark (2)		
129			•	•		Lengthwise Viewing adapter		
130			•	•		Color Comparator		
						REFILL KIT, CHEMICAL DETECTOR, VG (fig. 2-23)		
						ABC-M30		
131			•	•		Book of ABC-M8 Vesicant Detector Paper		
132			•	•		Bottle of Trihydroxymethylamino-methane (TRIS)		

Table 3-1. Operator Preventive Maintenance Checks and Services - Continued

NOTE: Within designated interval, these checks are to be performed in the order listed.

Item No.	Interval					Item to be Inspected	Procedures Check for and have repaired or adjusted as necessary	For Readiness Reporting Equipment is Not Ready Available If
	B	D	A	W	M			
133			•	•		Belt of 40 Detector Tickets, MSA 3-110	Visual Inspection of: 1 - Cases, fittings & inserts for function. Patch or replace. 2 - Lab-ware. Broken units are to be replaced. 3 - Shelf life. If expired, retain as identification only, replace. 4 - Containers for leakage and function. Clean up. Tighten caps. Replace.	1 - Less than the quantity of any type of reagent listed in Appendix C, required to perform function; or, not of effective shelf life. 2 - Leakage of any container is evident (until cleaned up and replaced). 3 - Lab-ware is broken or missing to an extent that accurate measurements cannot be made. 4 - Environmental exposure has been such that containers or contents are unreliable.
134			•	•	Dispenser of Substrate Solution			
					WATER TESTING KIT, CHEMICAL AGENTS AN-M2 (fig. 2-24)			
135			•	•	Reagent A			
136			•	•	Reagent B			
137			•	•	Reagent C			
138			•	•	Reagent D			
139			•	•	Reagent E			
140			•	•	Reagent F			
141			•	•	Reagent G			
142			•	•	Reagent H			
143			•	•	Reagent I			
144			•	•	Reagent J			
145			•	•	Reagent K			
146			•	•	Reagent X			
147			•	•	Water Testing Kit, Chemical Agent, M272			
					CHLORINE DEMAND AND COAGULATION TEST ASSEMBLY (fig. 2-22)			
148			•	•	Jars (4)			
149					Funnel, 45 mm.			
150			•	•	Measuring Spoon, .05q			
151			•	•	Graduated Cylinder, 25 ml (2)			

Table 3-1. Operator Preventive Maintenance Checks and Services - Continued

NOTE: Within designated interval, these checks are to be performed in the order listed.

Item No.	Interval					Item to be Inspected	Procedures Check for and have repaired or adjusted as necessary	For Readiness Reporting Equipment is Not Ready Available If		
	B	D	A	W	M					
151			•		•	OTHER REAGENTS AND LAB-WARE IN WQAS - ENG. (fig. 1-6, Loading Diagram) Limestone, Powdered	Visual Inspection of: 1 - Cases, fittings & inserts for function. Patch or replace. 2 - Lab-ware. Broken units are to be replaced. 3 - Shelf life. If expired, retain as identification only, replace. 4 - Containers for leakage and function. Clean up. Tighten caps. Replace.	1 - Less than the quantity of any type of reagent listed in Appendix C, required to perform function; or, not of effective shelf life. 2 - Leakage of any container is evident (until cleaned up and replaced). 3 - Lab-ware is broken or missing to an extent that accurate measurements cannot be made. 4 - Environmental exposure has been such that containers or contents are unreliable.		
152			•		•	Orthotolidine Solution				
153			•		•	Ferric Chloride, Solution				
154			•		•	Arsenite Solution				
155			•		•	Halazone Tablets (6)				
156			•			Plastic Bags				
157			•		•	pH Wide Range Indicator Solution				
158			•		•	Pipet Dropper				
159			•		•	Flask, Filtering, 500 ml				
160			•		•	Funnel, 70 ml				
161			•		•	Beaker, 250 ml				
162			•		•	CONDUCTIVITY METER: TOTAL DISSOLVED SOLIDS DETERMINATION (fig. 2-17) Conductivity Meter			Visual Inspection for: 1 - Cleanliness. 2 - Case Intact. 3 - Live battery. 4 - Moisture tight storage. 5 - Remove battery and store separately when not in daily use.	1 - Meter is not intact. 2 - Batteries not sealed or expended. 3 - Meter not capable of being zeroed.
163			•		•	Range Extender				
164			•		•	Comparator Ay, Hydrogen Ion and Residual Chlorine				
165						DPD Tablets	1. Visual Inspection to see that container is not damaged.	1. DPD Tablets have been consumed		

3-4. CHECKS WITH ASSISTANCE.

a. General. If a medical facility, testing laboratory, or other military unit which may have cobalt chloride solution and neodymium chloride solution, is convenient, the following two checks will certify the accuracy of the spectrophotometer.

b. Instrument Linearity Check. To determine if your instrument is giving a linear response and to insure that the instrument's optical system is functioning properly, the following procedure may be used.

(1) Fill a clean 50 ml graduate cylinder to the 25.0 mark with cobalt chloride solution. Fill the graduated cylinder to a final volume of 50.0 ml with demineralized water.

(2) Repeat step 1 using 20, 15, and 5 ml of cobalt chloride solution and filling each graduated cylinder to a final volume of 50 ml with demineralized water.

(3) Insert the % transmittance - absorbance meter scale in the meter and adjust the wavelength dial to 510 nm.

(4) Fill a sample cell with demineralized water, place it in the cell holder and set the meter to read 100% T or 0 absorbance.

(5) Place the sample prepared in step (1) in the cell holder and read the absorbance value from the meter scale.

(6) Repeat step (5) using the dilutions prepared in step (2).

(7) Graph the results on linear paper, plotting the ml of cobalt chloride solution used for each sample versus the absorbance reading obtained in figure 3-1.

NOTE

The results should be a straight line passing through zero as shown by plot A on the graph (fig 3-1). Deviations from a straight line such as plot B may be caused by stray light due to light leakage, optical imperfections or improper optical alignment and maintenance. Turn improper performing instruments in for a replacement.

c. Instrument Wavelength Accuracy Check. The wavelength dial setting on your DR/2 spectrophotometer may be checked in the following manner.

(1) Turn the spectrophotometer on and adjust the wavelength dial to 575 nm. Insert the % transmittance - absorbance meter scale in the meter.

(2) Fill a sample cell with neodymium chloride solution and place it in the sample cell holder.

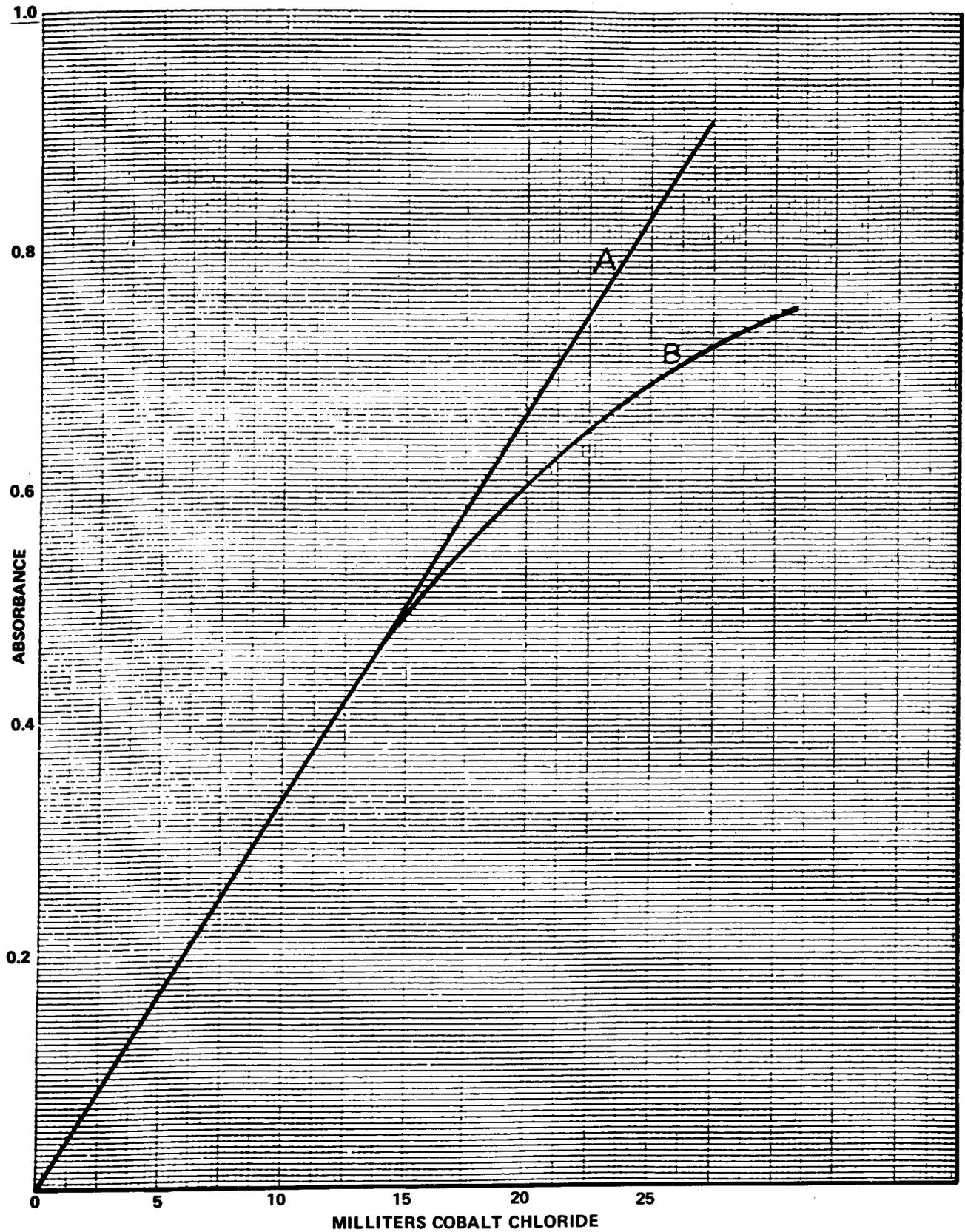


Figure 3-1. Linearity Graph

(3) Adjust the light control for a 90% T meter reading.

(4) Slowly rotate the wavelength dial between 560 and 590 nm. Determine and note the wavelength setting that gives the maximum deflection from 100% T on the meter scale.

(5) The wavelength dial setting on your spectrophotometer is accurately adjusted if the wavelength setting determined in step (4) is 575 nm.

### Section III. TROUBLESHOOTING

	Page
General	3-14
Irregular Water Test Results	3-14
Test Results Are Suspect	3-14
Exceeded Shelf Life	3-15
Replacement Chemicals	3-15
Operating Checks on Meters (Summary)	3-15

#### 3-5. GENERAL.

a. This section contains troubleshooting information for locating and correcting most of the operating troubles which may develop in the water quality analysis set. Each malfunction for individual component, or unit is followed by a list of test or inspections which will help you determine corrective action to take. You should perform the test/inspections and corrective action in the order listed.

b. This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective action. If a malfunction is not listed or is not corrected by the list corrective actions, notify your supervisor.

c. The table 3-2 lists the common malfunctions which you may find during the operating of maintenance of the set or its components. You should perform the tests/inspections and corrective action in the order listed. Appendix B (MAC) assigns repair and calibration responsibilities of some items to the organization/support level. Because the operator is usually in an isolated or forward position, not readily available to the organization/support level the troubleshooting procedures have been expanded. If the need arises and the effort must be made to keep the WOAS functional, you, the operator, shall effect such corrective action as within your skill and means.

#### 3-6. IRREGULAR WATER TEST RESULTS.

a. Test results are suspect. Lack of cleanliness and other contamination (interference) of lab-ware should be considered. Repeat the test and compare results. Evaluate. When the comparison is similar but still suspect, the reason may lie in a faulty procedure,

chemical solutions, equipment or interferences. The U.S. Environmental Protection Agency recommends as many as seven comparison tests for a dependable indication. Bear in mind the sample dilution with a corresponding constant will offset a heavy concentration of the substance being tested for.

b. Exceeded shelf life in the field can be anticipated as the greatest cause of test unreliability. The analyst will have to use these reagents as an indication until the reagent can be compared to a known sample or a standard solution.

c. Replacement chemicals from other sources. Other standard solutions and additional chemicals may be obtained or test results compared using military or civilian facilities as convenient, to supplement the WOAS. Refurbishment of specified supplies must be from the designated source or equal.

d. Operating Checks on Meters (Summary).

(1) Spectrophotometer.

- (a) Operating controls (table 2-6).
- (b) Power connections (para 2-18a(2)(a)).
- (c) Filtering wedge (para 2-18a(2)(a)).
- (d) Mode of control, wavelength dial (para 2-18b).
- (e) Proper setup (para 2-18c).
- (f) After use checks (para 2-18d).

(2) Conductivity meter.

- (a) Operating controls (para 2-22f(1)(a)).
- (b) Calibration, precautions and cleaning of cell (para 2-22f).

#### NOTE

Before you use table 3-2, be sure you have performed all applicable operating checks.

Table 3-2. Troubleshooting, Operator

---

MALFUNCTION
TEST/INSPECTION
CORRECTIVE ACTION

---

CHEMICAL REAGENTS

1. SUSPECT TEST RESULTS

Inspect successive test results for similarity.

Refer to paragraph 3-6.

WQAS CASES FOR SETS AND KITS

2. CASES FOR SETS AND KITS DAMAGED

Step 1. Inspect cases for any signs of damage.

a. Salvage contents as to capability to perform function in full or in part.

NOTE

Case material is thermoset. Repair surface must be sanded, scored or otherwise roughened for the fiberglass and resin to bond properly.

b. Reinforce with fiberglass and resin, or contain damaged case with straps, tape, clothing or whatever.

c. If not patchable, order replacement.

d. Replace or repair (rivet) fitting. Provide holding straps.

Step 2. Inspect inserts.

a. If functionable, clean up and reuse.

b. If not functionable, replace. Use cloth, grass, water in plastic bags, or whatever to cushion set and kit contents for temporary use.

c. If patchable, tape with any adhesive, being careful to avoid spillage or adhesion to case or kit contents.

Step 3. Check meter inclusion (if any).

a. Clean spillage.

b. Examine for damage.

Table 3-2. Troubleshooting, Operator - Continued

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
-------------	-----------------	-------------------

## SPECTROPHOTOMETER

## 3. METER NOT OPERATIVE

Step 1. Inspect for a distorted indicating needle.

- a. Straighten and unjam.
- b. Insure needle is fastened to post.

Step 2. Inspect condition of meter scales.

- a. Discard any found chipped or distorted.
- b. Replace.

Step 3. Inspect lamp operation in AC & DC mode.

- a. Adjust wavelength dial to 400 nm. Insure light shield is in place. Place meter on AC power (110 volts).
- h. Operate the light control - a full scale deflection should be obtained. If not obtained, replace lamp as follows:
  - (1) Disconnect power.
  - (2) Remove the panel, lay it face down on a protective mat. Disconnect the lamp cable from the amplifier board connection BC4 (fig. 4-1).
  - (3) Loosen the bulb setscrew in the lamp holder and extract the lamp.
  - (4) Install the replacement lamp assembly in reverse order of removal. The lamp must be aligned with the lamp filament positioned vertically, and placed as far in the lamp holder as possible.
  - (5) Reassemble the instrument and check alignment by placing a piece of paper in the cell holder and, with the light switch ON, adjusting the wavelength dial to 550 nm to bring the bulb filament image into focus on the paper. Proper alignment gives an image of a vertical, elongated circle completely enclosing the filament image.
  - (6) The filament image is positioned by rotating the bulb within the lamp holder. Avoid overtightening the bulb setscrew. Bulb damage could result.
- c. If lamp is operating on AC, remove AC source of power, lift out panel from case, lay it inverted on a protective cover, inspect battery. If leakage is visible, discard batteries and clean up case. Replace batteries from spare set as follows: Be sure polarity is correct.

Table 3-2. Troubleshooting, Operator - Continued

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MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
-------------	-----------------	-------------------

---

**NOTE**

The instrument requires 8 each 1 1/2V batteries.

- (1) Remove power source.
  - (2) Lift out panel, lay it on a protective cover.
  - (3) Remove installed batteries. Clean contacts.
  - (4) Replace batteries, taking care to align the polarity in accordance with the markings on the contacts.
  - (5) Exchange the battery pack cable with the AC connection on the BC5 amplifier board.
  - (6) Reassemble meter. Install the % transmittance - absorbance meter scale. Close the light shield lid. Place the light switch in zero check position. Now position the meter needle for a zero % T reading with the zero adjust control.
  - (7) Turn meter on. A 100% T reading must be obtained while adjusting the light control, to indicate batteries are fully charged. If unit is not operational, refer to organizational maintenance personnel.
-

## CHAPTER 4

## ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

## Section I. SERVICE UPON RECEIPT OF MATERIEL

**OVERVIEW**

This chapter contains organizational maintenance instructions for the WOAS covering Service Upon Receipt of Materiel, Repair Parts, Special Tools and Equipment, Lubrication, PMCS, and Troubleshooting.

## 4-1. INSPECTING AND SERVICING THE EQUIPMENT.

On initial receipt of the Water Quality Analysis Sets (WOAS) an inspection shall be made to cover the following:

a. Cases and Inserts. The condition of the set and kit containers and their shock absorbing inserts shall be evaluated to insure their serviceability. All items shall fit snugly in the plastic inserts in accordance with the loading diagrams (figs. 1-5 and 1-6). There shall be no spillage. Closures will be secure and fittings shall be functional.

b. Shelf-Life. The labels of all chemical components shall be examined to insure that the substances are within usable date limits. Shelf-life expired substances shall not be counted or issued to the field.

c. Batteries. Batteries shall be sealed against humidity and electrode ends shall be insulated against any conduction contacts.

d. Completeness. An inventory shall be made of the WOAS against the listings in Appendix C. Broken damaged and unserviceable units shall be repaired or replaced. The results shall be noted in the "Rec'd" column. The same Readiness criteria, as listed in table 3-1, shall be the basis for issue.

## 4-2. INSTALLATION.

The WOAS is designed to be portable and for use in the field.

Section II. REPAIR PARTS, SPECIAL TOOLS, TMDE AND SPECIAL EQUIPMENT

4-3. SPECIAL TOOLS AND EQUIPMENT.

There are no special tools and equipment required.

4-4. REPAIR PARTS.

Repair parts are listed in Appendix C.

4-5. FABRICATED EQUIPMENT.

No fabricated equipment is required.

Section III. PMCS, ORGANIZATIONAL

4-6. PMCS, ORGANIZATIONAL.

a. Since the sets are designed to be self-contained, to be functional for use in the field or stored awaiting issue, organizational maintenance procedure is the same as listed in paragraph 3-3 and the PMCS, in that an initial inspection shall be made of content and serviceability of the WOAS but that only a monthly inspection be conducted henceforth while in a stored condition. Current shelf-life of chemicals, percentage remaining of still usable units and the serviceability of containers and cases are to be considered in the same manner.

b. Appendix B - Maintenance Allocation Chart (MAC) places an additional repair/replace responsibility at the organizational level for carrying cases. It also specifies a replace responsibility for the spectrophotometer and conductivity meter.

Section IV. TROUBLESHOOTING

4-7. SCOPE.

Appendix B - MAC directs organizational and responsibility for WOAS cases. Table 4-1 lists repair procedures for the above units.

Table 4-1. Troubleshooting, Organizational

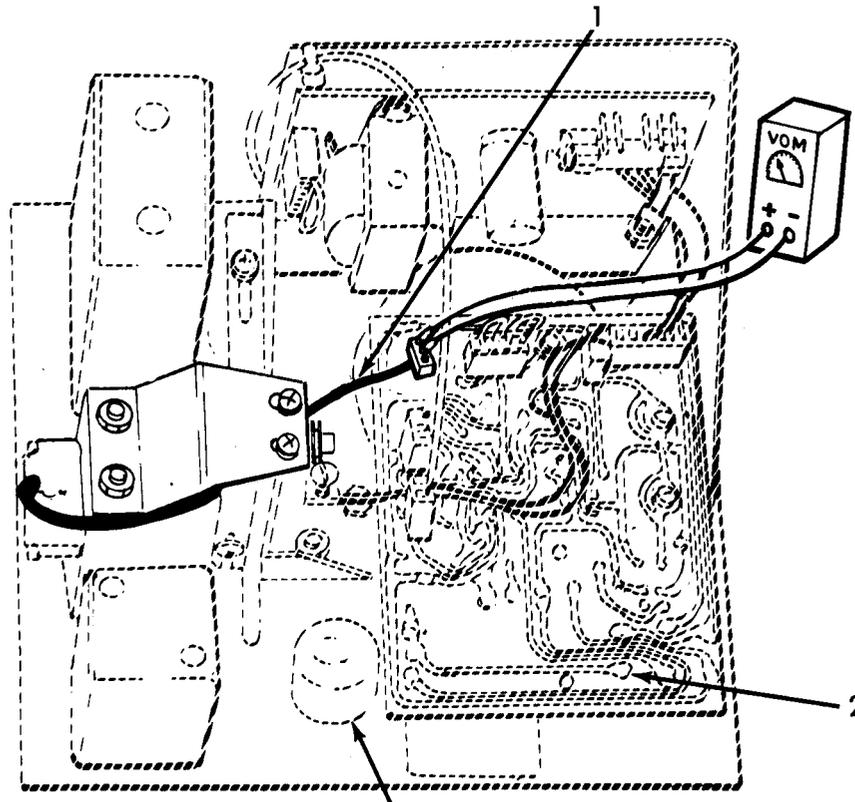
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MALFUNCTION	
TEST/INSPECTION	
CORRECTIVE ACTION	

---

## SPECTROPHOTOMETER

## 1. METER NOT OPERATING AFTER BASIC CHECKS

**LIGHT CONTROL (ON FRONT OF PANEL)**

- Step 1. Test photocell assembly. Lay the spectrophotometer on its left side and disconnect the photocell assembly cable (1) from amplifier circuit board (2) connection BC2. Set a VOM to the 50 microampere range and connect the positive lead to the photocell cable shield and the negative lead to the center conductor. Set the spectrophotometer wavelength dial to 700 nm and turn the instrument ON. Rotate the light control fully clockwise. The VOM should indicate from 5 to 15 microamperes. If not replace photocell.
- a. Place instrument in operation. Zero adjust control should cause movement of needle. If not and assuming previous correction actions have been completed, proceed as below.

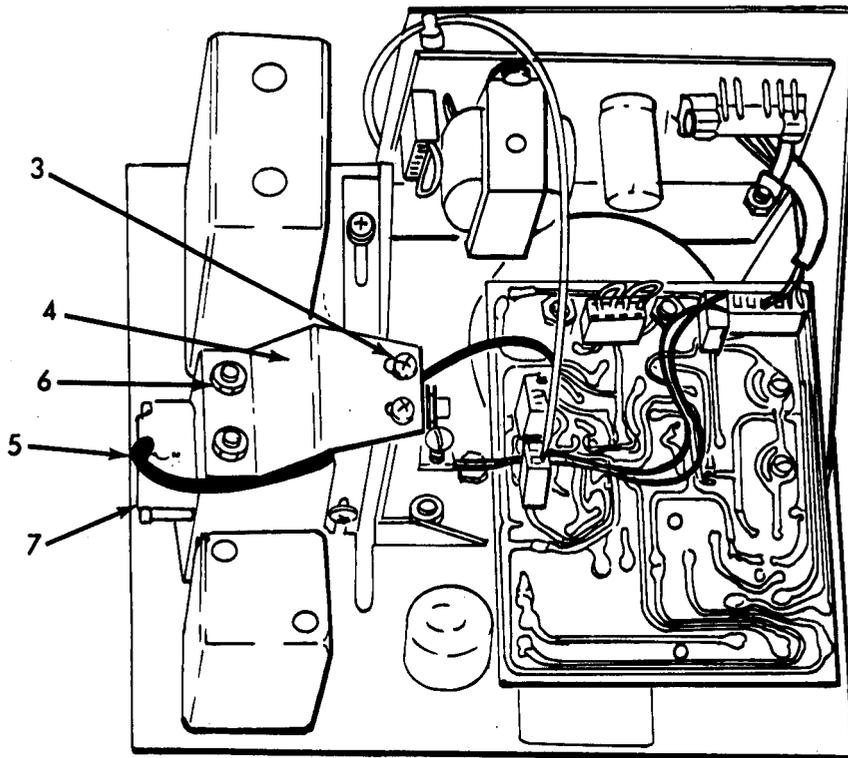
Table 4-1. Troubleshooting, Organizational - Continued

---

MALFUNCTION	
TEST/INSPECTION	
CORRECTIVE ACTION	

---

b. Disconnect power to instrument.



- c. Remove panel and lay it on a protective surface. Disconnect the photocell cable (1) from the amplifier circuit board (2) connection BC-2.
- d. Remove screws (3).
- e. Remove the stiffener bracket (4) to release the photocell cable (5).
- f. Remove nuts (6) then remove the photocell holder (7). The cell, cable and plug assembly will be replaced as an assembly.
- g. Place new assembly in holder, reassemble instrument in reverse order of disassembly.

Table 4-1. Troubleshooting, Organizational

MALFUNCTION  
TEST/INSPECTION  
CORRECTIVE ACTION

Step 2. Upon completion of the actions in step 1, without success, the trouble should be considered to be electrical. Refer to figure 4-1 for test point locations.



Some of the voltage checks must be made with ac power applied to the instrument. Use caution when performing these checks to avoid touching exposed leads and connections.

NOTE

A VOM rated at 20,000 ohms/volts DC, 5000 ohms/volts AC or better should be used.

Test Point	Location	Voltage	Probable Defect
TP1	Line Voltage Plug	110 Vdc or 220 Vdc	Fuse F-1
TP2	PowerCablePlug	8 Vdc (ac oper) 4.8 Vdc (batt)	Power Supply Board or Battery Pack
TP3	Amplifier Circuit Board	3 Vdc	Amplifier Circuit Board
TP4	Amplifier Circuit Board	2.75 Vdc	Amplifier Circuit Board
TP5	Lamp Cable Plug	Varies 0 to 4 Vdc with Range of Light Control	Amplifier Circuit Board

- a. Connect power sources. Turn instrument ON. If inoperative, disconnect power source.
- b. Conduct a visual check. Remove the panel from its case, place it upside down. Check the fuse F-1 (8) on the power supply board (9). Check each plug, connector and circuit board for proper connection. Use your nose as well as your eyes to locate possible burn areas.
- c. With VOM in ohms mode, check continuity of switches and connections for malfunctions and open circuits.

Table 4-1. Troubleshooting, Organizational

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
-------------	-----------------	-------------------

- |    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |  |
|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| d. | Meter check. Remove the shorting plug from the amplifier circuitboard connection BC3 (fig. 4-1). Set the VOM to the RX100 range and connect the VOM leads to the meter studs (+ to + and - to -). The meter should deflect full scale and the VOM should indicate approximately 40 ohms. Disconnect one lead and the meter should return smoothly to zero. If the meter is open (infinite resistance and does not deflect) or appears to stick at any point while returning to zero, it should be replaced. |  |
| e. | Circuit boards check. Replace shorting plug. Rig meter for battery operation. Install the battery pack cable on the BC and connect. The spectrophotometer circuit boards can be checked by taking voltage measurements at various key points. If the proper readings are not obtained, the applicable circuit board should be replaced. Most of the checks can be made with the instrument operating on battery power. This practice is recommended as a safety precaution.                                 |  |

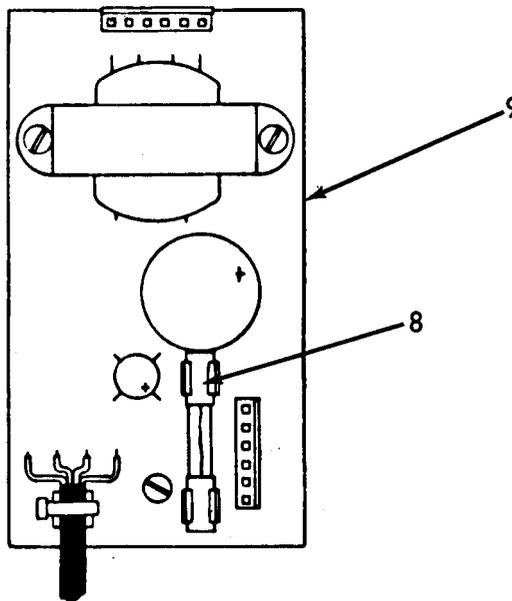
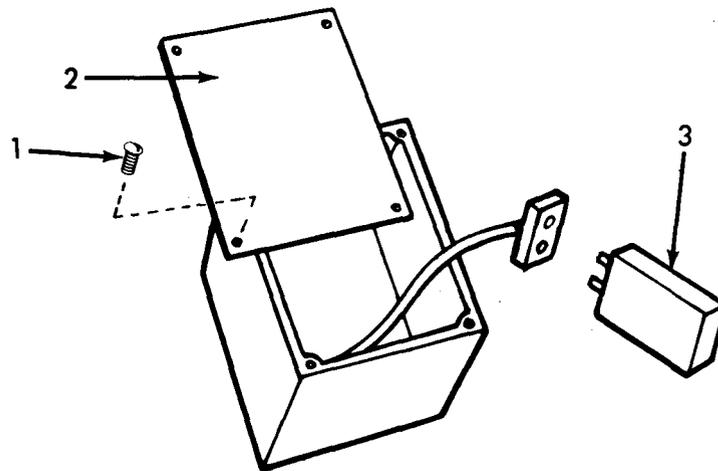


Table 4-1. Troubleshooting, Organizational

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
-------------	-----------------	-------------------

CONDUCTIVITY METER

2. METER NOT OPERATIVE



Step 1. Turn the master calibration control (accessible through a finger hole in the bottom) to maximum.

If the reading is less than full scale, remove screws (1) that attach the bottom plate (2) and replace the 9 volt zinc carbon type battery (3). Do not use a mercury or alkaline battery.

Step 2. The meter is a sealed unit with the battery compartment the only accessible area.

If general cleaning of terminals, probes and cell and replacing the battery does not correct the malfunction, the meter must be replaced.

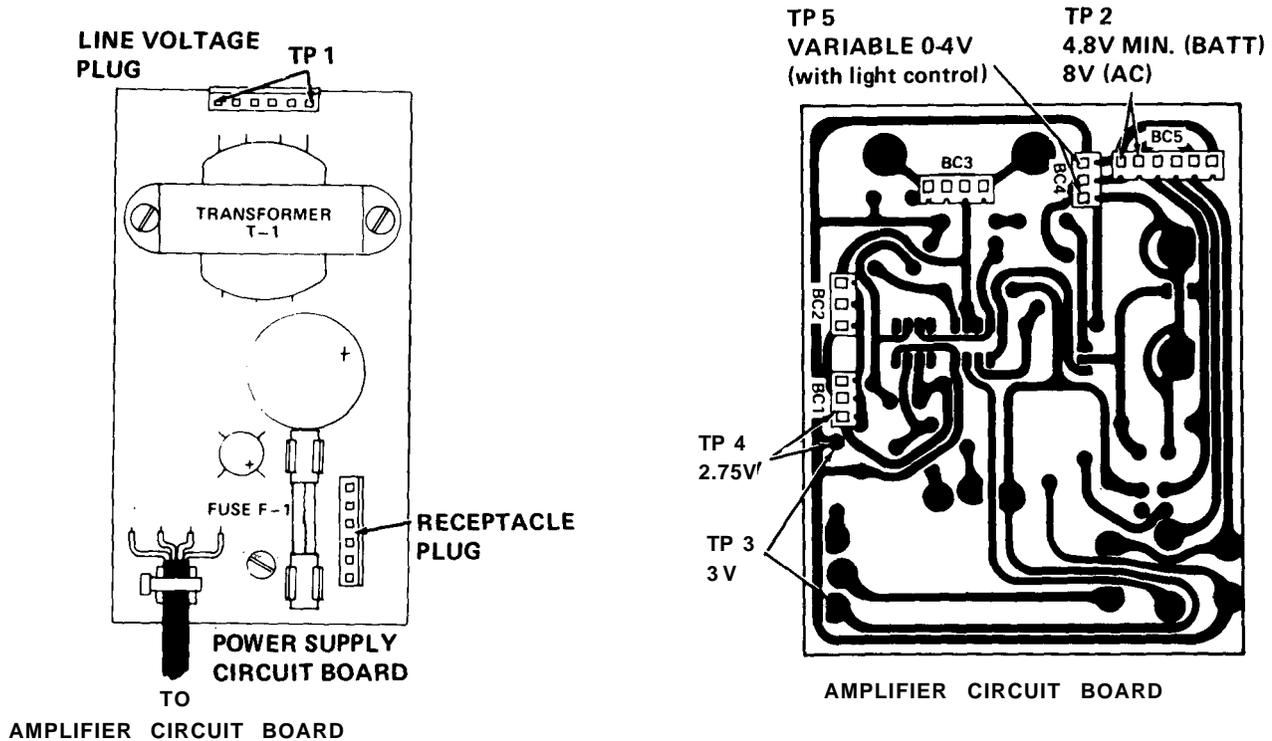
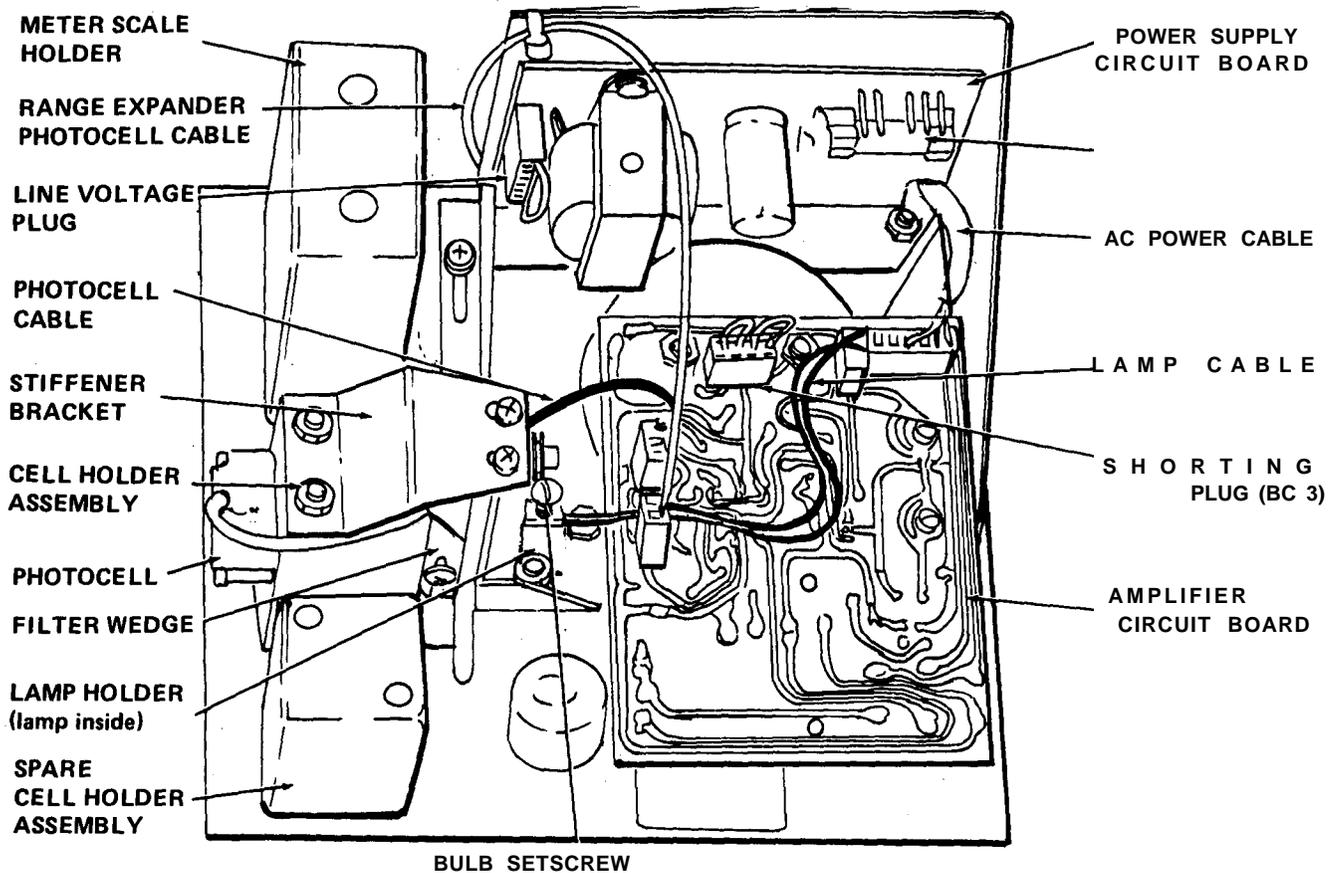


Figure 4-1. Spectrophotometer Circuit Board

## Section V. MAINTENANCE OF WOAS

## 4-8. RESPONSIBILITY.

The information contained in paragraph 4-6 applies to organization repair responsibilities. Those WOAS in stock, awaiting issue, shall be inspected monthly in accordance with the instructions in paragraph 4-1. Malfunctions noted shall be replaced or repaired as described in table 4-1.







## APPENDIX B

## MAINTENANCE ALLOCATION CHART

## Section I. INTRODUCTION

## B-1. GENERAL.

a. This section provides a general explanation of all maintenance and repair functions authorized at various maintenance levels.

b. The Maintenance Allocation Chart (MAC) in Section II designates that overall responsibility for the performance of maintenance functions on the identified end item or component. The implementation of the maintenance functions upon the end item or component will be consistent with the assigned maintenance functions.

co No special tools/tests are required for maintenance function.

## B-2. MAINTENANCE FUNCTIONS.

a. Inspect. To determine the serviceability of an item by comparing its physical, mechanical and/or electrical characteristics with established standards through examination.

b. Calibrate. To determine and cause corrections to be made or to be adjusted on instruments or test measuring and diagnostic equipment used in precision measurement. Consists of comparisons of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

c. Replace. The act of substituting a serviceable like type part, subassembly, or module (component or assembly) for an unserviceable counterpart.

d. Repair. The application of maintenance services or other maintenance actions to restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module (component or assembly), and item or system."

## B-3. COLUMN ENTRIES USED IN THE MAC.

Column 1, Group Number. Column 1 lists group numbers, the purpose of which is to identify components, assemblies, subassemblies, and modules with the next higher assembly.

b. Column 2, Component Assembly. Column 2 contains the names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. Column 3, Maintenance Functions. Column 3 lists the functions to be performed on the item listed in column 2. (For detailed explanation of these functions, see para B-2.)

d. Column 4, Maintenance Level. Column 4 specifies, by the listing of a work time figure in the appropriate subcolumn (s), the lowest level of maintenance authorized to perform the function listed in column 3. This figure represents the active time required to perform the maintenance function at the indicated level of maintenance. If the number or complexity of the tasks within the listed maintenance function vary at different maintenance levels, appropriate work time figures will be shown for each level. The number of manhours specified by the work time figure represents the average time required to restore an item (assembly, subassembly, component, module, end item or system) to a serviceable condition under typical field operation conditions. This time includes preparation time, troubleshooting time, and quality assurance/equality control time in addition to the time required to perform the specific tasks identified for the maintenance allocation chart. The symbol designations for the various maintenance levels are as follows:

- C-Operator Or Crew
- O-Organization Maintenance
- F-Direct Support Maintenance
- H-General Support Maintenance
- D-Depot Maintenance

e. Column 5, Tools and Equipment. Column 5 specifies by Code, those common tool sets (not individual tools) and special tools, TMDE and support equipment required to perform the designated function.

f. Column 6, Remarks. This column shall when applicable, contain a Letter Code, in Alphabetic Order, which will be keyed to the Remarks contained in Section IV.

Section II. MAINTENANCE ALLOCATION CHART

(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) *Maintenance Category					(5) Tools and Equipment	(6) Remarks
			C	O	F	H	D		
01	Case, Carrying	Inspect Repair Replace	0.2 0.2 0.2	0.5				1	
0101	Latches	Inspect Replace	0.1 0.1	0.5				1	
0102	Cutouts, Styrafoam and Flyleaf Inserts	Inspect Replace	0.5 0.1						
02	Meter, Dissolved Solids (Conductivity)	Inspect Repair Replace Calibrate	0.2 0.1 0.5 0.5	1.0				1, 2, 3	A
03	Spectrophotometer	Inspect Repair Replace Calibrate	0.2 0.1 0.5 0.5	1.0				1, 2, 3	B

\* Subcolumns are as follows:

C - Operator/Crew    O - Organizational    F - Direct Support    H - General Support    D - Depot

Section III. TOOL AND TEST EQUIPMENT  
REQUIREMENTS

(1) Refer- ence code	(2) Mainte- nance level	(3)  Nomenclature	(4)  National/NATO stock number	(5)  Tool number
1	0	Tool Kit, General Mechanics, Automotive	5180-00-177-7033	None
2	0	Kit, Soldering Gun, 115V, 60 Cycle, complete with solder and carrying case	3439-00-930-1638	None
3	0	Multimeter, 0 to 5000V	6625-00-998-6084	None

**Section IV. REMARKS**

Reference Code	Remarks
A	Meter must be checked and calibrated in accordance with the instructions in paragraph 2-21f(1)(b).
B	Sample Cells must be matched in accordance with the instructions in paragraph 2-17d.



## APPENDIX C

## COMPONENTS OF END ITEMS LIST

## Section I. INTRODUCTION

## C-1. SCOPE.

This appendix lists intergral components (COEIL) and basic issue items (BII) for the Water Quality Analysis Set (WQAS) to help you inventory items for safe and efficient operation. The (COEIL) is divided into two sections.

## C-2. GENERAL.

a. Section II. Intergral Components of the End Item (COEIL). These principal kits when assembled, comprise the entire Water Quality Analysis Set and must accompany it whenever it is transferred or turned in. Section IIA itemizes the sets and kits which make up the WQAS - Preventive Medicine complete set. Section IIB itemizes those kits which make up the WQAS - Engineer.

b. Section III. Basic Issue Items (BII) - Not applicable.

c. (DELETED)

## C-3. REPLACEMENT OF COMPONENTS.

This manual is your authority to requisition replacement items in order to meet operational requirements as specified in the PMCS for Readiness Reporting, based on Table of Organization and Equipment (TOE), and Modified Tables of Organization (MTOE).

## C-4. EXPLANATION OF COLUMNS (COEIL AND BII Form).

a. Illustration. This column is divided as follows:

(1) Figure Number. Indicates the figure number of the illustration on which the item is shown (if applicable).

(2) Item Number. The number used to identify item called out in the illustration.

b. National Stock Number (NSN). Indicates the National Stock Number which will be used for requisitioning.

c. Part Number (P/N). Indicates the primary number used by the manufacturer, which controls the design and characteristics of the item by means of its engineering drawings, specifications, standards, and inspection requirements to identify an item or range of items. 97403 is the Federal code identity of the Mobility Engineering Research and Development Command (MERADCOM).

d. Description. Indicates the Federal item name and, if required, a minimum description to identify the item.

e. Location. The physical location of each item listed is given in this column. The lists are designed to inventory all items in one area of the major item before moving on to an adjacent area. Example: The units contained in each kit are under one grouping.

f. Usable on Code. "Usable on" codes are included to help you identify which component items are used on the different sets. Identification of the codes used in these lists are:

Code	Used on
1	WQAS-Preventive Medicine
2	WQAS-Engineer

g. Quantity Required (Qty. Reqd). This column lists the quantity of each item required for a complete major item.

h. Quantity. This column is left blank for use during inventory. Under the Rcv'd column, list the quantity you actually received on your major item. The Date columns are for use when you inventory the major item at a later date: such as for shipment to another site.



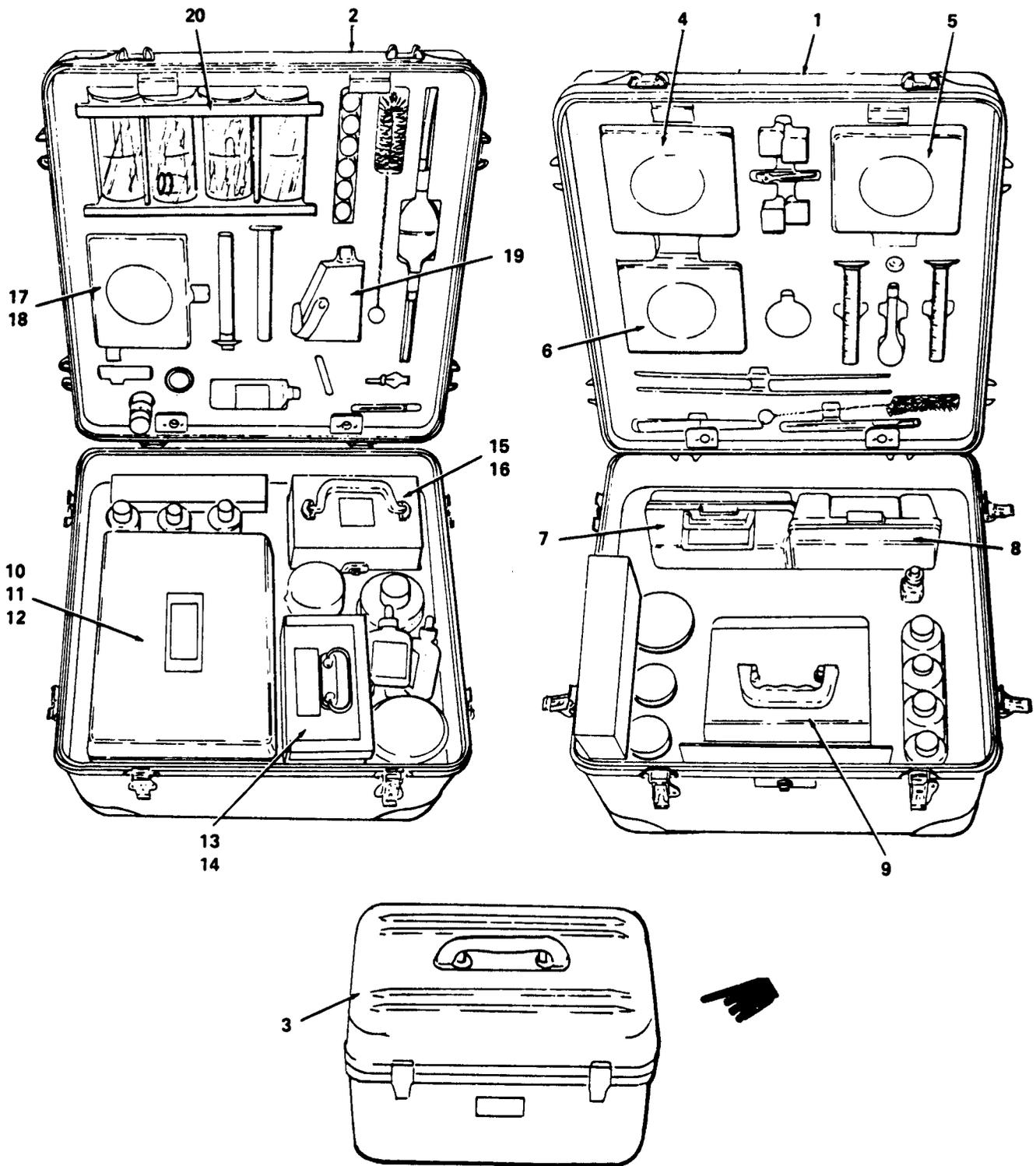


Figure C-1. Water Quality Analysis Sets

(1) ILLUSTRATION		(2)	(3)	(4)	(5)	(6)	(7)	(8) QUANTITY			
(a) FIGURE NO.	(b) ITEM NO.	NATIONAL STOCK NUMBER	PART NO. & FSCM	DESCRIPTION	LOCATION	USABLE ON CODE	QTY REQ'D	RCV'D	DATE	DATE	DATE
C-1	1	6630-00-140-7826	13222E0620 (97403) 13222E7900 (97403)	• Water Quality Analysis Set, Preventive Maintenance		1	1				
C-1	2	6630-00-140-7820	13222E0621 (97403)	• Water Quality Analysis Set, Engineer		2	1				
C-1	3	6665-00-682-4765	13222E7800 (97403) XX64-037-11 (08071)	• Water Test Kit, Bacterio- logical		1	1				

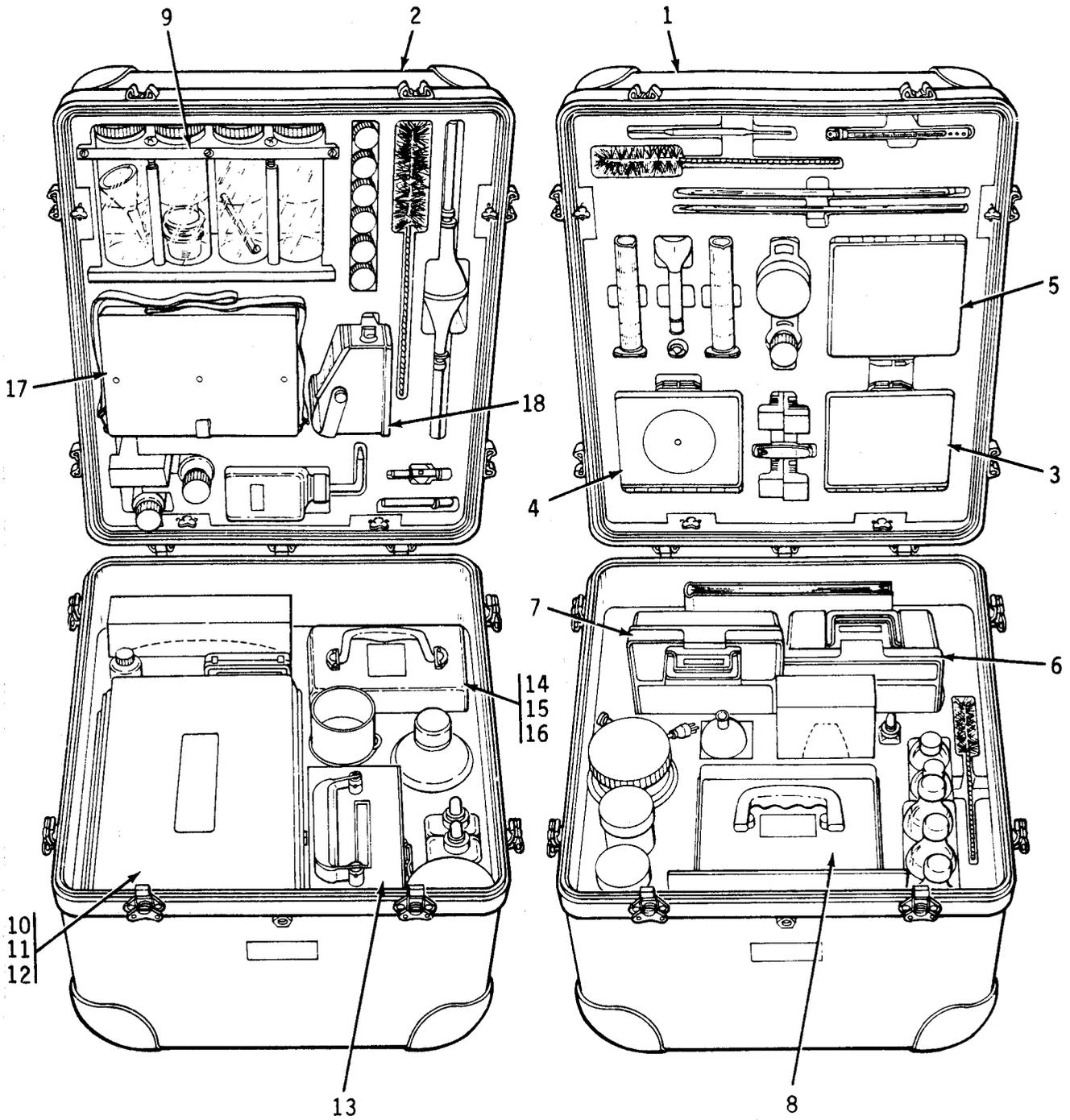
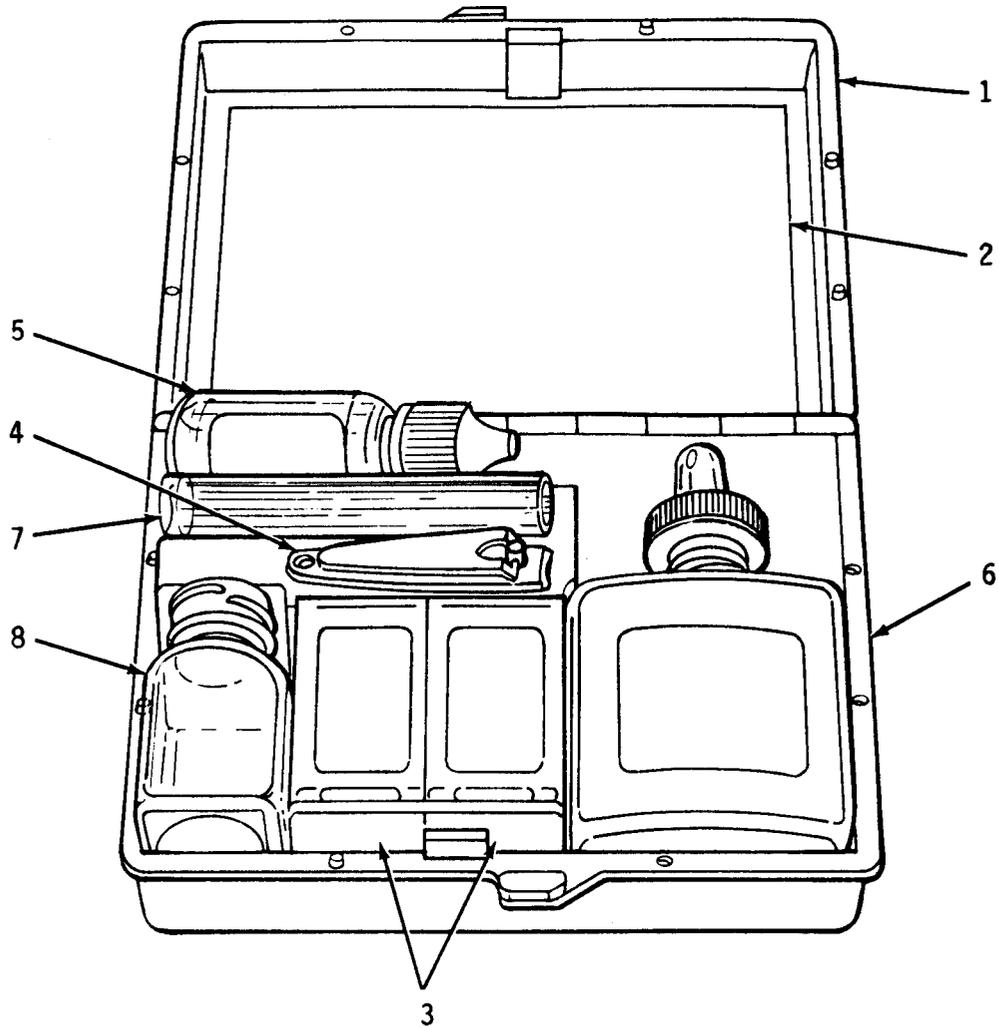


Figure C-1.1. Water Quality Analysis Sets (Not Used in Buys 1 and 2)

(1) ILLUSTRATION		(2)	(3)	(4)	(5)	(6)	(7)	(8) QUANTITY			
(a) FIGURE NO.	(b) ITEM NO.	NATIONAL STOCK NUMBER	PART NO. & FSCM	DESCRIPTION	LOCATION	USABLE ON CODE	QTY REQ'D	RCV'D	DATE	DATE	DATE
C-2		6630-01-026-5600	13222E0614 (97403) 13222E7890 (97403)	Acidity Test Kit		1	1				
C-2	1	6630-01-073-2984	13222E0759 (97403)	• Case, Polypropylene		1	1				
C-2	2		13222E0760 (97403)	• Instructions		1	1				
C-2	3	6810-00-798-9844	13222E0629 (97403)	• Indicator, Pillows, Brom-cresol Green Methyl-Red, 50 EA.		1	2				
C-2	4		13222E0628 (97403)	• Clippers, Small		1	1				
C-2	5	6810-00-798-9643	13222E0630 (97403)	• Indicator Solution, Phenolphthalein		1	1				
C-2	6	6810-01-071-3612	13222E0631 (97403)	• Sodium Hydroxide Standard Solution		1	1				
C-2	7		13222E0632 (97403)	• Measuring Tube, 5.38 ML							
C-2	8	6640-01-068-9153	13222E0627 (97403)	• Mixing Bottle, 15 ML		1	1				



*Figure C-2.1. Acidity Test Kit (Not Used in Buys 1 and 2)*

(1) ILLUSTRATION		(2)	(3)	(4)	(5)	(6)	(7)	(8) QUANTITY			
(a) FIGURE NO.	(b) ITEM NO.	NATIONAL STOCK NUMBER	PART NO. & FSCM	DESCRIPTION	LOCATION	USABLE ON CODE	QTY REQ'D	RCV'D	DATE	DATE	DATE
C-3		6630-01-035-1159	13222E0617 (97403) 13222E7896 (97403)	Ferric Iron Test Kit		1	1				
C-3	1	6630-01-073-2984	13222E0763 (97403)	• Case, Polypropylene		1	1				
C-3	2		13222E0764 (97403)	• Instructions		1	1				
C-3	3	6630-01-072-8704	13222E0655 (97403)	• Comparator, Color		1	1				
C-3	4	6630-01-071-1551	13222E0654 (97403)	• Adapter, Viewing		1	1				
C-3	5	6630-01-071-1772	13222E0659 (97403)	• Tubes, Viewing		1	2				
C-3	6	6640-01-071-1552	13222E0658 (97403)	• Stoppers; Tube		1	2				
C-3	7	6630-01-073-3021	13222E0656 (97403) 13222E7894 (97403)	• Color Disc (0-1.0 mg/l)		1	1				
C-3	8		13222E0628 (97403)	• Clippers, Small		1	1				
C-3	9	6810-01-008-3015	13222E0657 (97403) 13222E7897 (97403)	• Ferrover (Iron Reagent Powder Pillows) (25 ML Sample) 50 EA.		1	2				
C-3	10	6630-01-076-3913	13222E0713 (97403)	• Color Disc, (0-10.0 mg/l)		1	1				

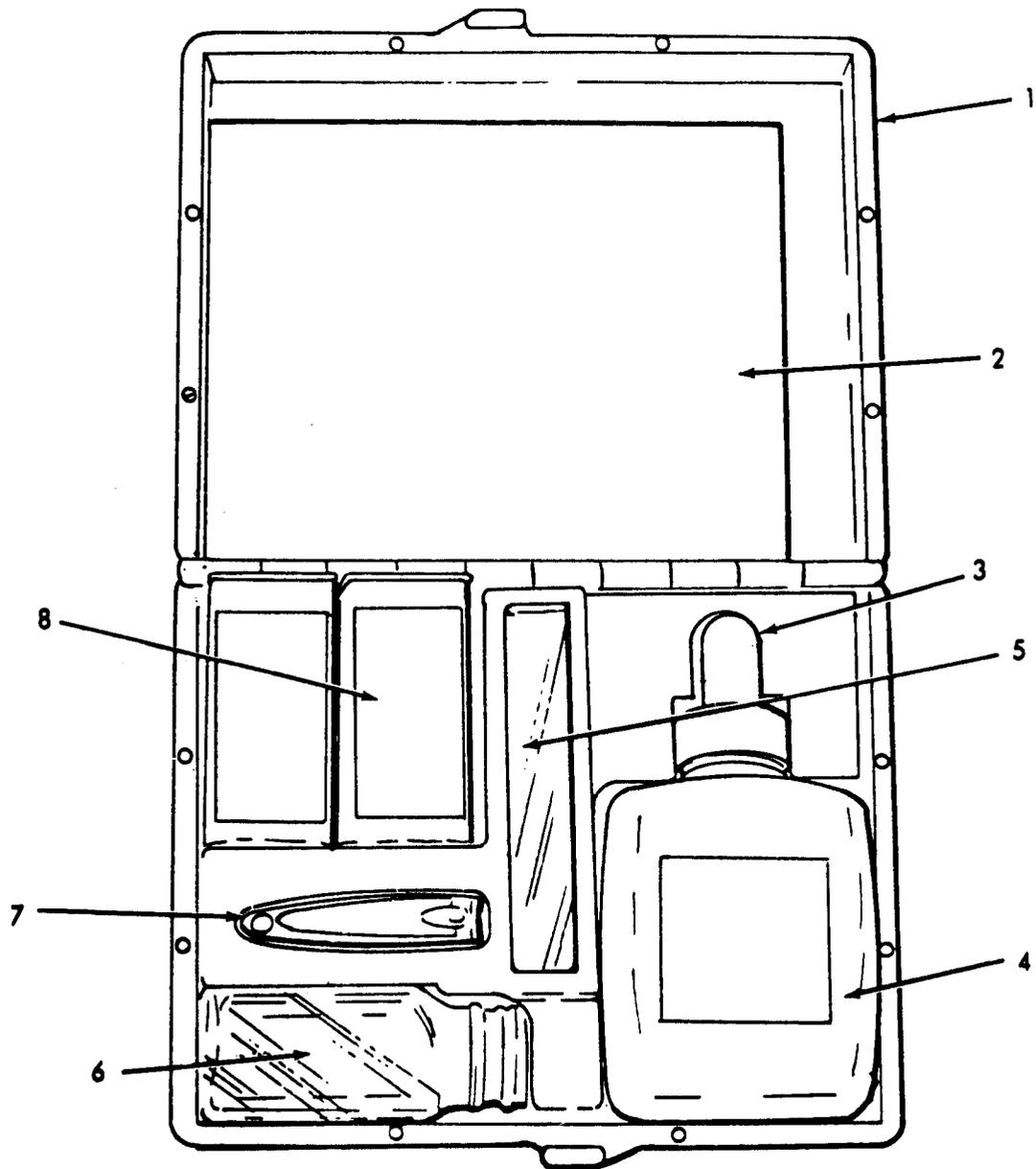


Figure C-4. High Range Chloride Test Kit

(1) ILLUSTRATION		(2)	(3)	(4)	(5)	(6)	(7)	(8) QUANTITY			
(a) FIGURE NO.	(b) ITEM NO.	NATIONAL STOCK NUMBER	PART NO & FSCM	DESCRIPTION	LOCATION	JSABLE ON CODE	QTY REQ	RCV	DATE	DATI	DATE
C-4		6630-01-060-1844	13222 (97403) 13222 (97403)	Chloride Test Kit (High Range)		1	1				
C-4	1	6630-01-073-2984	13222 (97403)	• Case, Polypropylene		1	1				
C-4	2		13222 (97403)	• Instructions		1	1				
C-4	3		13222 (97403)	• Dropper, Pipet		1	1				
C-4	4		13222 (97403)	• Chloride Titrant (Silver Nitrate) High Range		1	1				
C-4	5		13222E0632 (97403)	• Measuring Tube (5.83 ML)		1	1				
C-4	6	6640-01-068-9153	13222E0635 (97403)	• Bottle, Mixing		1	1				
C-4	7		13222E0628 (97403)	• Clippers, Small		1	1				
C-4	8	6810-00-798-9790	13222E0637 (97403)	• Chloride Indicator Pillows (50 ea.)		1	2				

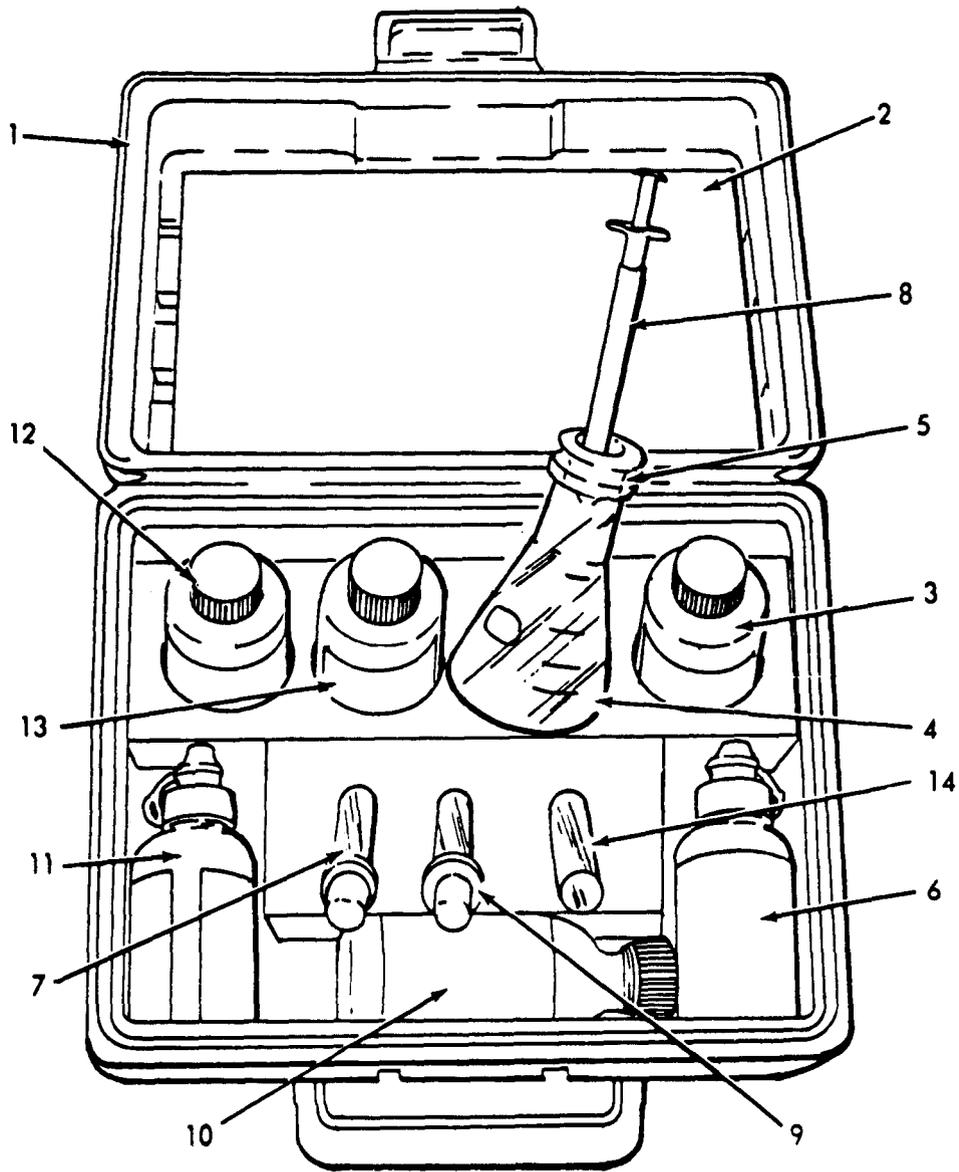


Figure C-5. Dissolved Oxygen Test Kit

(1) ILLUSTRATION		(2)	(3)	(4)	(5)	(6)	(7)	(8) QUANTITY			
(a) FIGURE NO.	(b) ITEM NO.	NATIONAL STOCK NUMBER	PART NO. & FSCM	DESCRIPTION	LOCATION	USABLE ON CODE	QTY REQ'D	RCV'D	DATE	DATE	DATE
C-5		6630-01-035-1160	13222 E0616 (97403) 13222 E7895 (97403)	Dissolved Oxygen Test Kit		1	1				
C-5	1	6640-01-070-3067	13222 E0765 (97403)	• Case, Polypropylene		1	1				
C-5	2		13222 E0766 (97403)	• Instructions		1	1				
C-5	3	6680-01-141-1460	13222 E0640 (97403)	• Acid, Sulfuric		1	1				
C-5	4		13222 E0644 (97403)	• Flask, Erlenmeyer, 50 ML		1	1				
C-5	5	6640-01-071-6710	13222 E0648 (97403)	• Stopper, Flask		1	1				
C-5	6	6810-01-070-0714	13222 E0645 (97403)	• Manganese Sulfate Solution		1	1				
C-5	7		13222 E0650 (97403)	• Dropper, Pipet, 0.5 ML		1	1				
C-5	8	6640-01-101-5644	13222 E0642 (97403)	• Burette, Micro		1	1				
C-5	9	6640-01-094-8349	13222 E0651 (97403)	• Dropper, Pipet 1.0 ML		1	1				
C-5	10	6810-01-070-1819	13222 E0647 (97403)	• Starch Solution		1	1				
C-5	11		13222 E0646 (97403)	• Alkaline Potassium Iodide Solution		1	1				
C-5	12	6640-01-093-3244	13222 E0641 (97403)	• Bottle, Sample		1	1				
C-5	13	6630-01-070-0715	13222 E0649 (97403)	• Sodium Thiosulfate Solution		1	1				
C-5	14		13222 E0643 (97403)	• Tube, Plastic		1	2				

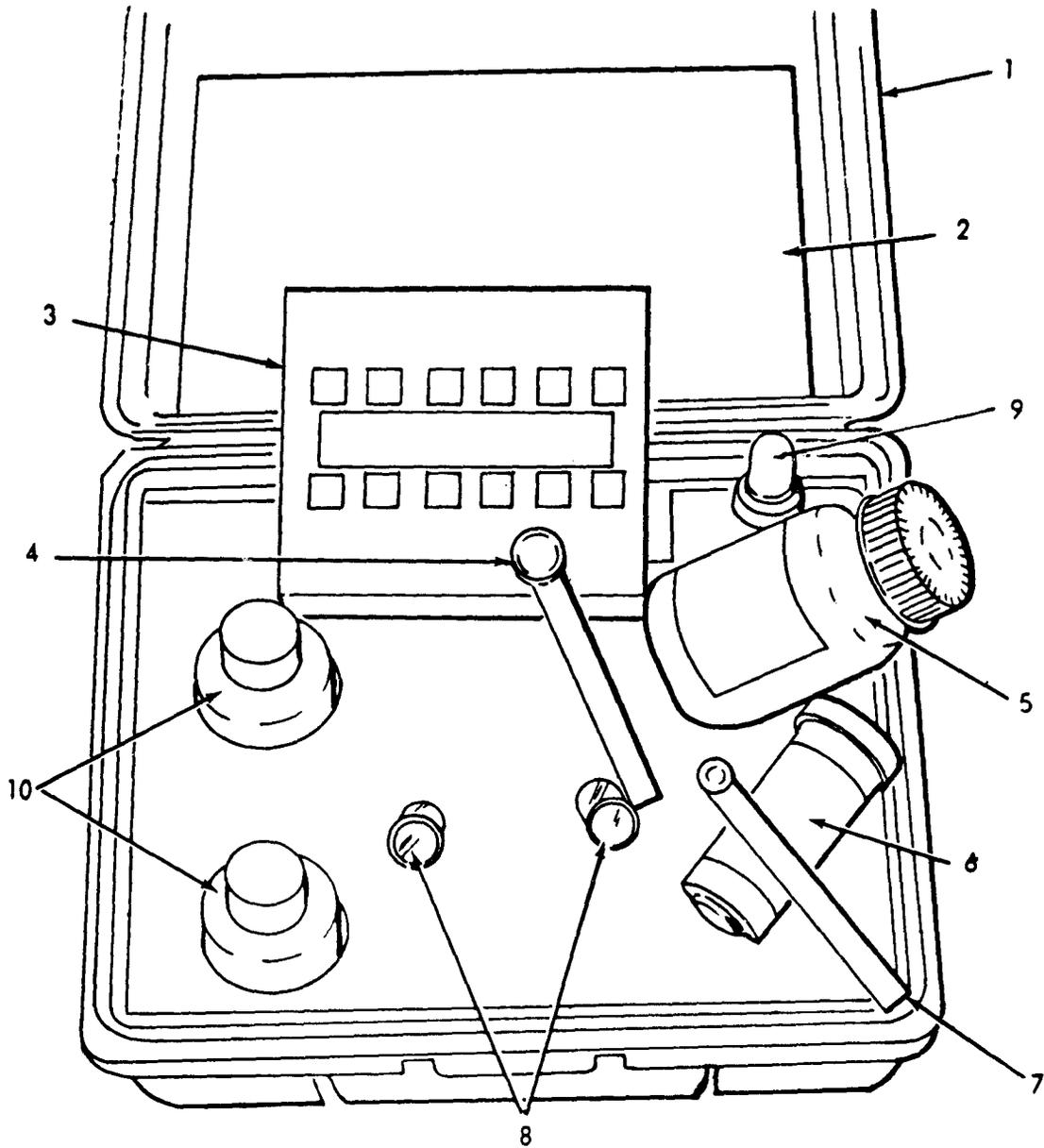
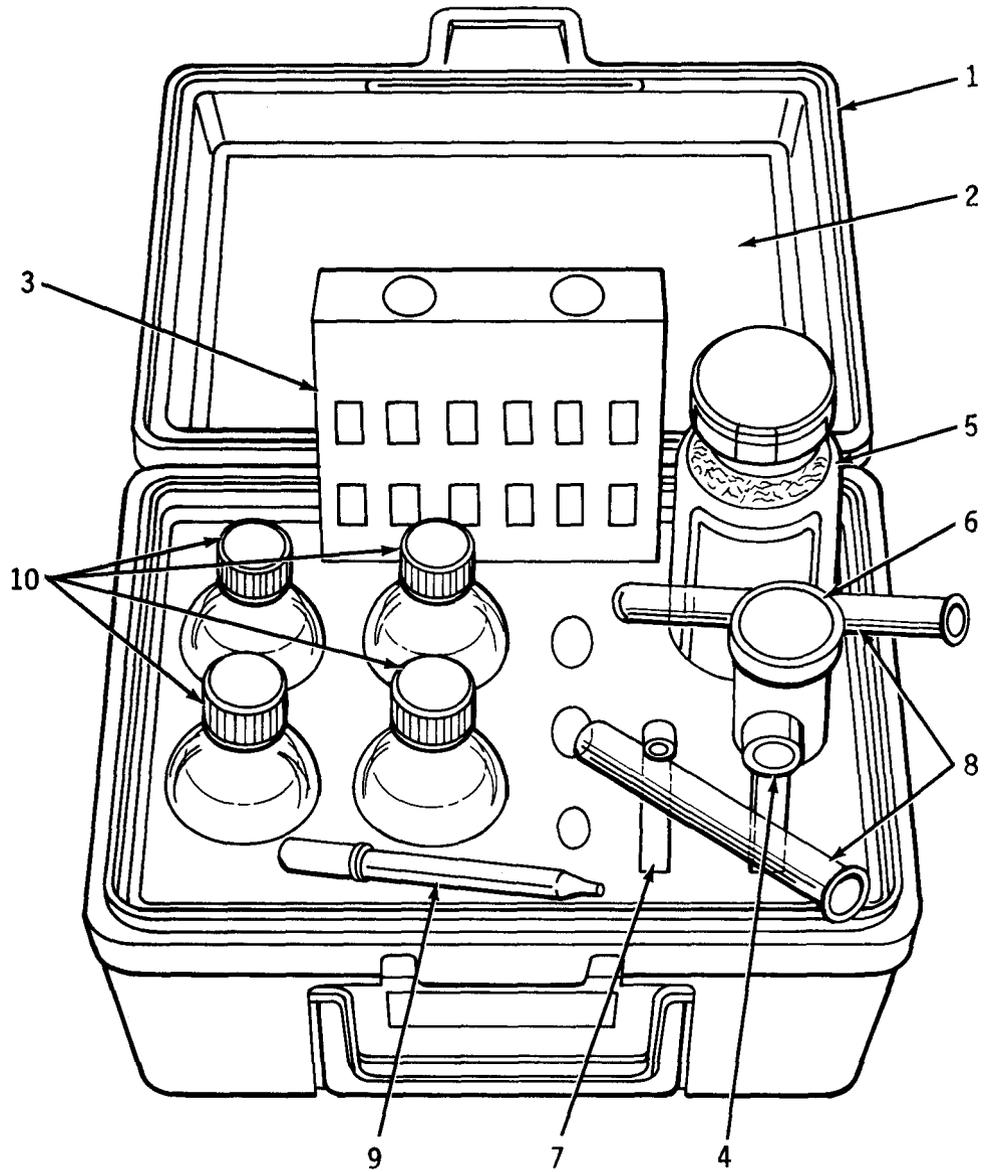


Figure C-6. Zinc Test Kit

(1) ILLUSTRATION		(2) NATIONAL STOCK NUMBER	(3) PART NO. & FSCM	(4) DESCRIPTION	(5) LOCATION	(6) USABLE ON CODE	(7) QTY RLQD	(8) QUANTITY			
(a) FIGURE NO.	(b) ITEM NO.							RCV'D	DATE	DATE	DATE
C-6		6630-01-026-4529	13222 E0618 (97403) 13222 E7915 (97403)	Zinc Test Kit		1	1				
C-6	1	6640-01-070-3067	13222 E0767 (97403)	● Case, Polypropylene		1	1				
C-6	2		13222 E0768 (97403)	● Instructions		1	1				
C-6	3	6630-01-071-2827	13222 E0662 (97403)	● Comparator, Color, 0-10 ppm Zinc		1	1				
C-6	4	6640-01-070-7877	13222 E0664 (97403)	● Spoon, Measuring, 0.5 gm		1	1				
C-6	5	6810-01-070-6483	13222 E0668 (97403)	● Zinc Reagent, 2 oz.		1	1				
C-6	6	6810-01-076-9571	13222 E0667 (97403)	● Zinc Conditioning Reagent, 5 gm		1	1				
C-6	7		13222 E0663 (97403)	● Spoon, Measuring, 0.05 gm		1	1				
C-6	8	6640-01-093-3289	13222 E0665 (97403)	● Tube, Test, 5 ml		1	1				
C-6	9		13222 E0651 (97403)	● Dropper, Pipet 1.0 ML		1	1				
C-6	10	6810-01-070-1784	13222 E0666 (97403)	● Water, Deionized, 2 oz.		1	2				
C-6	6		13222 E0643 (97403)	● Tube, Plastic		1	1				



*Figure C-6.1. Zinc Test Kit (Not Used in Buy 1)*

(1) ILLUSTRATION		(2)	(3)	(4)	(5)	(6)	(7)	(8) QUANTITY			
(a) FIGURE NO.	(b) ITEM NO.	NATIONAL STOCK NUMBER	PART NO. & FSCM	DESCRIPTION	LOCATION	USABLE ON CODE	QTY REQ'D	RCV'D	DATE	DATE	DATE
C-6.1		6630-01-026-4529	13222E7915 (97403) 66153-01-9 (53390)	Zinc Test Kit		1	1				
C-6.1	1	6630-01-070-3067	6309-01-8 (53390)	*Case, Polypropylene		1	1				
C-6.1	2			*Instructions		1	1				
C-6.1	3	6630-01-071-2827	6272-01-7 (53390)	*Comparator, Color, Block 0-10 mg/1		1	1				
C-6.1	4	6640-01-070-7877	6361-01-8 (53390)	*Spoon, Measuring, Plastic, 0.5 g		1	1				
C-6.1	5	6810-01-070-6483	6273-18-9 (53390)	*Zinc Reagent, 2 oz.		1	1				
C-6.1	6	6810-01-076-9571	6274-08-8 (53390)	*Zinc Conditioning Reagent, 5 g		1	1				
C-6.1	7	6640-01-125-5386	6358-01-5 (53390)	*Spoon, Measuring, Plastic, 0.05 g		1	1				
C-6.1	8	6640-01-093-3289	6977-01-3 (53390)	*Tube, Test, Glass, 5 ml		1	2				
C-6.1	9	6640-01-094-8349	7460-01-7 (53390)	*Pipet, Polyethylene, 1.0 ml		1	1				
C-6.1	10	6810-01-070-1784	6170-18-7 (53390)	*Water, Deionized, 2 oz.		1	4				

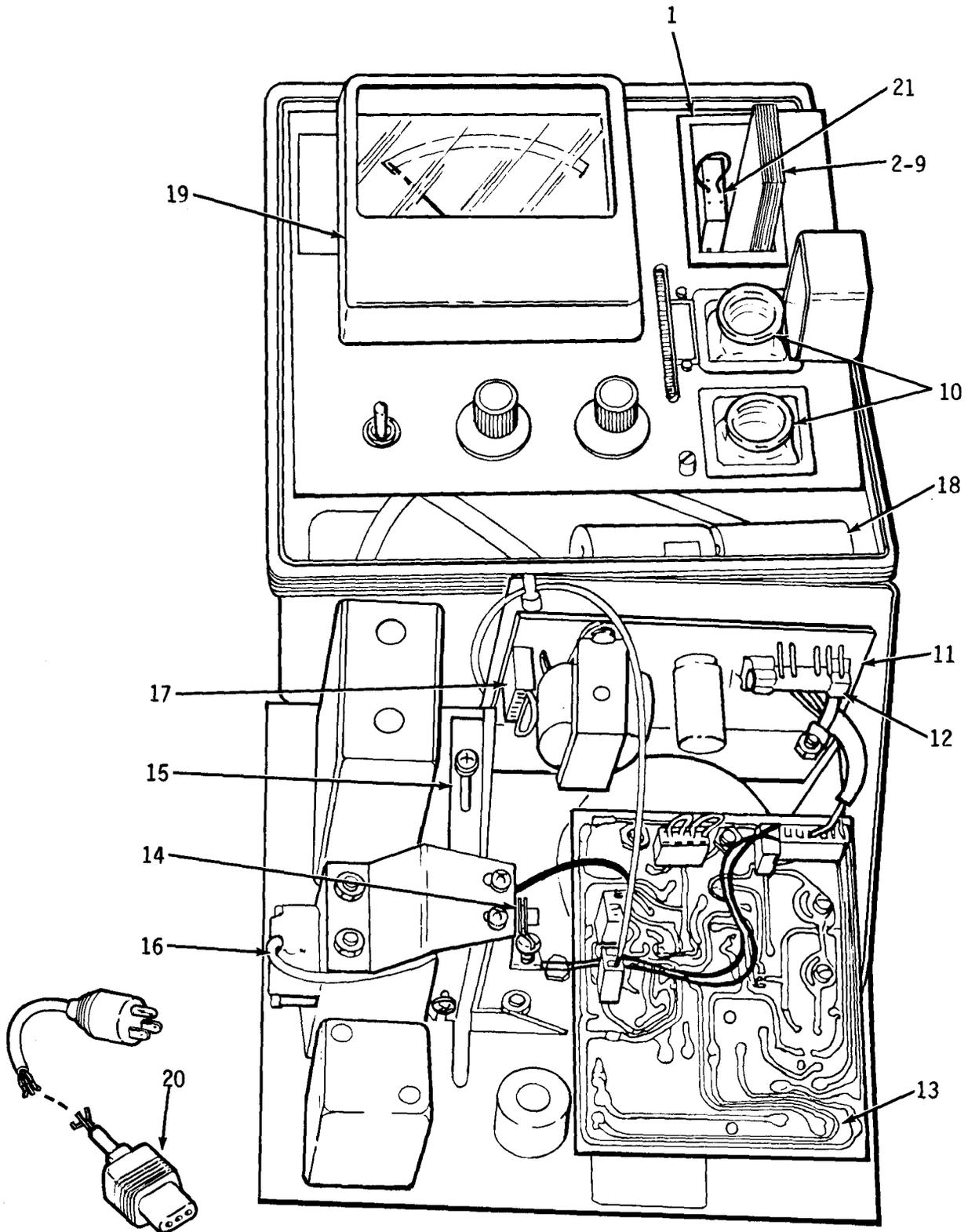


Figure C-7. Spectrophotometer

(1) ILLUSTRATION		(2) NATIONAL STOCK NUMBER	(3) PART NO. & FSCM	(4) DESCRIPTION	(5) LOCATION	(6) USABLE ON CODE	(7) QTY REQ'D	(8) QUANTITY			
(a) FIGURE NO.	(b) ITEM NO.							RCV'D	DATE	DATE	DATE
C-7		6650-01-012-3290	13222E0757 (97403) 13222E7912 (97403)	Spectrophotometer		1	1				
C-7	1		13222E0757-3 (97403)	• Holder, Meter Scale		1	1				
C-7	2		13222E0757-7 (97403)	• Scale, PH Wide Range		1	2				
C-7	3		13222E0757-8 (97403)	• Scale, Fluoride		1	2				
C-7	4	6630-01-072-8053	13222E0757-9 (97403)	• Scale, Iron		1	2				
C-7	5		13222E0757-10 (97403)	• Scale, Nitrogen-Ammonia		1	2				
C-7	6	6630-01-075-8734	13222E0757-11 (97403)	• Scale, Nitrogen-Nitrate		1	2				
C-7	7	6630-01-075-8735	13222E0757-12 (97403)	• Scale, Sulfate		1	2				
C-7	8		13222E0757-13 (97403)	• Scale, Turbidity		1	2				
C-7	9	6630-01-072-8052	13222E0757-16 (97403)	• Meter Scale, % Transmittance Absorbance		1	2				
C-7	10	6630-01-073-6029	13222E0757-15 (97403)	• Cell, Colorimeter Sample		1	2				
C-7	11		12600-25 (91224)	• Circuitboard, AC Power		1	1				
C-7	12	5920-00-281-0205	MIL-F-15160/2 (81349)	• Fuse Cartridge		1	3				
C-7	13		16706 (91224)	• Circuitboard Amplifier		1	1				
C-7	14	6630-01-125-5385	11493-33 (91224)	• Lamp Assembly Spectrophotometer		1	2				
C-7	15	6640-01-072-9829	13222E0757-5 (97403)	• Filter Wedge		1	1				

(1) ILLUSTRATION		(2) NATIONAL STOCK NUMBER	(3) PART NO. & FSCM	(4) DESCRIPTION	(5) LOCATION	(6) USABLE ON CODE	(7) QTY REQD	(8) QUAN	
(a) FIGURE NO.	(b) ITEM NO.							RCV'D	DATE
C-7	16	6625-01-071-3272	11446-23 (91224)	● Photocel 1 Assembly		1	1		
C-7	17		13222 E0757 -14 (97403)	● Plug, Line Voltage, 115V		1	1		
C-7	18		13222 E0757 -2 (97403)	● Battery, Size D, 1.5V		1	8		
C-7	19		9305-41 (91224)	● Meter, API, 503-S		1	1		
C-7	20	6150-01-073-5108	13222 E0757 -4 (97403)	● Cord, Power		1	1		
C-7	7	Not Illustrated	11687-56 (91224)	● Plug, Line Voltage: 220 V		1	1		

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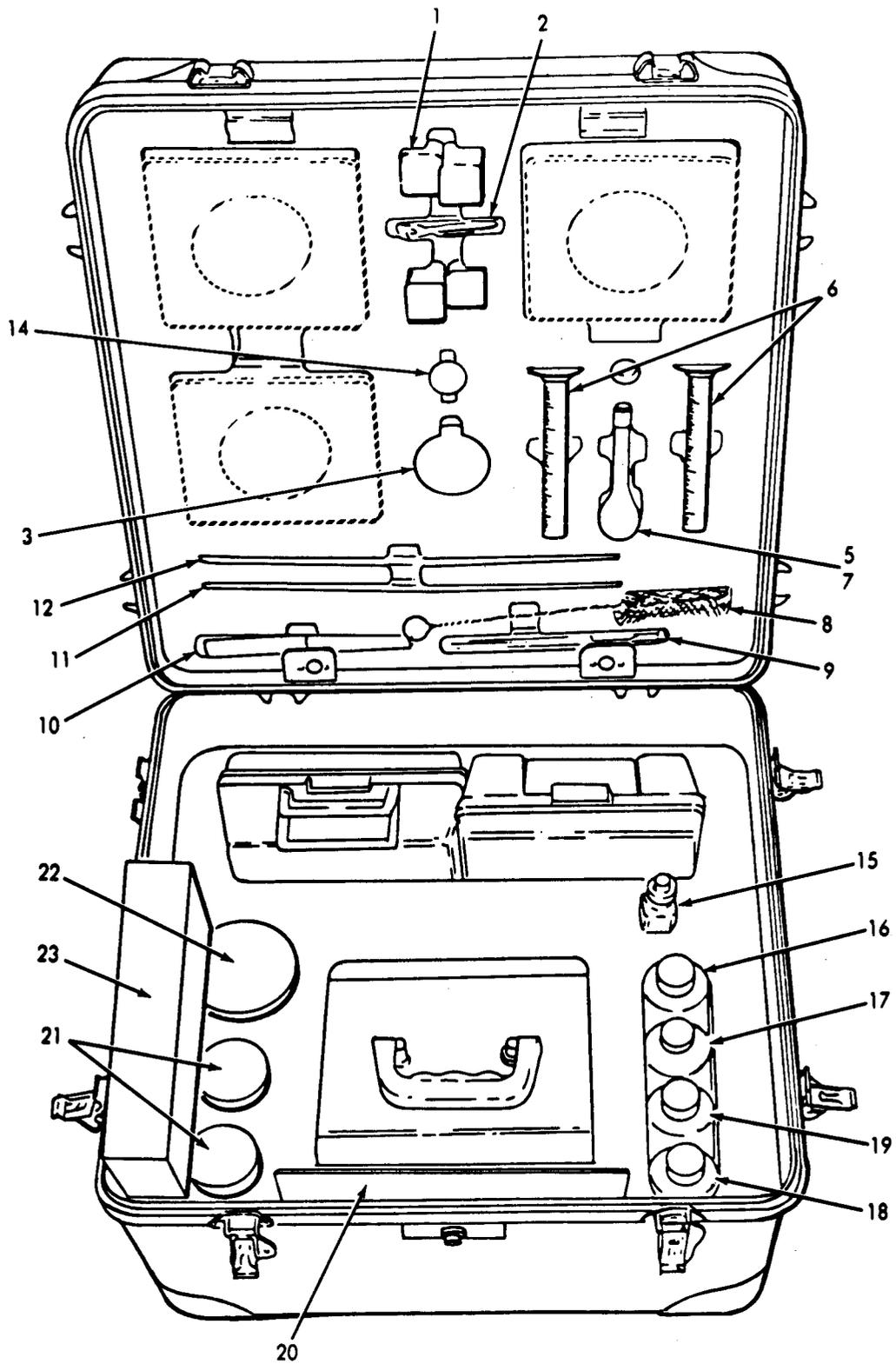


Figure C-8. Water Quality Analysis Set, Preventive Medicine

(1) ILLUSTRATION		(2)	(3)	(4)	(5)	(6)	(7)	(8) QUANTITY			
(a) FIGURE NO.	(b) ITEM NO.	NATIONAL STOCK NUMBER	PART NO. & FSCM	DESCRIPTION	LOCATION	USABLE ON CODE	QTY REQ'D	RCV'D	DATE	DATE	DATE
C-8		6630-00-140-7826	13222E0620 (97403) 13222E7900 (97403)	Water Quality Analysis Set, Preventive Medicine		1	1				
C-8	1	6810-01-070-1783	13222E0714 (97403) 13222E7898 (97403)	• Ferrover (Iron Reagent Power Pillows) (5 ml Samples)		1	2				
C-8	2	6630-00-127-4765	13222E0710 (97403) 13222E7893 (97403)	• Clippers, Large		1	1				
C-8	3	6810-01-012-6447	13222E0657 (97403) 13222E7897 (97403)	• Ferrous Iron Reagent Powder Pillows		1	2				
C-8	5&7	6640-01-120-0204	13222E0716 (97403) 13222E7902 (97403)	• Flask, Volumetric w/Stopper, 25 ml		1	1				
C-8	6	6640-00-339-0315	13222E0711 (97403) 13222E7781 (97403)	• Cylinder, Graduated, 25 ml		1	2				
C-8	8	7920-00-297-1510	13222E0709 (97403)	• Brush, Test Tube		1	2				
C-8	9	6640-00-024-0039	13222E0723 (97403) 13222E7909 (97403)	• Micro Pipet		1	1				
C-8	10	6685-00-174-6238	13222E0727 (97403) 13222E7914 (97403)	• Thermometer, Armored, -30 to +120 Deg. F		1	1				
C-8	11	6640-01-013-1865	13222E0722 (97403) 13222E7908 (97403)	• Pipet, Transfer, 5 ml		1	1				
C-8	12	6640-01-185-3179	13222E0721 (97403) 13222E7907 (97403)	• Pipet, Transfer, 1. ml		1	1				
C-8	13	6810-01-012-6447	13222E0715 (97403) 13222E7899 (97403)	• Powder Pillows: Ferrous Iron (100 ea)		1	1				

(1) ILLUSTRATION		(2) NATIONAL STOCK NUMBER	(3) PART NO. & FSCM	(4) DESCRIPTION	(5) LOCATION	(6) USABLE ON CODE	(7) QTY REQ'D	(8) QUANTITY			
(a) FIGURE NO.	(b) ITEM NO.							RCV'D	DATE	DATE	DATE
C-8	14		13222E0712 (97403) 13222E7782 (97403)	• Detergent, 1 oz.		1	1				
C-8	15	6810-01-011-7191	13222E0725 (97403) 13222E7911 (97403)	• Salt Solution, Rochelle 1 oz. Bottle		1	1				
C-8	16	6810-01-012-0899	13222E0717 (97403) 13222E7903 (97403)	• Fluoride Solution, Standard 8 oz. Bottle		1	1				
C-8	17	6810-01-010-3168	13222E0718 (97403) 13222E7904 (97403)	• Fluoride Solution, SPADNS, 8 oz. Bottle		1	1				
C-8	18	6810-01-105-1427	13222E0719 (97403) 13222E7905 (97403)	• Indicator Solution, PH Wide Range		1	1				
C-8	19	6810-01-011-7192	13222E0724 (97403) 13222E7910 (97403)	• Reagent Test Solution, Nessler's APHA 8 oz.		1	1				
C-8	20		13222E0784 (97403) 13222E7917 (97403)	• Loading Plan		1	1				
C-8	20		13222E0783 (97403) 13222E7916 (97403)	• Instruction Card, Spectrophotometer		1	1				
C-8	21	6810-01-013-2685	13222E0726 (97403) 13222E7913 (97403)	• Powder Pillows Sulfate Test, 50 ea.		1	2				
C-8	22	6810-01-011-7193	13222E0720 (97403) 13222E7906 (97403)	• Powder Pillows Nitrate Test, 100 ea.		1	1				
C-8	23	8540-00-459-2385	13222E0728 (97403) 13222E7798 (97403)	• Tissue, Facial, 100 ea.		1	1				
		6640-00-976-2446	13222E7901 (97403)	• Filler, Safety Pipet		1	1				

(1) ILLUSTRATION		(2) NATIONAL STOCK NUMBER	(3) PART NO. & FSCM	(4) DESCRIPTION	(5) LOCATION	(6) USABLE ON CODE	(7) QTY REQD	(8) QUANTITY			
(a) FIGURE NO.	(b) ITEM NO.							RCV'D	DATE	DATE	DATE
		7920-00-282-7784	3-574 (22527)	● Brush, Test Tube 3/4 in		1	1				
		8145-01-077-6891	13222 E0787 -1 (97403)	● Case, Transit and Storage (Preventive Medicine - WQAS)		1	1				
			13222 E7891 (97403)								
			13222 E0790 (97403)	●● Insert Foam, #1 TOP		1	1				
			1322 E0791 (97403)	●● Insert Foam, #2 TOP		1	1				
			13222 E0792 (97403)	●● Insert Foam, #3 TOP		1	1				
			NPN (19099)	●● Insert, Foam, #4 TOP		1	1				
			13222 E0797 (97403)	●● Insert, Fly Leaf		1	2				
			13222 E0793 (97403)	●● Insert, Foam, #1 BOTTOM		1	1				
			13222 E0794 (97403)	●● Insert, Foam, #2 BOTTOM		1	1				
			13222 E0795 (97403)	●● Insert, Foam, #3 BOTTOM		1	1				
			13222 E0796 (97403)	●● Insert, Foam #4 BOTTOM		1	1				
			NPN (19099)	●● Insert, Foam, #5 BOTTOM		1	1				

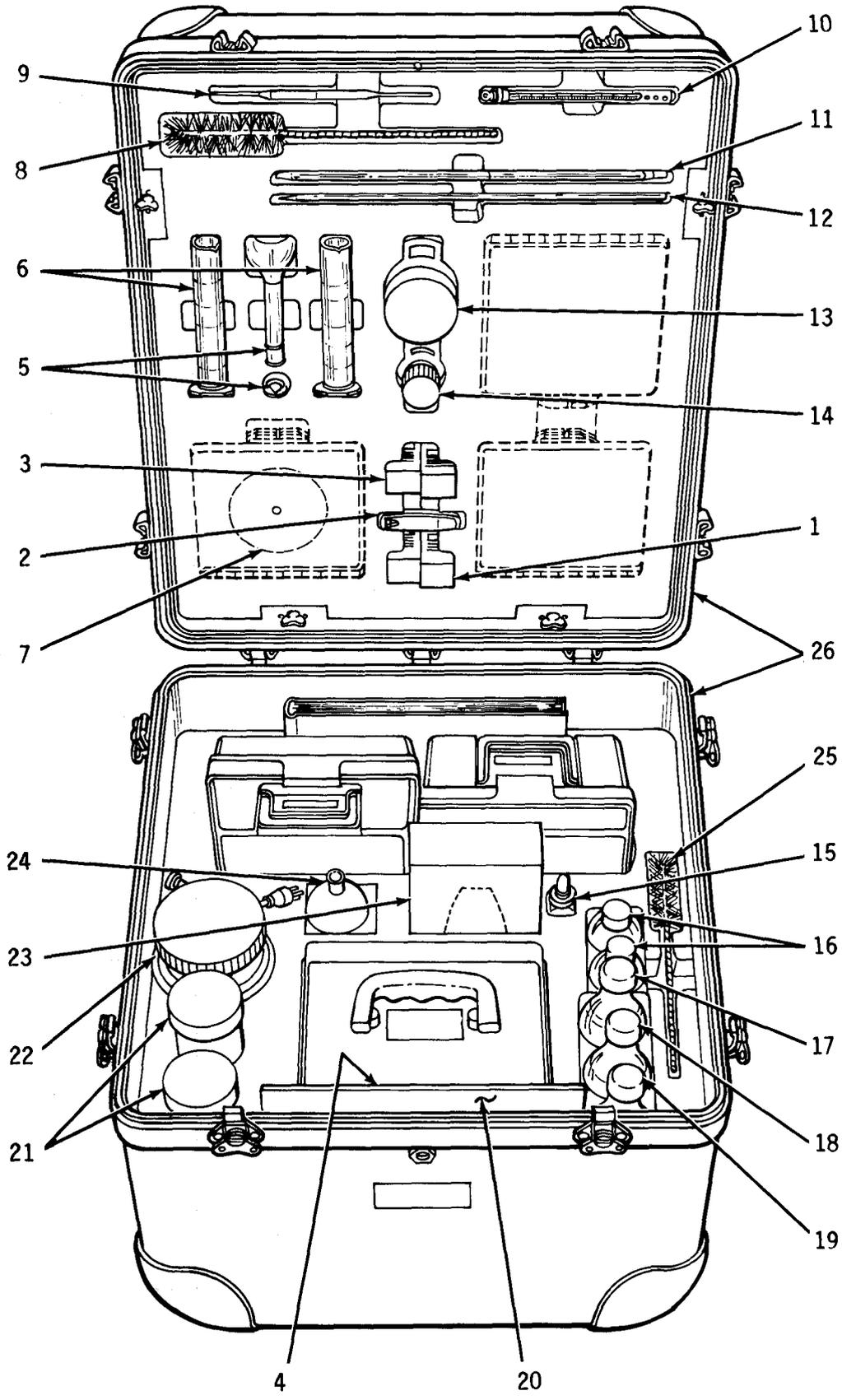


Figure C-8.1. Water Quality Analysis Set - Preventive Medicine. Labware and Support Items (Not Used in Buys 1 and 2)

(1) ILLUSTRATION		(2) NATIONAL STOCK NUMBER	(3) PART NO. & FSCM	(4) DESCRIPTION	(5) LOCATION	(6) USABLE ON CODE	(7) QTY REQ'D	(8) QUANTITY			
(a) FIGURE NO.	(b) ITEM NO.							RCV'D	DATE	DATE	DATE
C-8.1		6630-00-140-7826	13222E7900 (97403)	Water Quality Analy- sis Set, Preventive Medicine		1	1				
C-8.1	1	6810-01-070-1783	13222E7898 (97403)	●Ferric Iron Reagent (5 ml sample)		1	2				
C-8.1	2	6630-00-127-4765	13222E7893 (97403)	●Clipper, Large		1	1				
C-8.1	3	6810-01-008-3015	13222E7897 (97403)	●Ferric Iron Reagent (25 ml Sample)		1	2				
C-8.1	4	6630-01-119-7523	13222E7917 (97403)	●Loading Diagram		1	1				
C-8.1	5	6640-01-120-0204	13222E7902 (97403)	●Flask, Volumetric		1	1				
C-8.1	6	6640-00-339-0315	13222E7781 (97403)	●Cylinder, Graduated 25 ml		1	2				
C-8.1	7	6630-01-073-3021	13222E7894 (97403)	●Disc, Color, Iron		1	1				
C-8.1	8	7920-00-297-1510	H-B-1051 (81348)	●Brush, Test Tube, Type I, Style A, Class 1, Size 1-1/2		1	1				
C-8.1	9	6640-00-024-0040	13222E7909 (97403)	●Pipette, Micro		1	1				
C-8.1	10	6685-00-174-6238	13222E7914 (97403)	●Thermometer, Armored		1	1				
C-8.1	11	6640-01-013-1865	13222E7908 (97403)	●Pipette, 5.0 ml		1	1				
C-8.1	12	6640-01-185-3179	13222E7907 (97403)	●Pipette, 1.0 ml		1	1				
C-8.1	13	6810-01-012-6447	13222E7889 (97403)	●Ferrous Iron Reagent		1	1				

(1) ILLUSTRATION		(2) NATIONAL STOCK NUMBER	(3) PART NO. & FSCM	(4) DESCRIPTION	(5) LOCATION	(6) USABLE ON CODE	(7) QTY REQ'D	(8) QUANTITY			
(a) FIGURE NO.	(b) ITEM NO.							RCV'D	DATE	DATE	DATE
C-8.1	14	6640-01-136-2083	13222E7782 (97403)	●Detergent		1	1				
C-8.1	15	6810-01-011-7191	13222E7911 (97403)	●Reagent, Rochelle salt		1	1				
C-8.1	16	6640-01-105-1427	13222E7790 (97403)	●Indicator Solution, pH		1	2				
C-8.1	17	6810-01-012-0899	13222E7903 (97403)	●Fluoride Reagent		1	1				
C-8.1	18	6640-01-105-1428	13222E7904 (97403)	●Fluoride Reagent Solution, SPADNS		1	1				
C-8.1	19	6810-01-107-8314	13222E7910 (97403)	●Reagent, Nessler's		1	1				
C-8.1	20		13222E7916 (97403)	●Card		1	1				
C-8.1	21	6810-01-013-2685	13222E7913 (97403)	●Reagent, Sulfate Test		1	2				
C-8.1	22	6810-01-011-7193	13222E7906 (97403)	●Reagent, Nitrate, Test		1	1				
C-8.1	23	8540-00-793-5425	13222E7798 (97403)	●Tissue, Facial		1	1				
C-8.1	24	6640-00-976-2446	13222E7901 (97403)	●Filler, Safety, Pipette		1	1				
C-8.1	25	7920-00-282-7784	H-B-1051 (81348)	●Brush, Test Tube, CRES, Wire Handle, Type I, Style A Class 2, Size 3/4		1	1				
C-8.1	26	8115-01-121-0760	13222E7892 (97403)	Case, transit and storage		1	1				

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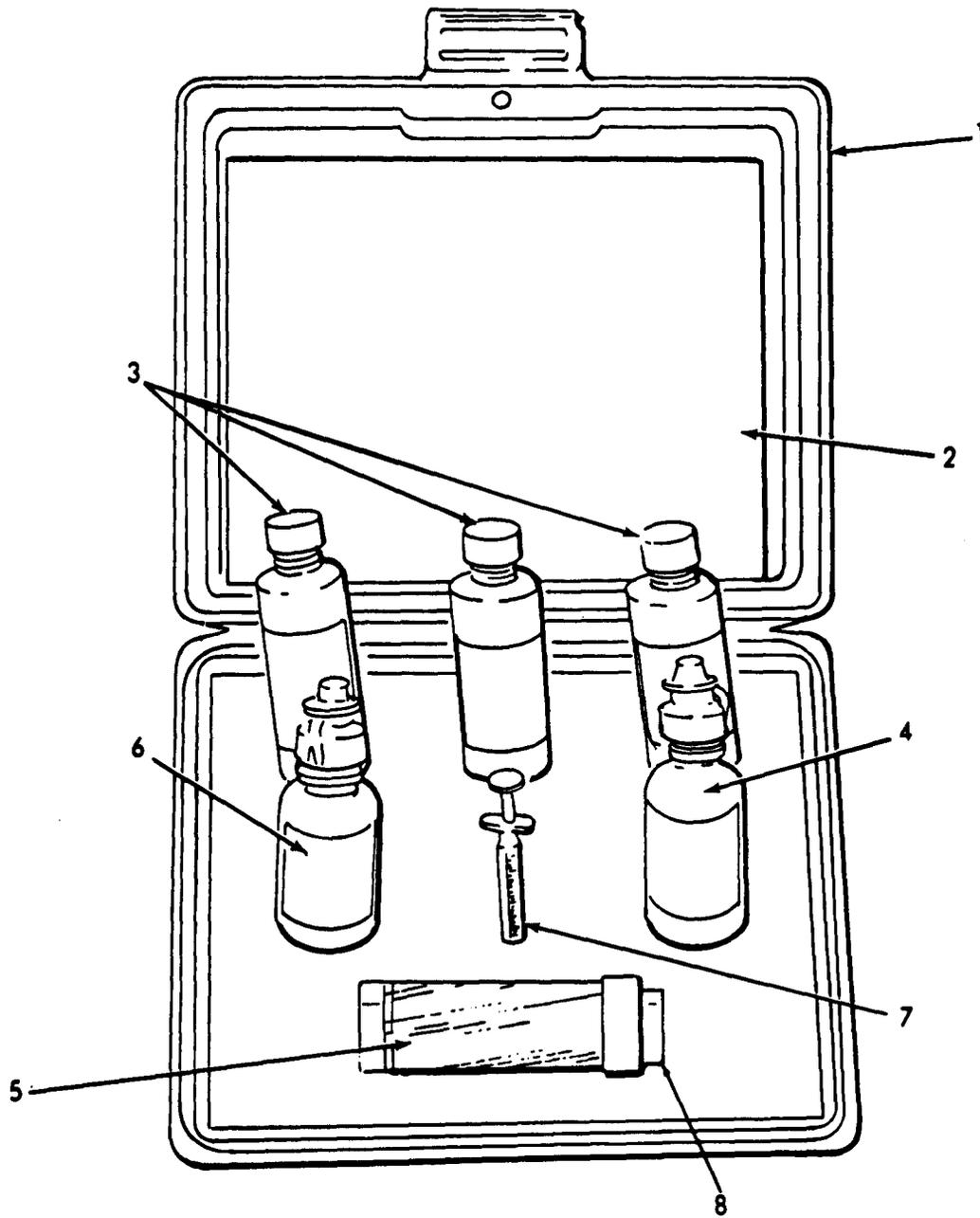


Figure C-9. Alkalinity Test Kit

(1) ILLUSTRATION		(2) NATIONAL STOCK NUMBER	(3) PART NO. & FSCM	(4) DESCRIPTION	(5) LOCATION	(6) USABLE OR CODE	(7) QTY REQD	(8) QUANTITY			
(a) FIGURE NO.	(b) ITEM NO.							RCV'D	DATE	DATE	DATE
C-9		6630-01-047-9316	13222 E0619 (97403) 13222 E7772 (97403)	Alkalinity Test Kit		2	1				
C-9	1	6630-01-070-3067	13222 E0769 (97403)	● Case, Polypropylene		2	1				
C-9	2		13222 E0770 (97403)	● Instructions		2	1				
C-9	3	6810-01-084-3648	13222 E0671 (97403)	● Alkalinity Titration Reagent, (Sulfuric Acid Standard)		2	3				
C-9	4	6630-01-071-5910	13222 E0672 (97403)	● Indicator, Total Alkalinity		2	1				
C-9	5		13222 E0674 (97403)	● Tube, Sample, 10 ML		2	1				
C-9	6		13222 E0673 (97403)	● Indicator Solution, Phenolphthalein		2	1				
C-9	7	6640-01-101-5644	13222 E0642 (97403)	● Burette, Micro		2	1				
C-9	8		3-15-04500 (53390)	● Tube, Storage		2	1				

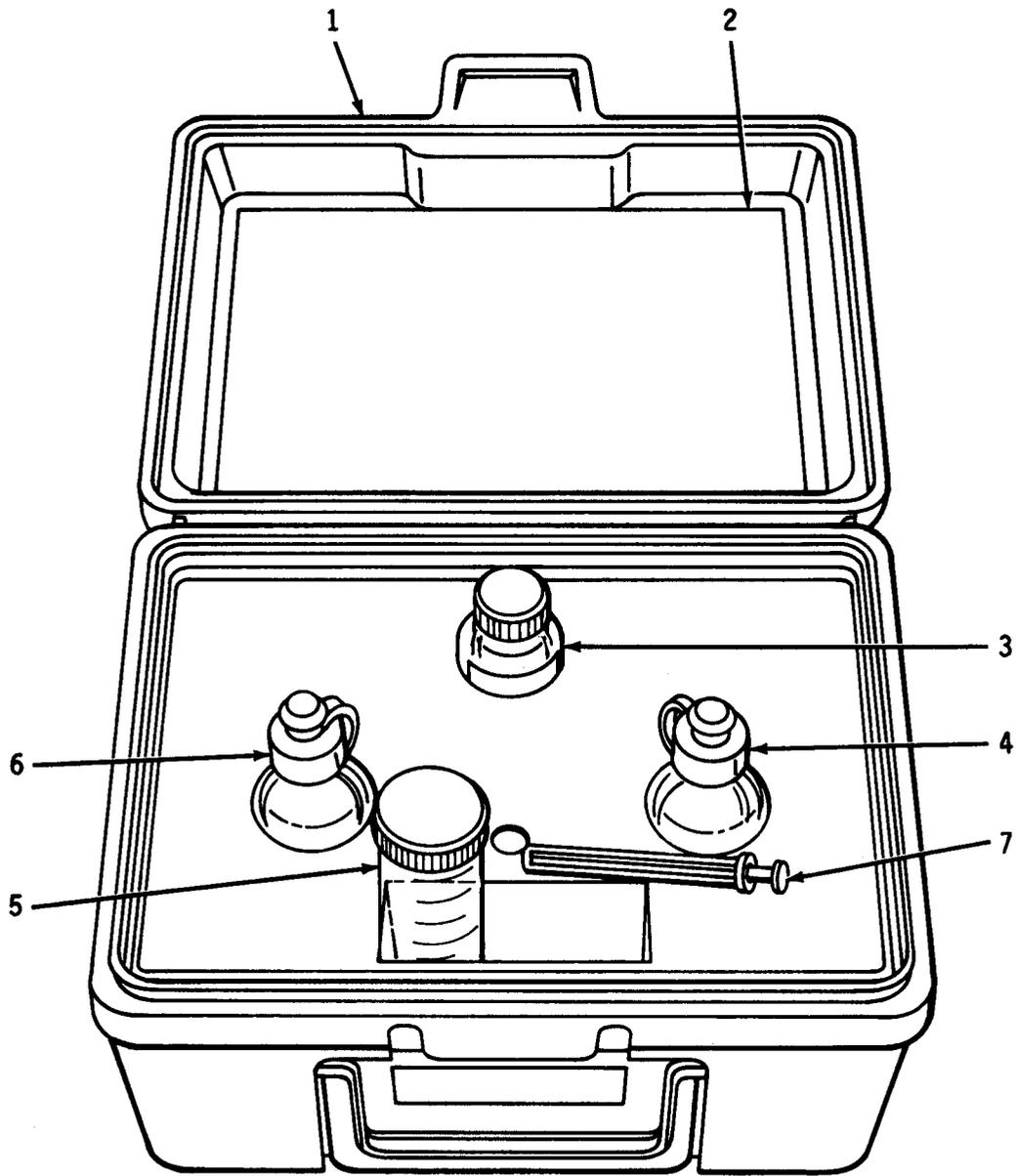


Figure C-9.1. Alkalinity Test Kit (Not Used in Buys 1 and 2)

(1) ILLUSTRATION		(2)	(3)	(4)	(5)	(6)	(7)	(8) QUANTITY			
(a) FIGURE NO.	(b) ITEM NO.	NATIONAL STOCK NUMBER	PART NO. & FSCM	DESCRIPTION	LOCATION	USABLE ON CODE	QTY REQ'D	RCV'D	DATE	DATE	DATE
C-9.1		6630-01-047-9316	7525-01-9 (53390)	Test Kit, Alkalinity		2	2				
C-9.1	1	6630-01-070-3067	6309-01-8 (53390)	*Case, Polypropylene		2	2				
C-9.1	2			*Instructions		2	2				
C-9.1	3	6810-01-084-3648	6158-18-3 (53390)	*Reagent, Alkalinity Titration, 2 oz.		2	2				
C-9.1	4	6630-01-071-5910	6156-17-9 (53390)	*Indicator, Total Alkalinity		2	2				
C-9.1	5		3634-01-2 (53390)	*Tube, Graduated, 10 ml		2	2				
C-9.1	6	6810-01-113-3149	0311-17-5 (53390)	*Indicator, Phenolphthalein, 1 oz		2	2				
C-9.1	7	6640-01-101-5644	6306-01-4 (53390)	*Burette, Mini, Polypropylene		2	2				

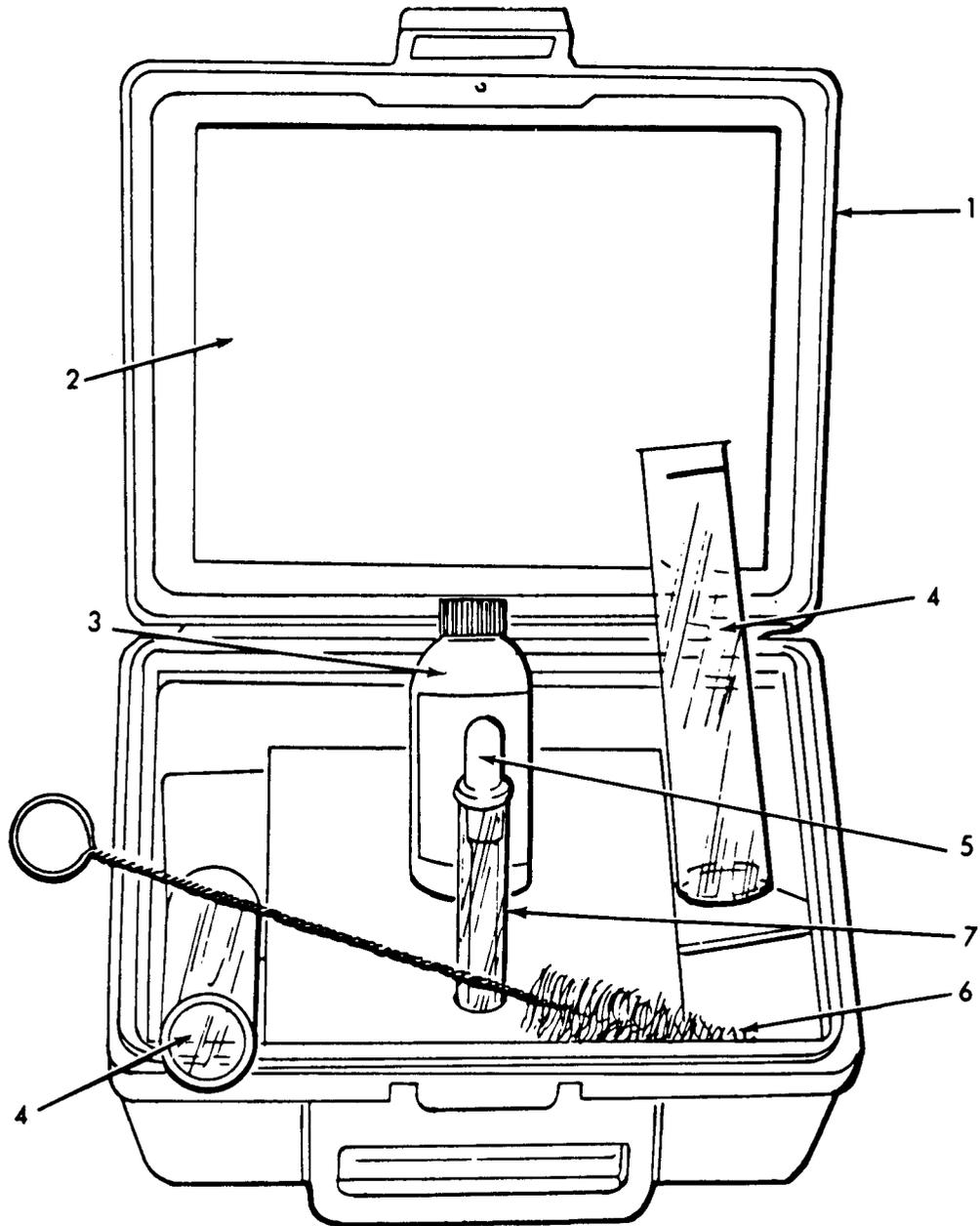


Figure C-10. Turbidity Test Kit

(1) ILLUSTRATION		(2)	(3)	(4)	(5)	(6)	(7)	(8) QUANTITY			
(a) FIGURE NO.	(b) ITEM NO.	NATIONAL STOCK NUMBER	PART NO. & FSCM	DESC RIPTION	LOCATION	USABLE ON CODE	QTY REQ'D	RCV'D	DATE	DATE	DATE
C-10		6630-01-035-1174	13222E0626 (97403) 13222E7799 (97403)	Turbidity Test Kit		2	1				
C-10	1	6630-01-070-3067	13222E0780 (97403)	• Case, Polypropylene		2	1				
C-10	2		13222E0781 (97403)	• Instructions		2	1				
C-10	3		13222E0705 (97403)	• Standard Turbidity Reagent		2	1				
C-10	4	6640-01-074-9062	13222E0706 (97403)	• Turbidity Column, 50/25 ml Mark		2	2				
C-10	5	6640-01-107-2118	13222E0650 (97403)	• Pipet, w/Dropper, 0.5 ml		2	1				
C-10	6		13222E0704 (97403)	• Brush, Tube, 3-1/2 × 10 in.		2	1				
C-10	7		3-15-04500 (97403)	• Tube, Storage		2	1				

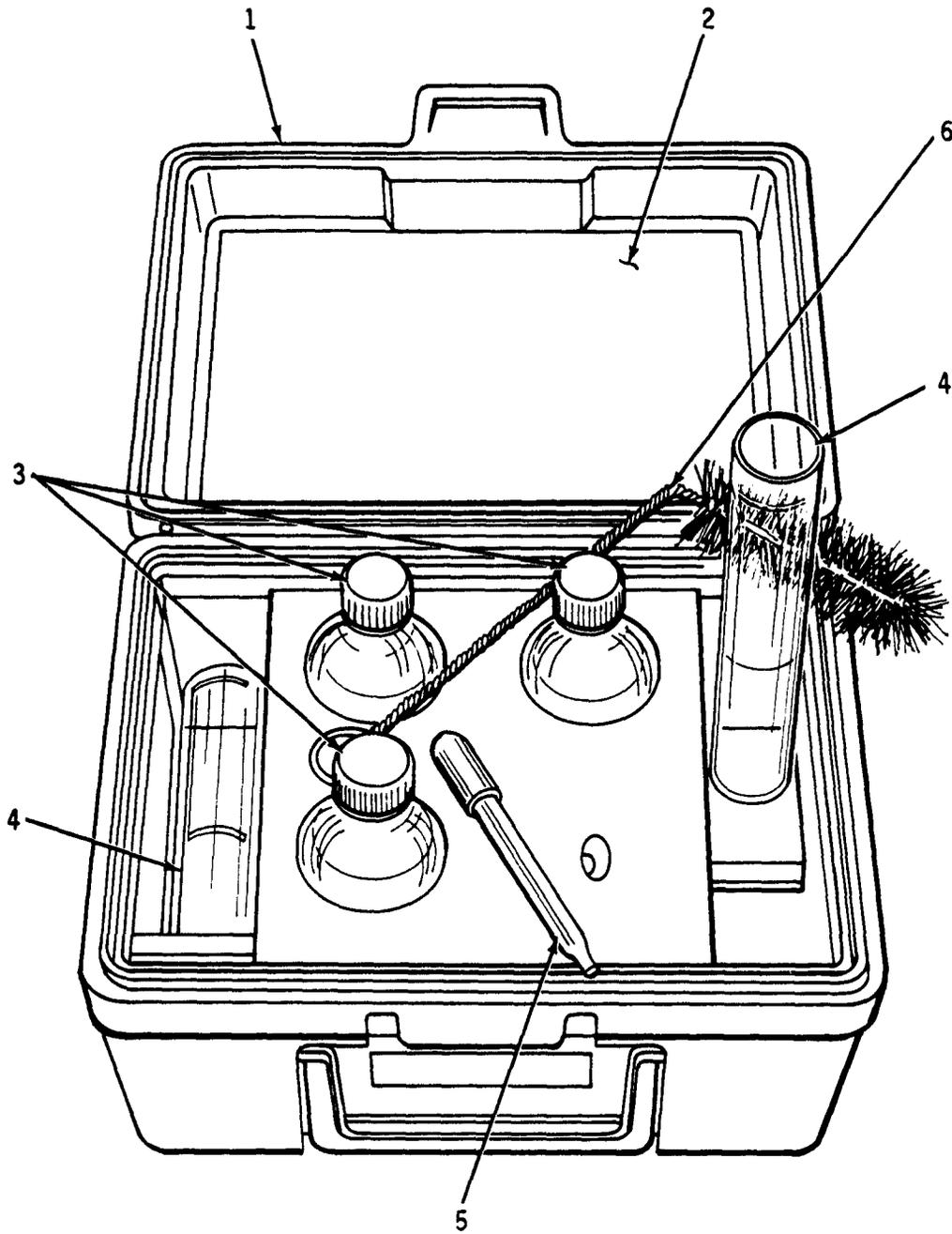


Figure C-10.1. Turbidity Test Kit (Not Used in Buys 1 and 2)

(1) ILLUSTRATION		(2)	(3)	(4)	(5)	(6)	(7)	(8) QUANTITY			
(a) FIGURE NO.	(b) ITEM NO.	NATIONAL STOCK NUMBER	PART NO. & FSCM	DESCRIPTION	LOCATION	USABLE ON CODE	QTY REQ'D	RCV'D	DATE	DATE	DATE
C-10.1		6630-01-035-1174	66152-01-1 (53390)	Turbidity Test Kit		2	1				
C-10.1	1	6630-01-070-3067	6309-01-8 (53390)	*Case, Polypropylene		2	1				
C-10.1	2			*Instructions		2	1				
C-10.1	3	6810-01-103-0080	6271-18-3 (53390)	*Reagent, Turbidity, Standard, 2 oz		2	3				
C-10.1	4	6640-01-074-9062	6387-01-4 (53390)	*Tube, Viewing, Turbidity		2	2				
C-10.1	5	6640-01-107-2118	7707-01-3 (53390)	*Dropper, Pipet, Polyethylene, 0.5 ml		2	1				
C-10.1	6	7920-01-115-4712	6083-01-8 (53390)	*Brush, Viewing Tube, 2-1/2 x 5/8 x 10 in.		2	1				

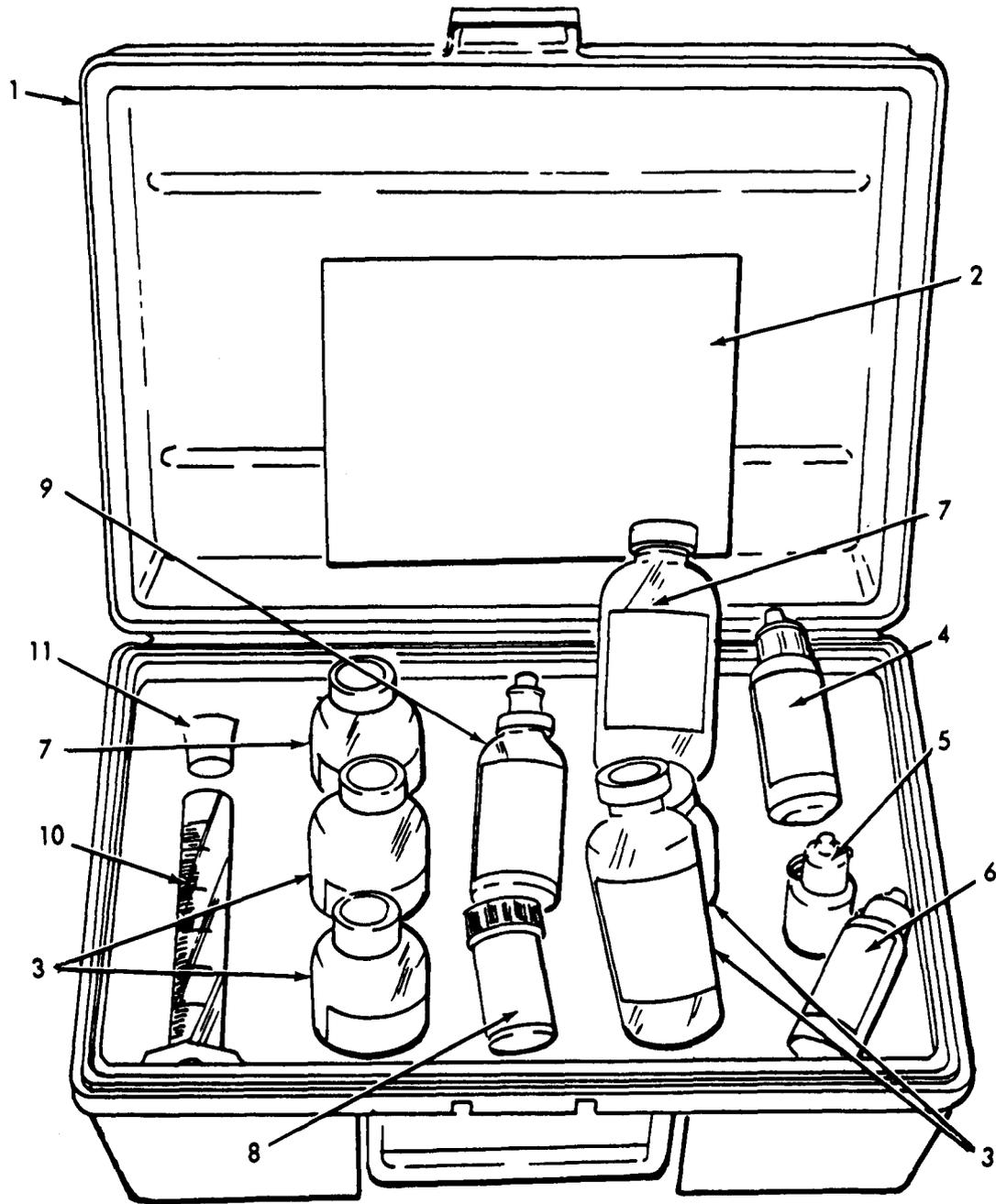


Figure C-11. Sulfate Test Kit

(1) ILLUSTRATION		(2) NATIONAL STOCK NUMBER	(3) PART NO. & FSCM	(4) DESCRIPTION	(5) LOCATION	(6) USABLE ON CODE	(7) QTY REQD	(8) QUANTITY			
(a) FIGURE NO.	(b) ITEM NO.							RCV'D	DATE	DATE	DATE
C-11		6630-01-101-4089	13222 E0625 (97403) 13222 E7796 (97403)	Sulfate Test Kit		2	1				
C-11	1	6630-01-070-3065	13222E0778 (97403)	● Case, Polypropylene		2	1				
C-11	2		13222E0779 (97403)	● Instructions		2	1				
C-11	3	6810-01-075-5546	13222E0694 (97403)	● Alcohol, Isopropyle, 4 oz.		2	4				
C-11	4	6810-01-082-0379	13222E0697 (97403)	● Acid, Hydrochloric, 1 oz.		2	1				
C-11	5		13222E0673 (97403)	● Indicator Solution, Phenolphthalein		2	1				
C-11	6	6810-01-070-6511	13222E0696 (97403)	● Indicator Solution, Bromocresol Green, 1 oz		2	1				
C-11	7	6810-01-075-0618	13222E0701 (97403)	● Water, Deionized, 4 oz.		2	2				
C-11	8		13222E0698 (97403)	● Indicator Powder, Sulfate		2	1				
C-11	9	6810-01-075-3505	13222E0695 (97403)	● Reagent, Standard Barium Chloride		2	1				
C-11	10		13222E0699 (97403)	● Cylinder, Graduated, 25 ml		2	1				
C-11	11	6640-01-044-3774	13222E0751 (97403)	● Stopper, Cylinder		2	1				

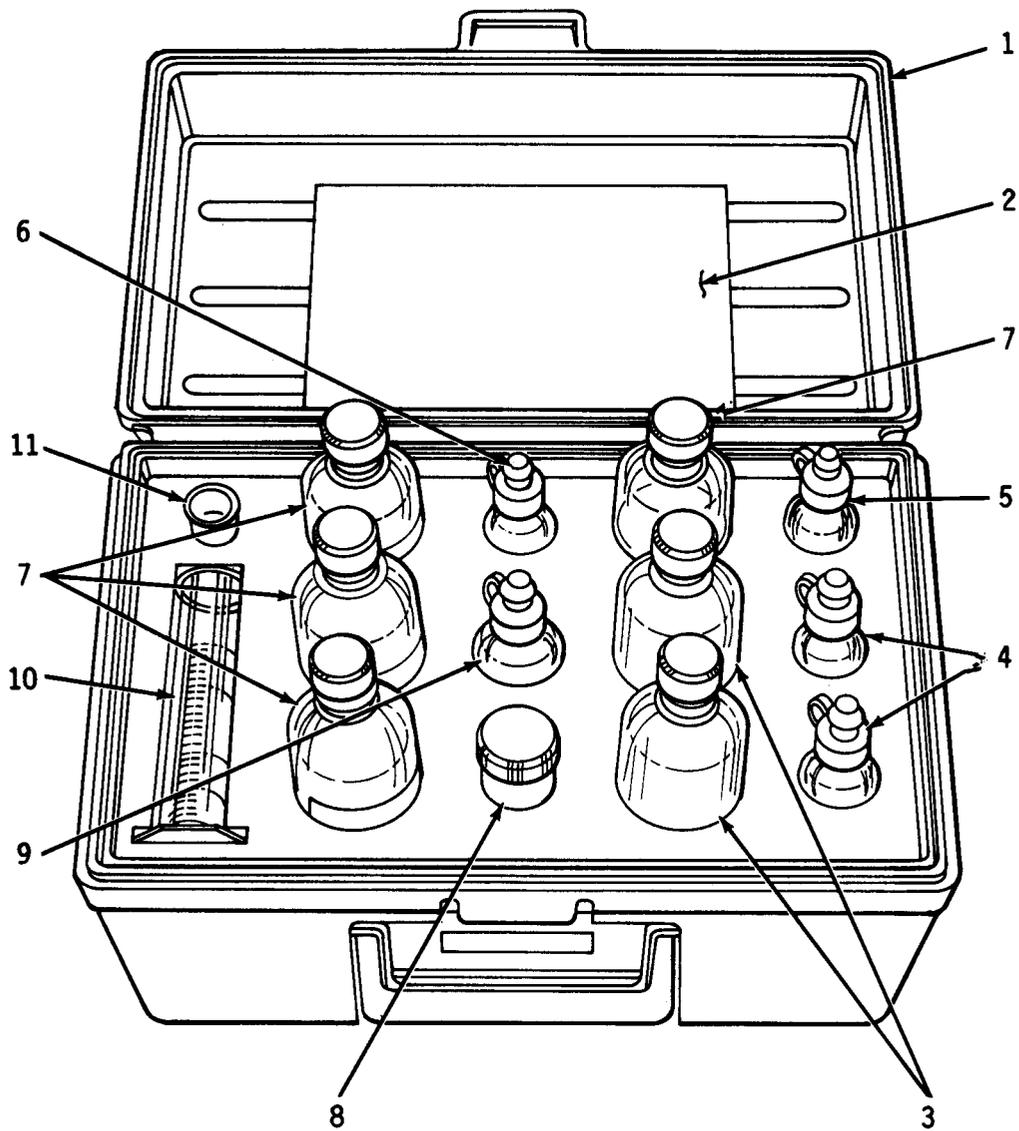


Figure C-11.1. Sulfate Test Kit (Not Used in Buys 1 and 2)

(1) ILLUSTRATION		(2)	(3)	(4)	(5)	(6)	(7)	(8) QUANTITY			
(a) FIGURE NO.	(b) ITEM NO.	NATIONAL STOCK NUMBER	PART NO. & FSCM	DESCRIPTION	LOCATION	USABLE ON CODE	QTY REQ'D	RCV'D	DATE	DATE	DATE
C-11.		6630-01-101-408	G-7688-01-5 (53390)	Test Kit, Sulfate		2	1				
C-11.	1	6630-01-070-306	6314-01-7 (53390)	*Case, Polypropylene		2	1				
C-11.	2			*Instructions		2	1				
C-11.	3	6810-01-075-061	6170-19-5 (53390)	*Water, Deionized, 4 oz.		2	2				
C-11.	4	6810-01-082-037	5091-17-8 (53390)	*Acid, Hydrochloric, 1 oz.		2	2				
C-11.	5	6810-01-113-314	0311-17-5 (53390)	*Solution, Indicator, Phenolphthalein, 1 o		2	1				
C-11.	6	6810-01-070-6511	6235-17-1 (53390)	*Solution, Indicator, Bromocresol Green, 1 oz.		2	1				
C-11.	7	6810-01-075-554	7618-19-4 (53390)	*Alcohol, Isopropyl, 4 oz.		2	4				
C-11.	8	6810-01-131-961	7616-08-1 (53390)	*Indicator Powder, Sulfate		2	1				
C-11.	9	6810-01-075-350	7617-18-8 (53390)	*Reagent, Barium Chloride, Standard, 2 oz.		2	1				
C-11.	10		5815-01-6 (53390)	*Cylinder, Graduated, 25 ml		2	1				
C-11.	11	6640-01-044-377	7000-01-1 (53390)	*Stopper, Cylinder		2	1				

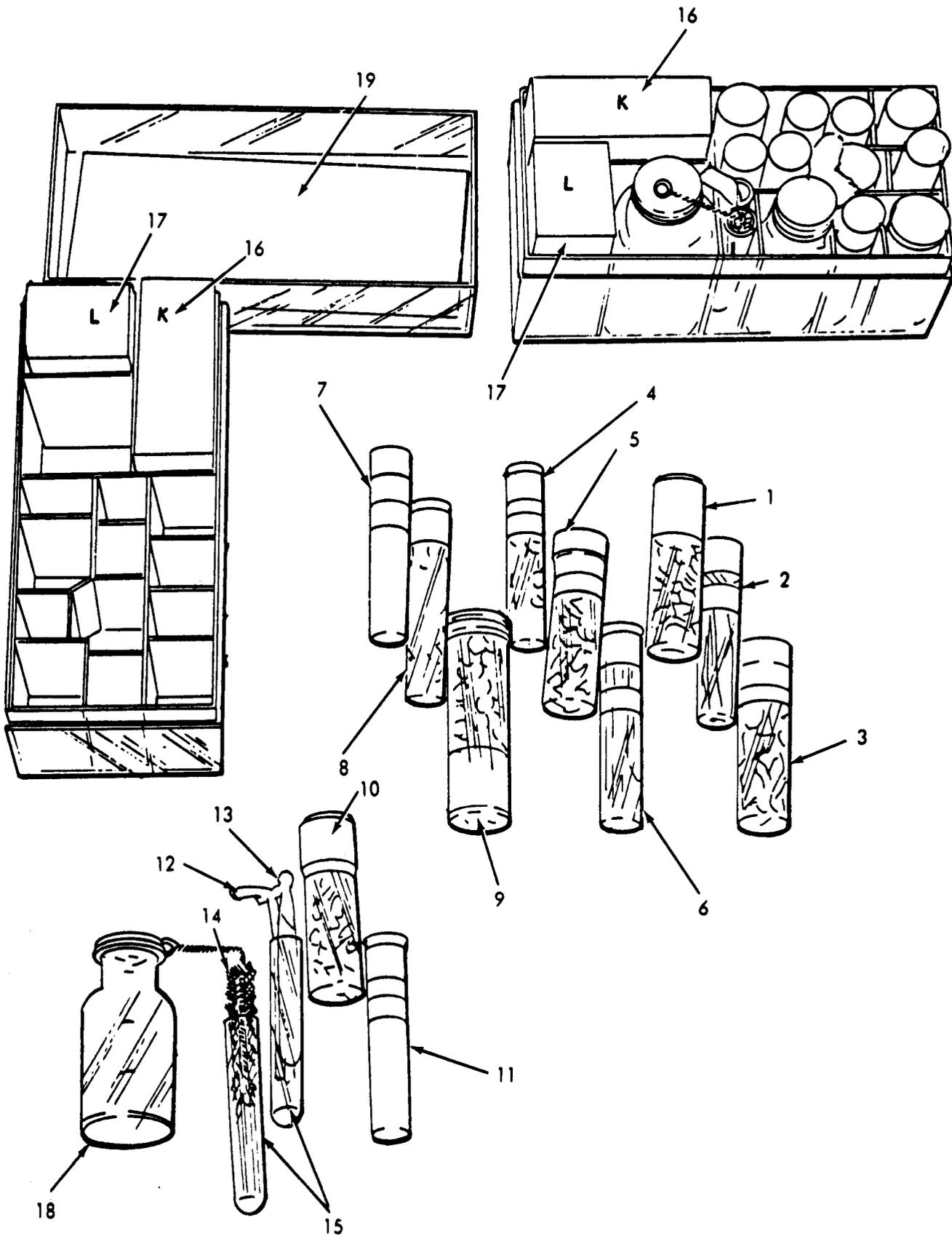


Figure C-12. Water Testing Kit, M272

(1) ILLUSTRATION		(2) NATIONAL STOCK NUMBER	(3) PART NO. & FSCM	(4) DESCRIPTION	(5) LOCATION	(6) USABLE ON CODE	(7) QTY REQ'D	(8) QUANTITY			
(a) FIGURE NO.	(b) ITEM NO.							RCV'D	DATE	DATE	DATE
C-12		6625-01-134-0885		Water Testing Kit M272		2	1				
C-12	1			• Reagent C (Brown Cap)		2	1				
C-12	2			• Reagent F (Black Cap)		2	1				
C-12	3			• Reagent A (Light Green Cap)		2	1				
C-12	4			• Reagent D (Blue Cap)		2	1				
C-12	5			• Reagent I (Orange Cap)		2	1				
C-12	6			• Reagent B (Yellow Cap)		2	1				
C-12	7			• Reagent H (Dark Green Cap)		2	1				
C-12	8			• Reagent G (White Cap)		2	1				
C-12	9			• Reagent Xt w/Black Cap and Test Vial)		2	1				
C-12	10			• Reagent E (Red Cap)		2	1				
C-12	11			• Reagent J (Grey Cap)		2	1				
C-12	12			• Pipe Cleaners		2	2				
C-12	13			• Scoop "J"		2	1				
C-12	14			• Brush, Tube		2	1				
C-12	15			• Tubes Test		2	2				
C-12	16			• Reagent K (In Carton)		2	1				
C-12	17			• Tube "L" Assembly (In Carton)		2	1				
C-12	18			• Bottle "P"		2	1				
C-12	19		• Instruction Book w/Nitrazine PH Color Chart		2	1					

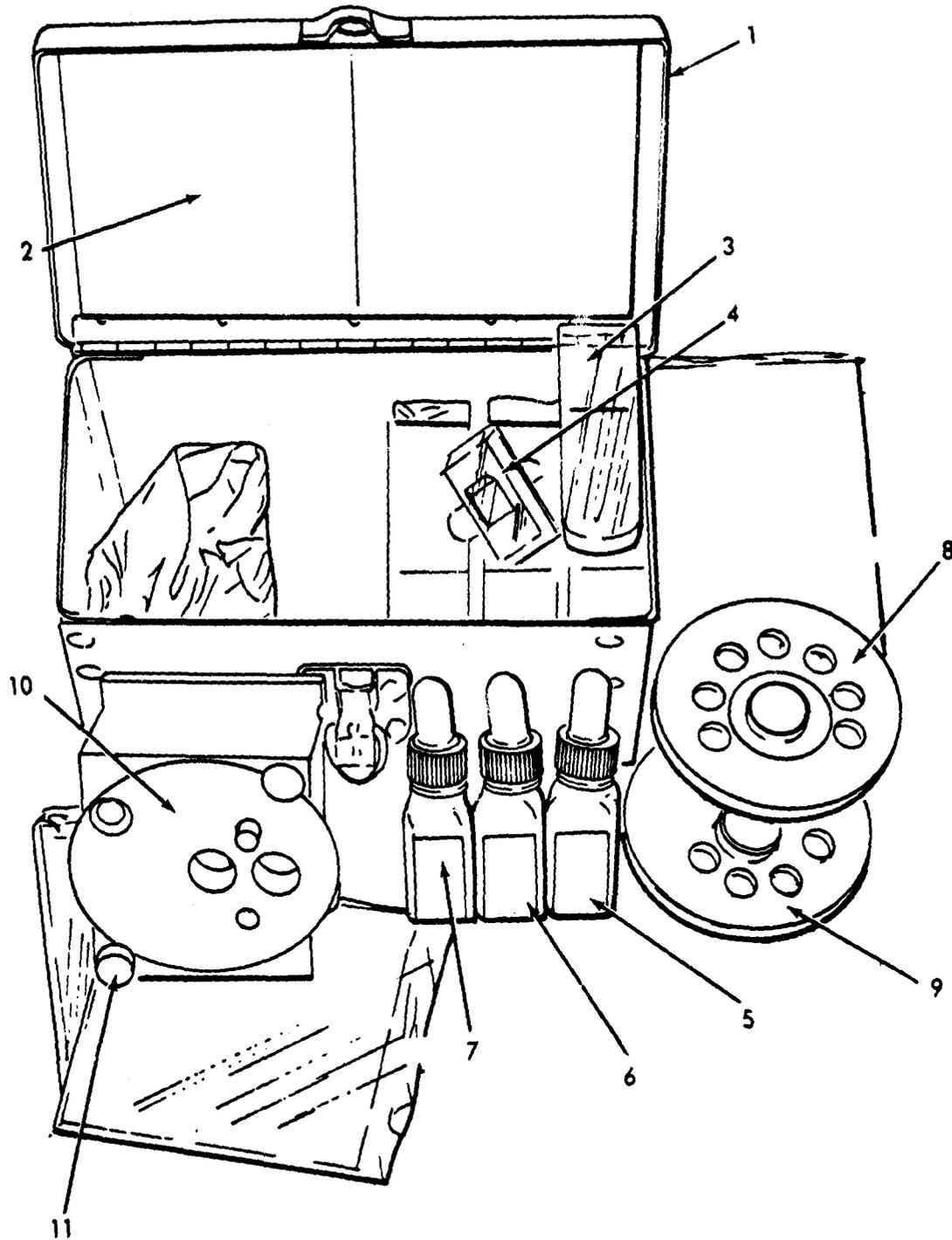


Figure C-13. Hydrogen Comparatpr, Color, Ion and Residual Chlorine

(1) ILLUSTRATION		(2) NATIONAL STOCK NUMBER	(3) PART NO. & FSCM	(4) DESCRIPTION	(5) LOCATION	(6) USABLE ON CODE	(7) QTY REQ'D	(8) QUANTITY			
(a) FIGURE NO.	(b) ITEM NO.							RCV'D	DATE	DATE	DATE
C-13		6630-00-087-1838		Comparator, Color Hydrogen Ion and Residual Chlorine		2	1				
C-13	1		70-CA (90767)	• Case, Carrying		2	1				
C-13	2		WAB50.280 (79172)	• Book, Instruction		2	1				
C-13	3		70-15-26 (90767)	• Cell, Sample, 15 ml		2	4				
C-13	4		70-PA (90767)	• Prism Attachment		2	1				
C-13	5		70-420 (90767)	• Indicator, Ortho-tolidine, (Yellow Cap Bottle)		2	1				
C-13	6		70-250-S (90767)	• Indicator, Wide Range PH, (White Cap Bottle)		2	1				
C-13	7		70-391-R (90767)	• Arsenite Reagent (Red Cap Bottle)		2	1				
C-13	8		70-333-D26 (90767)	• Disc, Color Standards, Residual Chlorine, 0.1 to 10.0 ppm		2	1				
C-13	9		70-250-D1 (90767)	• Disc, Color Standards, Wide Range PH, 3.0 to 11.0		2	1				
C-13	10		70-H (90767)	• Housing, Comparator		2	1				
C-13	11		70-L (90767)	• Screws, Locking		2	2				
		6630-01-044-0334	U25337 (79172)	Comparator Ay, Color, Hydrogen Ion and Residual Chlorine		2	1				
		6630-00-418-3580	P7201 (79172)	• Cell, Sample, 15 ml		2	2				
			U3160 (79172)	• Prism Attachment		2	1				
		6640-00-926-2236	U8936 (79172)	• Indicator, Wide Range PH (White Cap Bottle)		2	1				
			U20390 (79172)	• Case, Carrying		2	1				
			WAB50-280 (71972)	• Book, Instructions		2	1				

(1) ILLUSTRATION		(2)	(3)	(4)	(5)	(6)	(7)	(8) QUANTITY			
(a) FIGURE NO.	(b) ITEM NO.	NATIONAL STOCK NUMBER	PART NO. & FSCM	DESCRIPTION	LOCATION	USABLE ON CODE	QTY REQ'D	RCV'D	DATE	DATE	DATE
			U25315 (79172)	• Disc Color Standards, Free Chlorine (DPD) 0.1 to 10.0 ppm		2	1				
			U9450 (79172)	• Disc, Color Standards, Wide Range PH, 3.0 to 11.0 ppm		2	1				
			U818935 (79172)	• Housing Comparator		2	1				
		5305-00-496-3946	P7215 (79172)	• Screws, Locking		2	2				
			P51503 (79172)	• Rod, stirring		2	1				
		6810-01-044-0315	13222E7780 (97403)	• Tablets, DPD No. 1, 100 ea.		2	1				



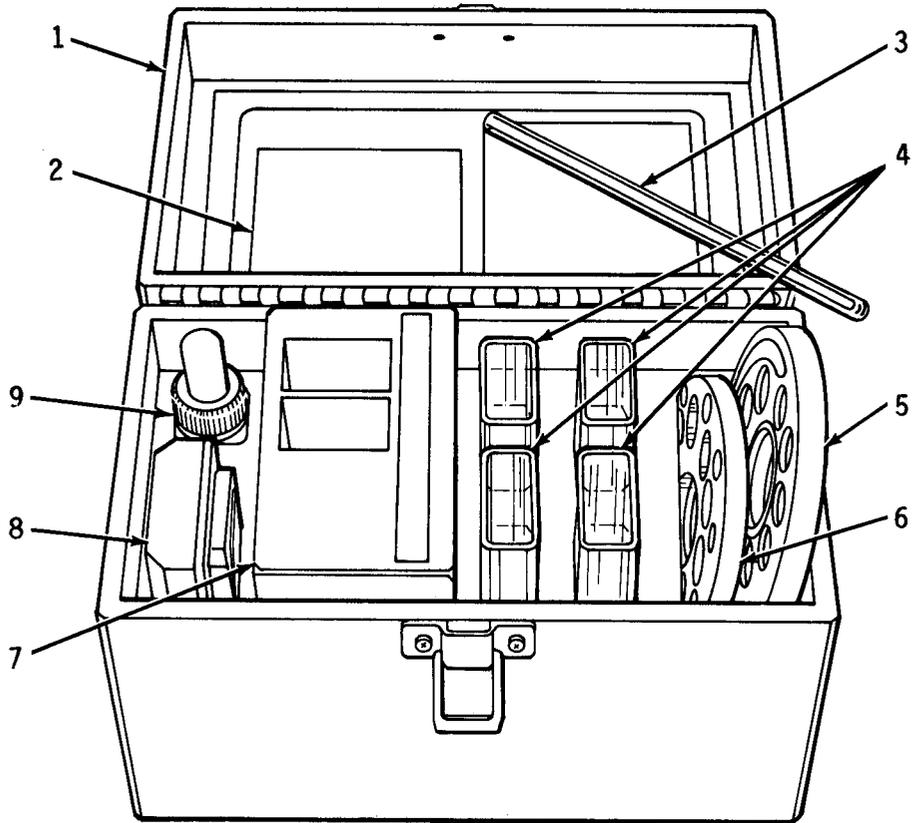


Figure C-13.1. Hydrogen-Ion and Chlorine Residual Color Comparator Test Kit (Not Used in Buy 1)

(1) ILLUSTRATION		(2)	(3)	(4)	(5)	(6)	(7)	(8) QUANTITY			
(a) FIGURE NO.	(b) ITEM NO.	NATIONAL STOCK NUMBER	PART NO. & FSCM	DESCRIPTION	LOCATION	JSABLE ON CODE	QTY REQ'D	RCV'D	DATE	DATE	DATE
C-13.		6630-01-044-033		Comparator, Color Hydrogen Ion and Residual Chlorine		2	1				
C-13.	1			*Case, Carrying		2	1				
C-13.	2			*Instructions		2	1				
C-13.	3			*Rod, Plastic Stirrin		2	1				
C-13.	4			*Cell, Sample, 15 ml		2	4				
C-13.	5			*Disc Color Standards Residual Chlorine		2	1				
C-13.	6			*Disc, Color Standard wide range pH		2	1				
C-13.	7			*Housing, Comparator		2	1				
C-13.	8			*Prism Attachment		2	1				
C-13.	9			*Indicator, Wide Range pH		2	1				

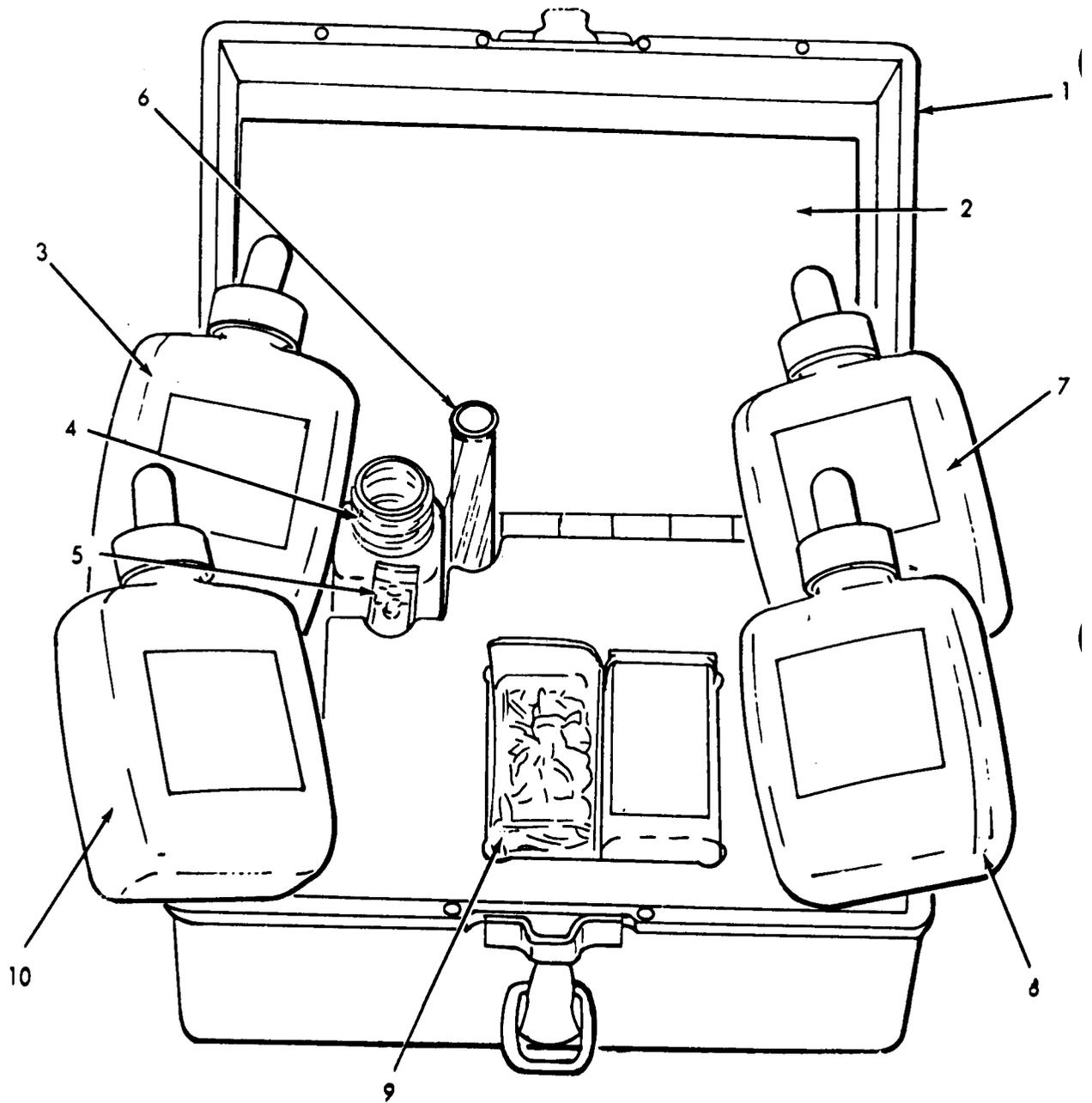


Figure C-14. Hardness Test Kit

(1) ILLUSTRATION		(2)	(3)	(4)	(5)	(6)	(7)	(8) QUANTITY			
(a) FIGURE NO.	(b) ITEM NO.	NATIONAL STOCK NUMBER	PART NO. & FSCM	DESCRIPTION	LOCATION	USABLE ON CODE	QTY REQ'D	RCV'D	DATE	DATE	DATE
C-14		6630-01-059-2490	13222E0624 (97403) 13222E7789 (97403)	Hardness Test Kit (Cal- cium and Total Hardness)		2	1				
C-14	1	6630-01-070-3066	13222E0776 (97403)	• Case, Polystyrene		2	1				
C-14	2		13222E0777 (97403)	• Instructions		2	1				
C-14	3	6810-00-798-9709	13222E0688 (97403)	• Buffer Solution, Hardness, #1 (PH 10.1)		2	1				
C-14	4	6640-01-068-9153	13222E0635 (97403)	• Bottle, Mixing		2	1				
C-14	5		13222E0628 (97403)	• Clipper, Small		2	1				
C-14	6	6630-00-127-4779	13222E0632 (97403)	• Tube, Measuring 5.83 ml		2	1				
C-14	7	6810-00-798-9667	13222E0690 (97403)	• Titration Solution Hardness, #3		2	1				
C-14	8	6810-00-798-9702	13222E0689 (97403)	• Manver Hardness Indicator, Hardness #2		2	1				
C-14	9	6810-01-070-4413	13222E0687 (97403)	• Calver II (Indicator Powder Pillows), 50 ea.		2	2				
C-14	10	6810-01-070-1847	13222E0691 (97403)	• Potassium Hydroxide Solution, 8N		2	1				

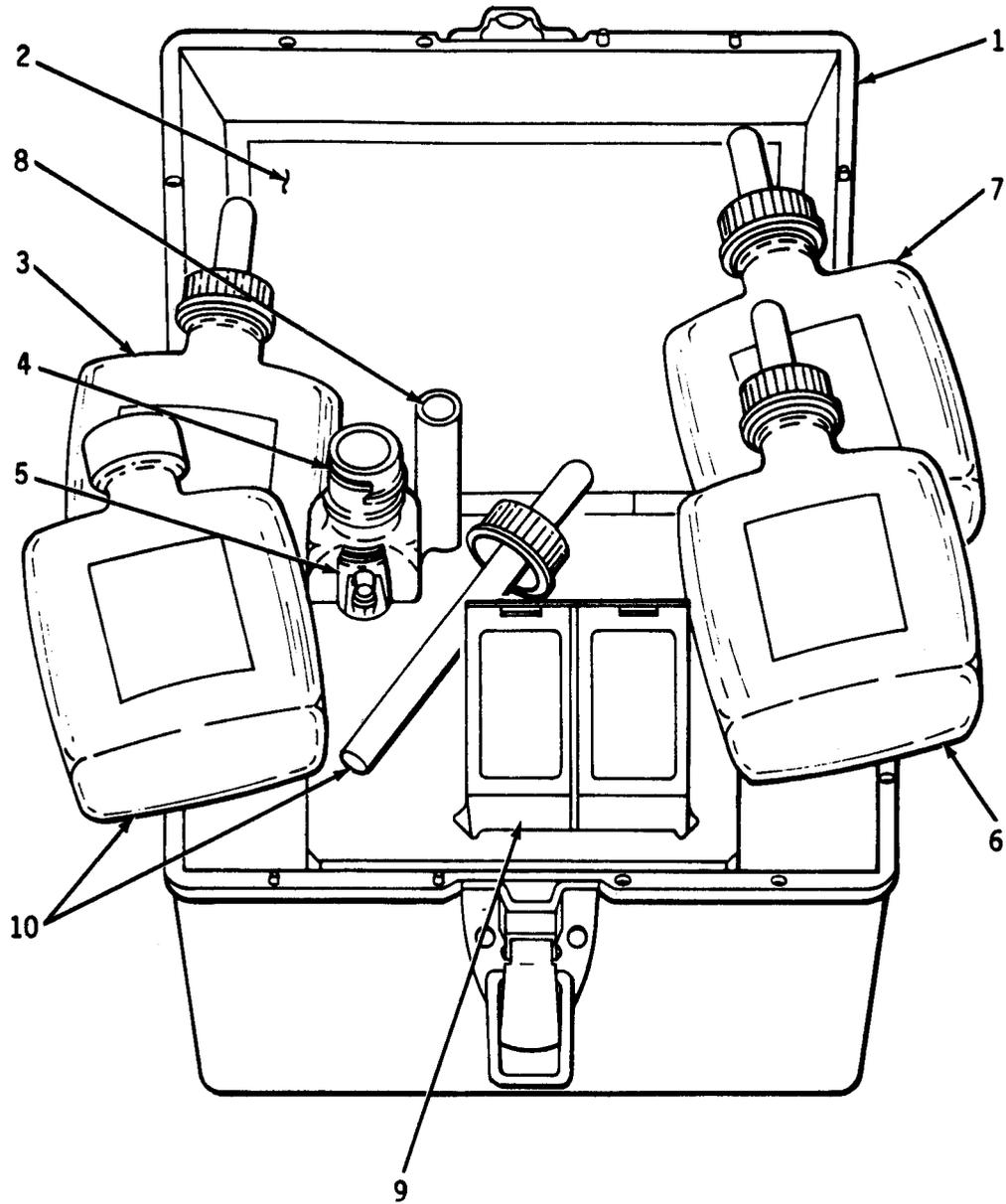


Figure C-14. 1. Hardness Test Kit (Not Used in Buy 1)

(1) ILLUSTRATION		(2)	(3)	(4)	(5)	(6)	(7)	(8) QUANTITY			
(a) FIGURE NO.	(b) ITEM NO.	NATIONAL STOCK NUMBER	PART NO. & FSCM	DESCRIPTION	LOCATION	USABLE ON CODE	QTY REQ'D	RCV'D	DATE	DATE	DATE
C-14.1		6630-01-059-2490	1457-00 (91224)	Test Kit, Hardness		2	1				
C-14.1	1	6630-01-070-3066	6006-00 (91224) 1457-52 (91224)	• Case, Polystyrene and Insert		2	1				
C-14.1	2			• Instructions		2	1				
C-14.1	3	6810-00-789-9709	424-37 (91224)	• Solution, Hardness 1, 4 oz.		2	1				
C-14.1	4	6640-01-068-9153	439-00 (91224)	• Bottle, Mixing, Square, Unmarked		2	1				
C-14.1	5	8530-00-929-8046	935-00 (91224)	• Clippers		2	1				
C-14.1	6	6810-00-798-9702	425-37 (91224)	• Solution, Hardness 2, 4 oz.		2	1				
C-14.1	7	6810-00-798-9667	427-37 (91224)	• Solution, Hardness 3		2	1				
C-14.1	8	6630-00-127-4779	438-00 (91224)	• Tube, Measuring		2	1				
C-14.1	9	6810-01-070-4413	947-99 (91224)	• Calcium Indicator, Calver II, 2 containers of 50 Powder Pillows each		2	1				
C-14.1	10	6810-01-070-1847	282-37 (91224)	• Solution, Potassium Hydroxide, 4 oz., with Blank Cap and Loose Dropper Cap		2	1				

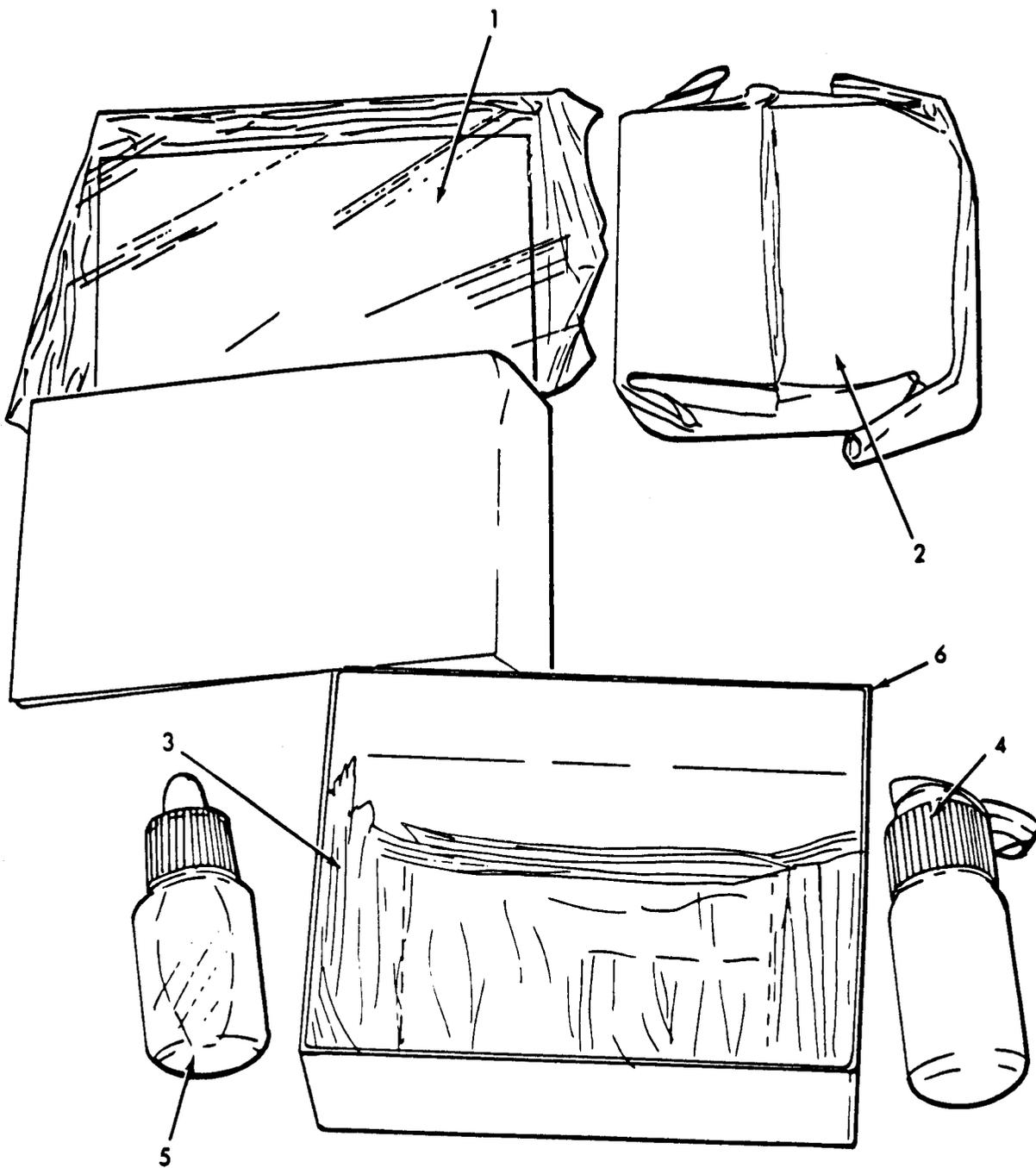


Figure C-15. Refill Kit, Chemical Agent Detector, V-G Compartments  
(Used for Buys 1 and 2 Only)

(1) ILLUSTRATION		(2)	(3)	(4)	(5)	(6)	(7)	(8) QUANTITY			
(a) FIGURE NO.	(b) ITEM NO.	NATIONAL STOCK NUMBER	PART NO. & FSCM	DESCRIPTION	LOCATION	USABLE ON CODE	QTY REQ'D	RCV'D	DATE	DATE	DATE
C-15		6665-01-134-0885		Refill Kit, Chemical Agent Detector, V-G Components		2	1				
C-15	1	6665-00-050-8529		• Paper, Chemical Agent Detector, VGH, ABC-M8 (25 Sheets)		2	1				
C-15	2	6630-01-125-5388	C5-77-808 (81361)	• Ticket, Detector		1	40				
C-15	3	6630-01-125-5387	B5-77-805 (81361)	• Pocket, Plastic		2	40				
C-15	4	6665-01-105-1390	197-54-826 (81361)	• Substrate Solution, Dispenser (Red Dot on Cap)		2	1				
C-15	5		C5-77-790-2 (81361)	• Trihydroxymethylaminomethane (TRIS) (White Lined Bottle)		2	1				
C-15	6			• Box, Cardboard		2	1				

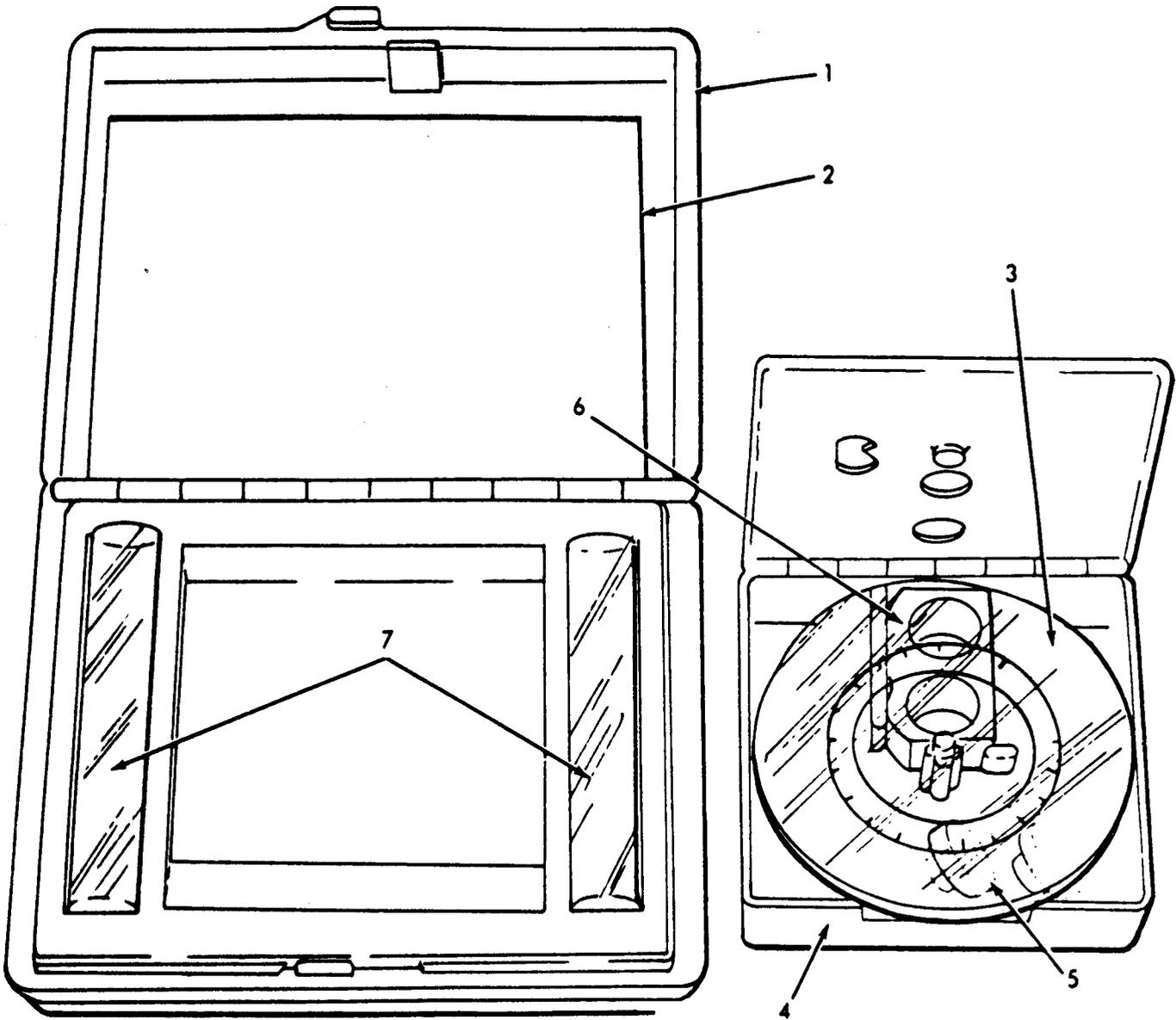


Figure C-16. Color Test Kit (Disc Installed)

(1) ILLUSTRATION		(2)	(3)	(4)	(5)	(6)	(7)	(8) QUANTITY			
(a) FIGURE NO.	(b) ITEM NO.	NATIONAL STOCK NUMBER	PART NO. & FSCM	DESCRIPTION	LOCATION	USABLE ON CODE	QTY REQ'D	RCV'D	DATE	DATE	DATE
C - 16		6630-01-026-4528	13222E0623 (97403) 13222E7797 (97403)	Color Test Kit		2	1				
C - 16	1	6630-01-073-2984	13222E0773 (97403)	• Case, Polypropylene		2	1				
C - 16	2		13222E0774 (97403)	• Instructions		2	1				
C - 16	3	6630-01-093-2903	13222E0682 (97403)	• Color Disc, 0-100 Units		2	1				
C - 16	4	6630-01-072-8704	13222E0655 (97403)	• Comparator, Color		2	1				
C - 16	5	6640-01-071-1552	13222E0658 (97403)	• Stoppers, Viewing Tube		2	2				
C - 16	6	6630-01-071-1551	13222E0654 (97403)	• Adapter, Viewing Tube		2	2				
C - 16	7	6630-01-071-1772	13222E0659 (97403)	• Tubes, Viewing		2	2				

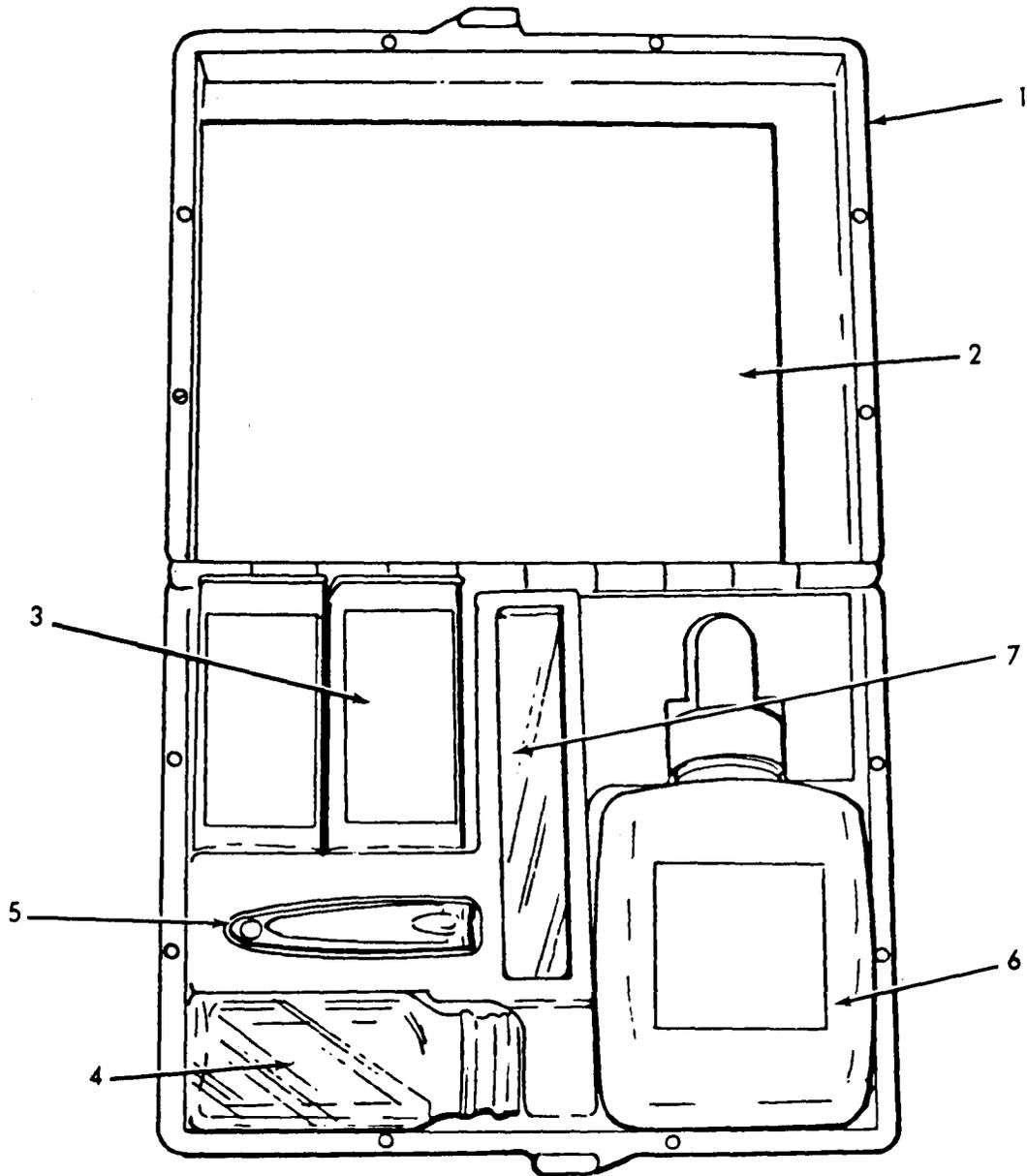


Figure C-17. Low Range Chloride Test Kit

(1) ILLUSTRATION		(2)	(3)	(4)	(5)	(6)	(7)	(8) QUANTITY			
(a) FIGURE NO.	(b) ITEM NO.	NATIONAL STOCK NUMBER	PART NO. & FSCM	DESCRIPTION	LOCATION	USABLE ON CODE	QTY REQ'D	RCV'D	DATE	DATE	DATE
C-17		6630-00-033-8778	13222E7778 (97403) 1440-00 (91224)	Test Kit, Chloride, Low Range		2	1				
C-17	1	6630-01-073-2984	5975-00 (91224)	• Case, Polypropylene		2	1				
C-17	2			• Instructions		2	1				
C-17	3	6810-00-798-9789	1043-99 (91224)	• Solution, Chloride Test, 4 oz.							
C-17	4	6640-01-068-9153	2327-00 (91224)	• Bottle, Mixing, Square, 23 ml		2	1				
C-17	5	8530-00-929-8046	936-00 (91224)	• Clipper		2	1				
C-17	6	6810-00-798-9790	397-37 (91224)	• Indicator, Chloride, 2 Containers, of 50 Powder Pillows each		2	1				
C-17	7	6630-00-127-4779	438-00 (91224)	• Tube, Measuring		2	1				

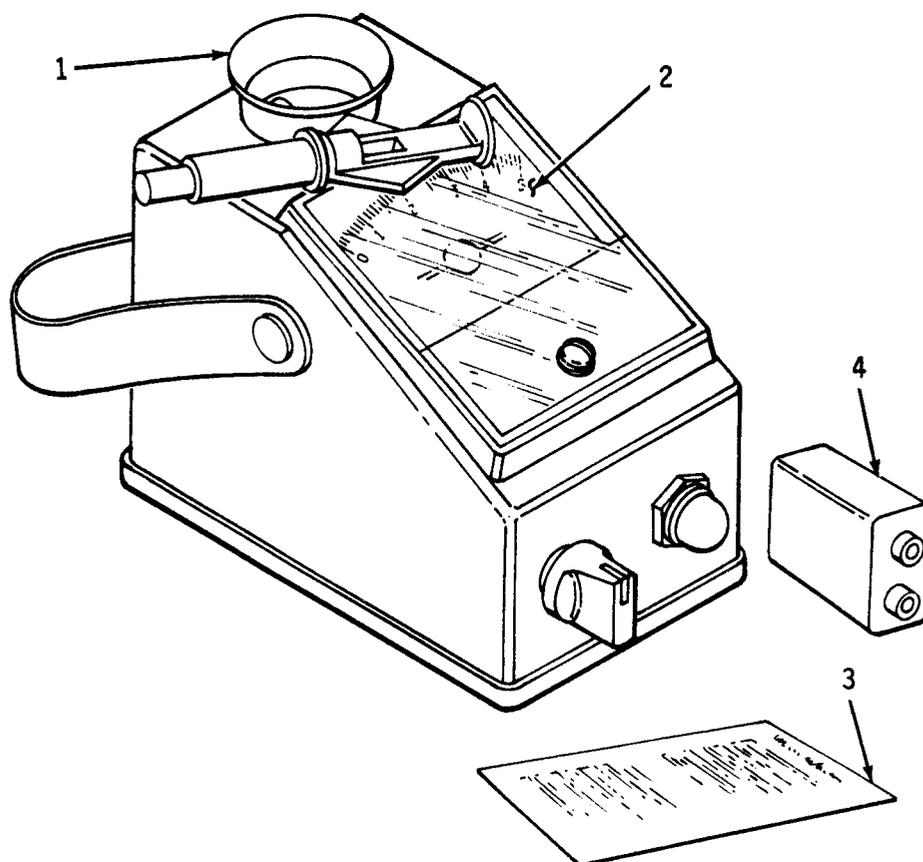


Figure C-18. Conductivity Meter, Total Dissolved Solids, with RE10 Range Extender

(1) ILLUSTRATION		(2)	(3)	(4)	(5)	(6)	(7)	(8) QUANTITY			
(a) FIGURE NO.	(b) ITEM NO.	NATIONAL STOCK NUMBER	PART NO. & FSCM	DESCRIPTION	LOCATION	USABLE ON CODE	QTY REQ'D	RCV'D	DATE	DATE	DATE
C-18		6630-00-127-4774	13222E0750 (97403) 13222E5258 (97403)	Meter, Dissolved Solids (Conductivity)		2	1				
C-18	1		13222E0750 -2 (97403)	• Range Extender		2	1				
C-18	2		13222E0750 -1 (97403)	• Meter (sealed)		2	1				
C-18	3		13222E0775 (97403)	• Instructions		2	1				
C-18	4		13222E0750 -3 (97403)	• Battery, 9 Volt		2	1				

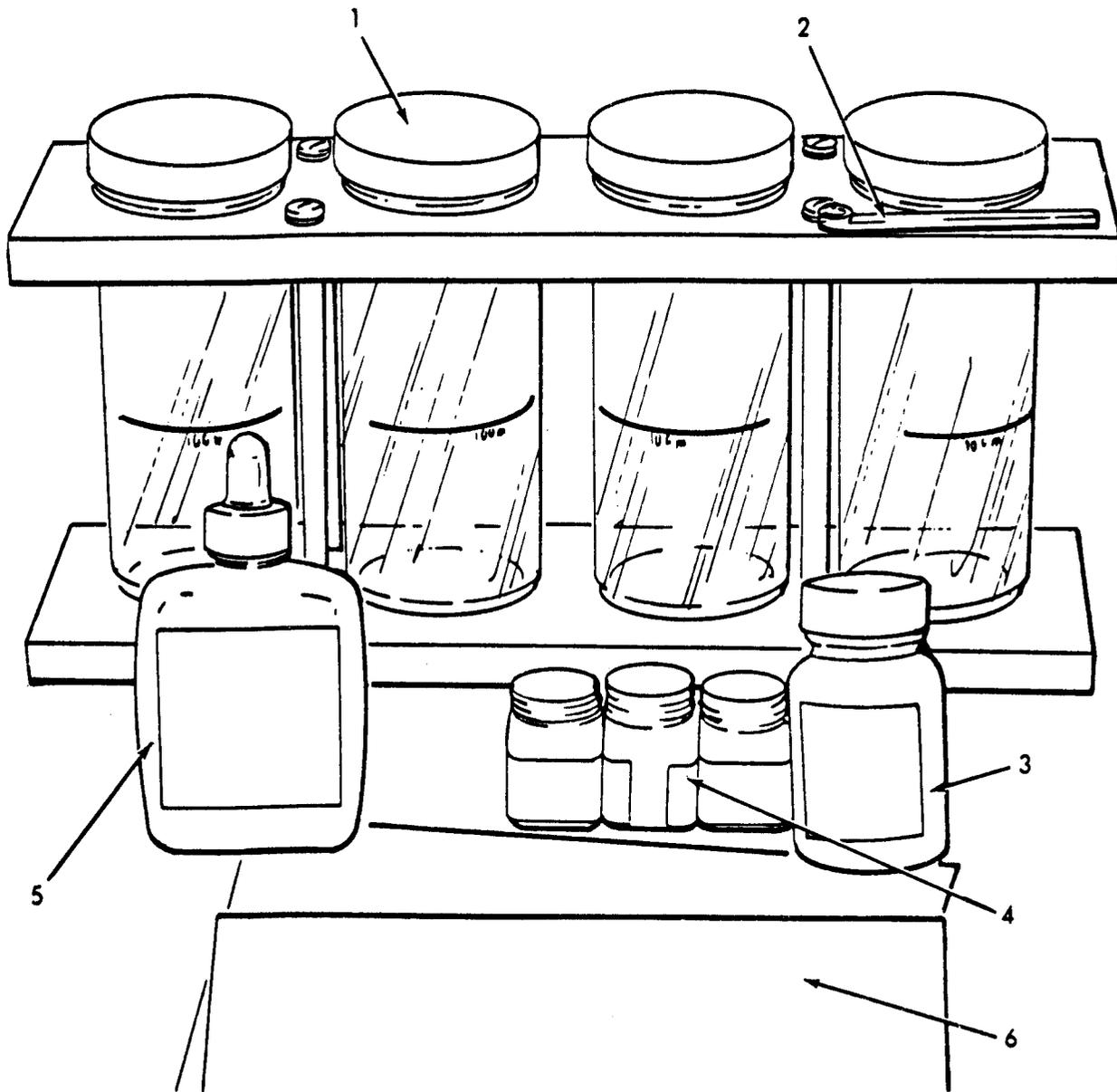


Figure C-19. Chlorine Demand and Coagulation Test Assembly

(1) ILLUSTRATION		(2)	(3)	(4)	(5)	(6)	(7)	(8) QUANTITY			
(a) FIGURE NO.	(b) ITEM NO.	NATIONAL STOCK NUMBER	PART NO. & FSCM	DESCRIPTION	LOCATION	USABLE ON CODE	QTY REQ'D	RCV'D	DATE	DATE	DATE
C-19	1	6630-00-127-4775	13222 E0745 (97403) 13223 E7786 (97403)	• Jar Test Assembly		2	1				
C-19	2	6640-01-012-7534	13222E0663 (97403) 13222E7793 (97403)	• Spoon, Measuring, .05 mg		2	2				
C-19	3	6810-00-798-9651	13222E0746 (97403) 13222E7791 (97403)	• Limestone, Powdered, Analytical Grade		2	1				
C-19	4	6810-01-011-7145	13222 E0738 (97403) 13222E7779 (97403)	• Halazone, Tablets, 100 ea.		2	6				
C-19	5	6810-00-798-9722	13222E0740 (97403) 13222 E7784 (97403)	• Ferric Chloride Solution (40 grams/liter)		2	2				
C-19	6		13222 E0782 (97403) 13222 E7803 (97403)	• Coagulation Test Card		2	1				

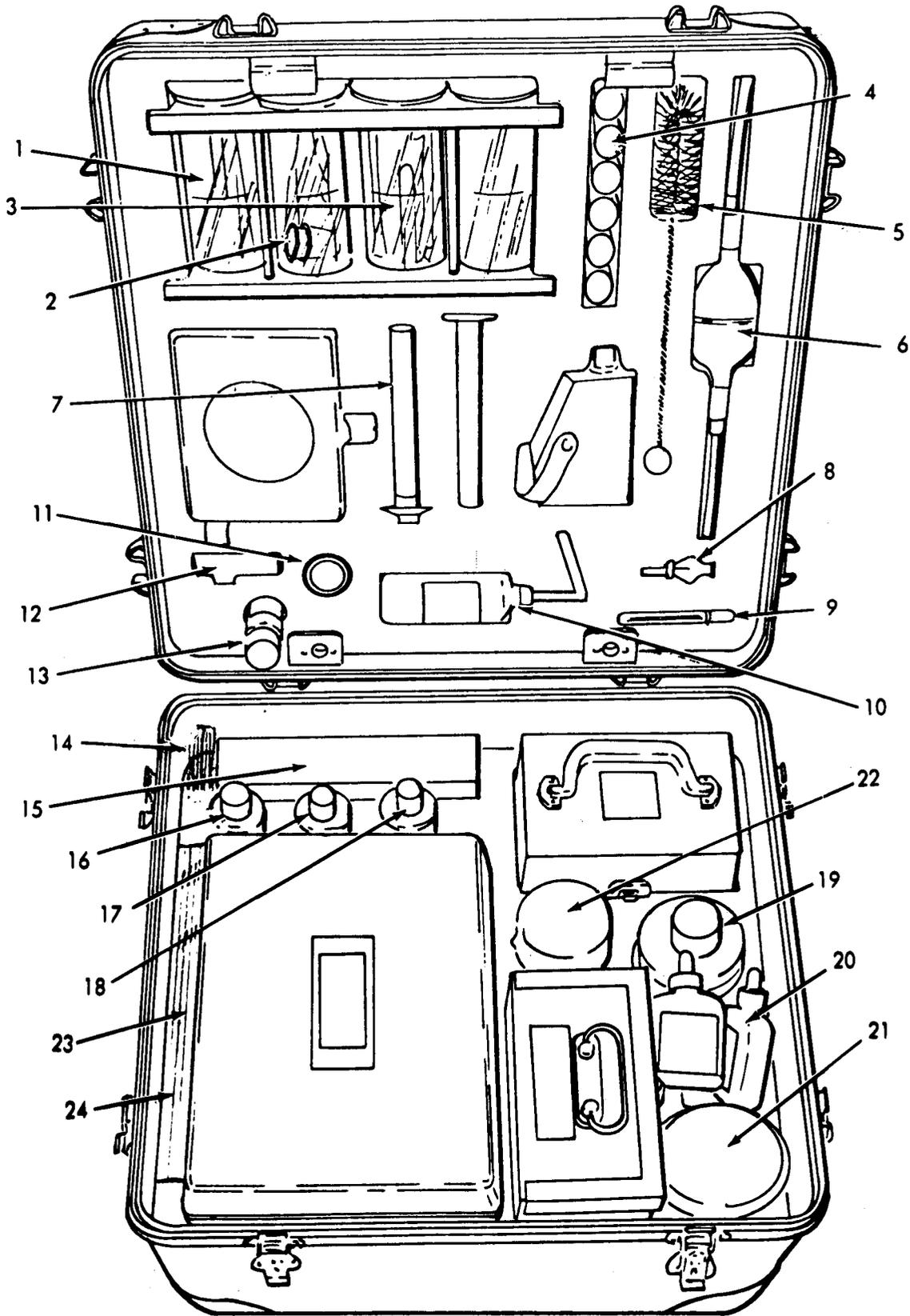


Figure C-20. WQAS - Engineer, Lab-Ware and Support Items

(1) ILLUSTRATION		(2) NATIONAL STOCK NUMBER	(3) PART NO. & FSCM	(4) (5) DESCRIPTION LOCATION	(6) USABLE ON CODE	(7) QTY REQ'D	(8) QUANTITY			
(a) FIGURE NO.	(b) ITEM NO.						RCV'D	DATE	DATE	DATE
C-20	1	6640-01-013-1866	13222 E0742 (97403) 13222 E7787 (97403)	• Funnel, Laboratory, 45 mm (Inside Jar)	2	1				
C-20	2		13222 E0751 (97403) 13222 E7794 (97403)	• Stopper, Cylinder	2	2				
C-20	3	6640-01-012-7534	13222 E0663 (97403) 13222 E7793 (97403)	• Spoon, Measuring, .05 mg	2	2				
C-20	4	6810-01-011-7145	13222 E0738 (97403) 13222 E7779 (97403)	• Halazone Tablets, 100 ea.	2	6				
C-20	5	7920-00-297-1510	13222 E0709 (97403)	• Brush, Tube, 10 in. lg.	2	1				
C-20	6	6640-01-107-4486	13222 E0737 (97403) 13222 E7776 (97403)	• Bulb Assembly, 2 Way	2	1				
C-20	7	6640-00-339-0315	13222 E0711 (97403) 13222 E7781 (97403)	• Cylinder, Graduated, 25 ml	2	2				
C-20	8		13222 E0750 -2 (97403)	• Range Extender, Conductivity Meter	2	1				
C-20	9	6630-01-026-1274	13222 E0739 (97403) 13222 E7783 (97403)	• Dropper, Pipet, 1 cc	2	1				
C-20	10	6640-00-127-4761	13222 E0736 (97403) 13222 E7775 (97403)	• Bottle, Wash, 250 ml, w/Resin	2	1				
C-20	11	6810-00-798-9651	13222 E0746 (97403) 13222 E7791 (97403)	• Limestone, Powdered, Analytical Grade	2	1				
C-20	12	6640-00-290-5776	13222 E0748 (97403)	• Paper, Filter, 100 ea.	2	1				
C-20	13		13222 E0712 (97403) 13222 E7782 (97403)	• Detergent, 1 oz.	2	1				

(1) ILLUSTRATION		(2) NATIONAL STOCK NUMBER	(3) PART NO. & FSCM	(4) DESCRIPTION	(5) LOCATION	(6) USABLE ON CODE	(7) QTY REQ'D	(8) QUANTITY			
(a) FIGURE NO.	(b) ITEM NO.							RCV'D	DATE	DATE	DATE
C-20	14	8105-00-721-9912	13222E0733 (97403) 13222E7792 (97403)	• Bag, Plastic		2	100				
C-20	15	8540-00-459-2385	13222E0728 (97403) 13222E7798 (97403)	• Tissue, facial, 100 ea.		2	1				
C-20	16	6810-00-937-0975	13222E0744 (97403) 13222E7790 (97403)	• Indicator Solution, D PH Wide Range		2	1				
C-20	17	6810-00-937-0974	13222E0749 (97403)	• Arsenite Solution, 4 oz.		2	1	NOT USED IN 2ND BUY			
C-20	18	6810-00-270-8293	13222E0747 (97403)	• Orthotolidine, 4 oz.		2	1	NOT USED IN 2ND BUY			
C-20	19	6640-00-411-5485	13222E0735 (97403) 13222E7774 (97403)	• Bottle, Sample, 32 oz.		2	1				
C-20	20	6810-00-798-9722	13222E0740 (97403) 13222E7784 (97403)	• Ferric Chloride Solution, (40 grams/liter)		2	2				
C-20	21	6640-01-075-9201	13222E0741 (97403) 13222E7785 (97403)	• Flask, Filtering, 500 ml		2	1				
C-20	22	6640-00-592-7848	13222E0734 (97403) 13222E7773 (97403)	• Beaker, 250 ml		2	1				
C-20	22		13222E0743 (97403) 13222E7788 (97403)	• Funnel, Buchner, 70 mm		2	1				
C-20	22		13222E0752 (97403) 13222E7795 (97403)	• Stopper Rubber 1 Hole		2	1				
C-20	23		13222E0785 (97403) 13222E7802 (97403)	• Diagram, Loading		2	1				
C-20	23		13222E0775 (97403) 13222E7805 (97403)	• Instructions, Conductivity meter		2	1				

(1) ILLUSTRATION		(2) NATIONAL STOCK NUMBER	(3) PART NO. & FSCM	(4) DESCRIPTION	(5) LOCATION	(6) USABLE ON CODE	(7) QTY REQD	(8) QUANTITY			
(a) FIGURE NO.	(b) ITEM NO.							RCV'D	DATE	DATE	DATE
C-20	24		13222 E0782 (97403) 13222 E7803 (97403)	● Instructions, Coagu- lation Test		2	1				
C-20	24		13222 E0805 (97403) 13222 E7804 (97403)	● Instruction, Turbidity Free Water		2	1				
C-20	24		TM 5-6630 - 215-12	● WQAS - MAINTENANCE AND OPERATOR 'S MANUAL		2	1				
			13222 E0787-2 (97403) 13222 E7777 (97403)	● Case, Transit and Storage, Engineer - (WQAS)		2	1				
			13222 E0798 (97403)	● ● Insert, Foam, #1 TOP		2	1				
			13222 E0799 (97403)	● ● Insert, Foam, #2 TOP		2	1				
			13222 E0800 (97403)	● ● Insert Foam, #3 TOP		2	1				
			NPN (19099)	● ● Insert Foam #4, TOP		2	1				
			13222 E0797 (97403)	● ● Insert, Fly Leaf		2	2				
			13222 E0801 (97403)	● ● Insert, Foam, #1 BOTTOM		2	1				
			13222E802 (97403)	● ● Insert, Foam, #2		2	1				
			13222 E0803 (97403)	● ● Insert, Foam, #3 BOTTOM		2	1				
			13222 E0804 (97403)	● ● Insert, Foam, #4		2	1				
			NPN (19099)	● ● Insert, Foam, #5 BOTTOM		2	1				

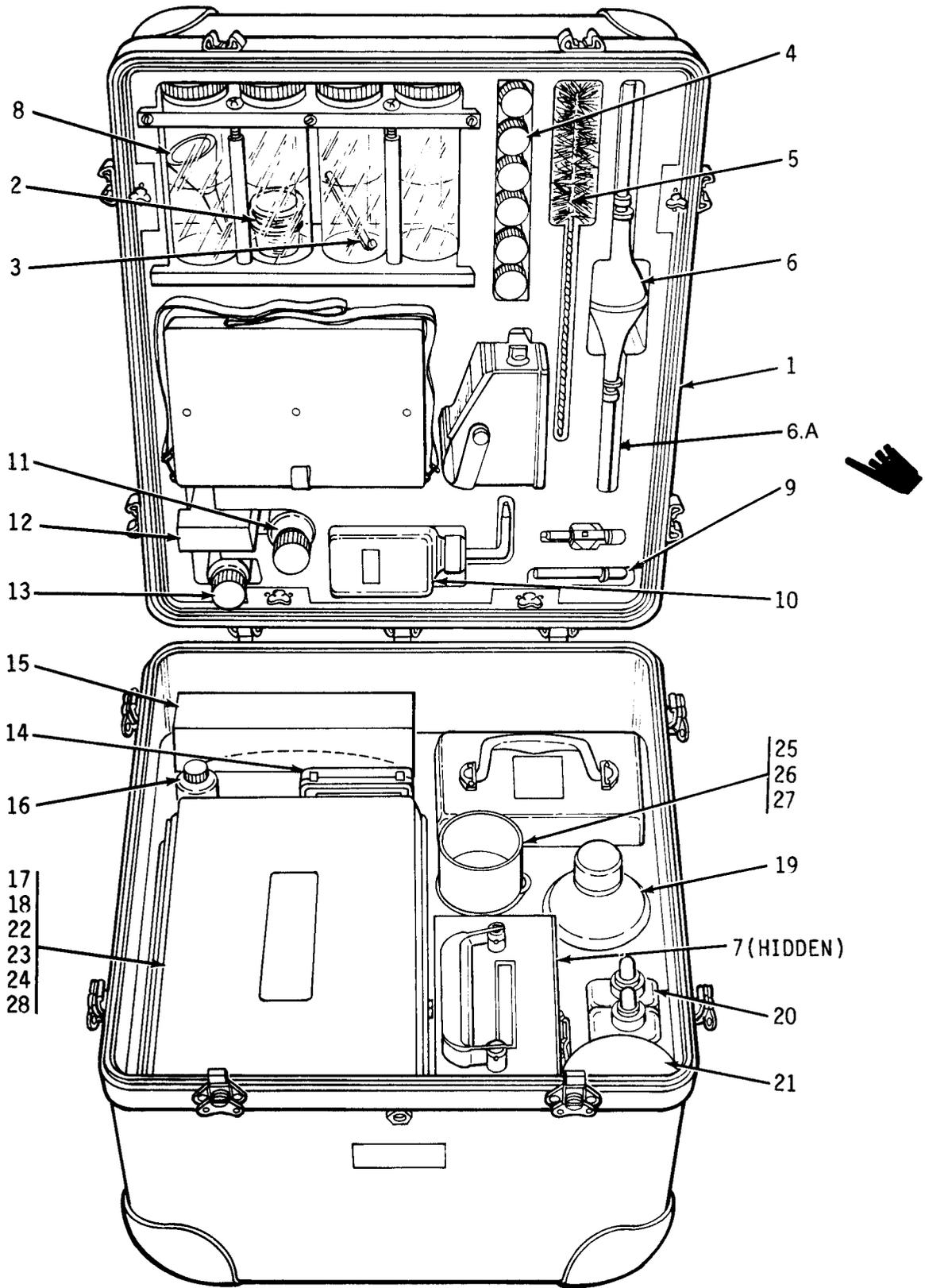


Figure C-20.1. WQAS - Engineer, Labware and Support Items  
(Not Used in Buys 1 and 2)

(1) ILLUSTRATION		(2) NATIONAL STOCK NUMBER	(3) PART NO. & FSCM	(4) DESCRIPTION	(5) LOCATION	(6) USABLE ON CODE	(7) QTY REQ'D	(8) QUANTITY			
(a) FIGURE NO.	(b) ITEM NO.							RCV'D	DATE	DATE	DATE
C-20.1		6630-00-140-7820	13222E7800 (97403)	Water Quality Analysis Set, Engineer		2	1				
C-20.1	1	8115-01-101-4085	13222E7777 (97403)	• Case		2	1				
C-20.1	2	6640-01-116-3977	13222E7744 (97403)	• Stopper, Cylinder		2	2				
C-20.1	3	6640-01-012-7534	13222E7743 (97403)	• Spoon, Measuring, 0.05 g		2	1				
C-20.1	4	6810-01-011-7145	13222E7779 (97403)	• Tablets		2	6				
C-20.1	5	7920-00-282-7784	H-B-1051 (81348)	• Brush, Test Tube, Type 1, Style A, Class 1, Size 1-1/2		2	1				
C-20.1	6	6640-00-494-3726	MS-36074-1 (97403)	• Bulb		2	1				
C-20.1	6.A	4720-00-723-4802	22-T-831 (97403)	Tubing		2	1				
C-20.1	7	6640-00-339-0315	13222E7781 (97403)	• Cylinder, Graduated, 25 ml		2	2				
C-20.1	8	6640-01-125-5455	13222E7787 (97403)	• Funnel		2	1				
C-20.1	9	6640-01-026-1274	13222E7783 (97403)	• Dropper, Pipette, Plastic		2	1				
C-20.1	10	6640-00-127-4761	13222E7775 (97403)	• Bottle, Wash		2	1				
C-20.1	11		13222E7791 (97403)	• Limestone, Powdered		2	1				
C-20.1	12	6640-00-290-5776	NNN-P-1475 (81348)	• Paper, Filter, Type 1 Class 2, 7.0 cm Diameter		2	1				
C-20.1	13	6640-01-136-2083	13222E7782 (97403)	• Detergent		2	1				
C-20.1	14	6810-01-110-1493	13222E7780 (97403)	• Tablets		2	1				

(1) ILLUSTRATION		(2)	(3)	(4)	(5)	(6)	(7)	(8) QUANTITY			
(a) FIGURE NO.	(b) ITEM NO.	NATIONAL STOCK NUMBER	PART NO. & FSCM	DESCRIPTION	LOCATION	USABLE ON CODE	QTY REQ'D	RCV'D	DATE	DATE	DATE
C-20.1	15	8540-00-793-5425	13222 E7798 (97403)	• Tissue, Facial		2	1				
C-20.1	16	6810-01-110-1492	13222E7790 (97403)	• Indicator Solution		2	1				
C-20.1	17	9905-01-119-7479	13222E7805 (97403)	• Card, Instructions		2	1				
C-20.1	18	9905-01-119-7480	13222E7804 (97403)	• Card		2	1				
C-20.1	19	6640-00-411-5485	13222E7774 (97403)	• Bottle, Sample, 32 oz.		2	1				
C-20.1	20	6810-00-798-9722	13222E7784 (97403)	• Ferric Chloride Solution		2	2				
C-20.1	21	6640-01-075-9201	13222E7785 (97403)	• Flask, Filtering, 500 ml		2	1				
C-20.1	22	9905-01-119-7481	13222E7803 (97403)	• Card		2	1				
C-20.1	23	6630-01-119-7524	13222E7802 (97403)	• Loading Diagram		2	1				
C-20.1	24			• Job Aids Tec		2	1				
C-20.1	25	6640-01-112-7033	13222E7788 (97403)	• Funnel, Filtering, Buchner		2	1				
C-20.1	26	6640-00-592-7848	13222E7773 (97403)	• Beaker, 250 ml		2	1				
C-20.1	27	6640-01-102-9603	13222 E7795 (97403)	• Stopper, Rubber		2	1				
C-20.1	28		13222E7806 (97403)	• Card		2	1				



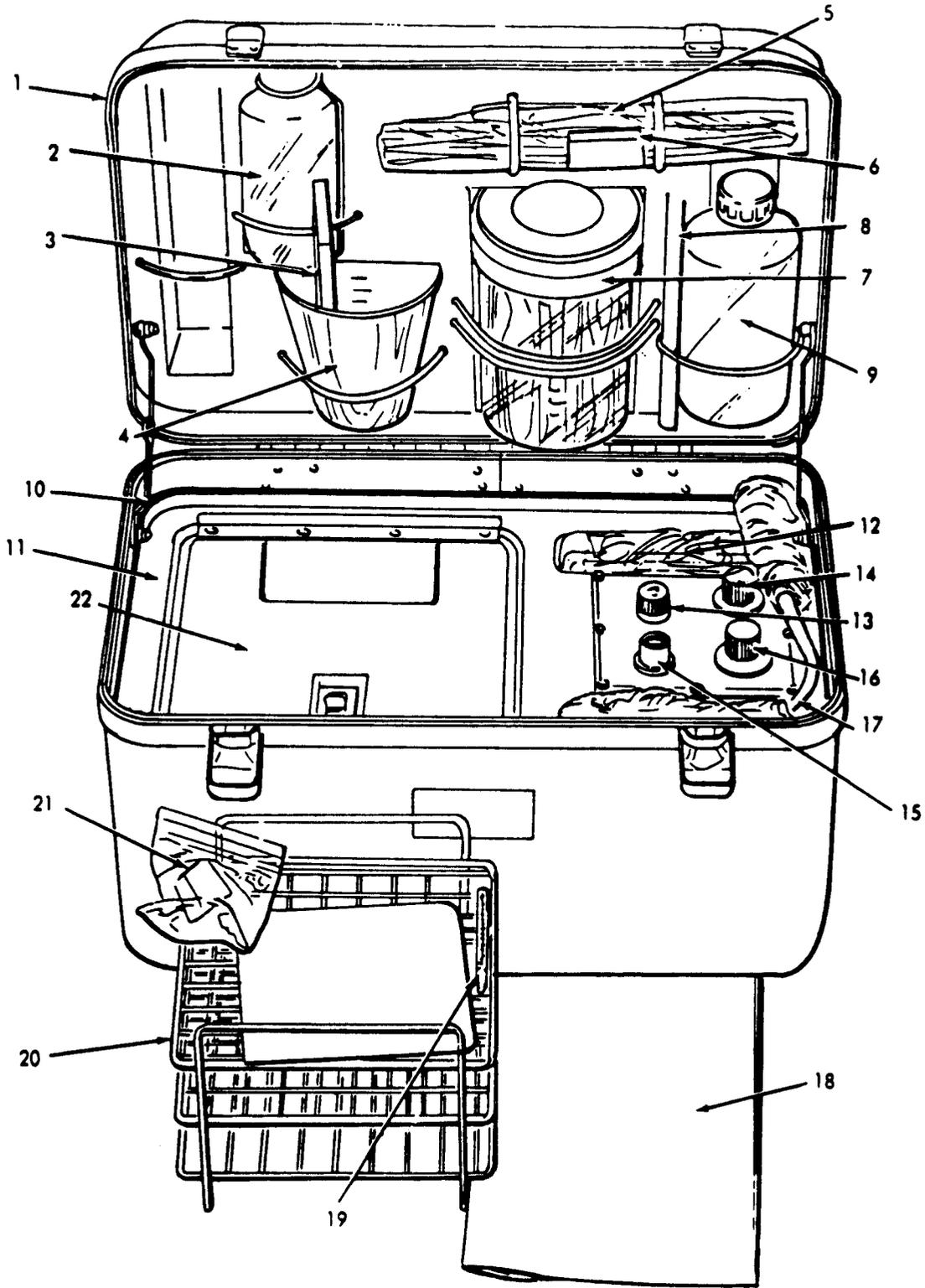


Figure C-21. Water Testing Kit - Bacteriological

(1) ILLUSTRATION		(2)	(3)	(4)	(5)	(6)	(7)	(8) QUANTITY			
(a) FIGURE NO.	(b) ITEM NO.	NATIONAL STOCK NUMBER	PART NO. & FSCM	DESCRIPTION	LOCATION	USABLE ON CODE	QTY REQ'D	RCV'D	DATE	DATE	DATE
C-21		6665-00-682-4765	XX63-001-00 (80701)	Water Test Kit, Bacteriological		3	1				
C-21	1		XX63-000-01 (80701)	• Case, Carrying		3	1				
C-21	2		XX65-047-05 (80701)	• Bottle, Alcohol, 120 ml		3	1				
C-21	3		XX62-000-06 (80701)	• Forceps		3	1				
C-21	4		XX62-000-03 (80701)	• Cup, Sample, Graduated		3	1				
C-21	5		XX62-000-35 (80701)	• Syringe, Vacuum		3	1				
C-21	6		XX63-000-58 (80701)-	• Tubing, Plastic		3	2				
C-21	7		XX63-001-20 (80701)	• Filter Holder Assembly		3	1				
			XX63-001-21 (80701)	• • Funnel, 100 ml		3	1				
			XX63-001-24 (80701)	• • Base, Sterilizing, Alum		3	1				
			XX20-047-01 (80701)	• • Ring, Funnel Locking		3	1				
			XX40-047-14 (80701)	• • Gasket, Locking Ring		3	1				
			XX20-047-08 (80701)	• • Support Screen, Stainless		3	1				
			XX20-047-03 (80701)	• • Gasket, Support Screen		3	1				
			XX20-047-07 (80701)	• • Lockwheel Set		3	1				
			XX63-001-25 (80701)	• • Support Holder, w/Ring		3	1				
			YY40-142-67 (80701)	• • O-Ring, Support		3	1				
		XX63-001-23 (80701)	• • O-Ring, Base		3	2					
		XX63-001-28 (80701)	• • Wick, Sterilizing, Base		3	1					
		XX63-001-35 (80701)	• Pipettes, Plastic		3	25					

(1) ILLUSTRATION		(2) NATIONAL STOCK NUMBER	(3) PART NO. & FSCM	(4) DESCRIPTION	(5) LOCATION	(6) USABLE ON CODE	(7) QTY REQ'D	(8) QUANTITY			
(a) FIGURE NO.	(b) ITEM NO.							RCV'D	DATE	DATE	DATE
C-21	8		77 (08423)	• Marker, China		3	1				
C-21	9		XX63-001-32 (80701)	• Flask, Dilution		3	1				
C-21	10		XX63-000-03 (80701)	• Gasket, Carrying Case		3	1				
C-21	11		XX63-000-02 (80701)	• Liner, Heating w/Taps		3	1				
C-21	12		XX63-000-50 (80701)	• Container, Spare Parts		3	1				
C-21	13		XX63-000-33 (80701)	• Post, Fuse		3	1				
C-21	14		XX63-000-36 (80701)	• Switch, Selector		3	1				
C-21	15		XX63-000-31 (80701)	• Light, Indicator		3	1				
C-21	16		XX63-000-30 (80701)	• Plate, Control		3	1				
C-21	17		XX63-000-38 (80701)	• Cord, Power		3	1				
C-21	18		XX2C160 (80701)	• Instructions		3	1				
C-21	19		XX63-000-12 (80701)	• Thermometer Ay		3	1				
C-21	20		XX63-001-11 (80701)	• Rack, Incubator		3	1				
C-21	21		XX63-000-52 (80701)	• Adapter Plug, European		3	1				
C-21	22		XX63-000-10 (80701)	• Cover, Incubator Well		3	1				
			XX63-000-37 (80701)	•• Thermostat Ay		3	1				
			XX63-000-35 (80701)	•• Receptacle		3	1				
			XX63-000-53 (80701)	•• Lamp, 14.4V In Spare Parts Container		3	1				

(1) ILLUSTRATION		(2)	(3)	(4)	(5)	(6)	(7)	(8) QUANTITY			
(a) FIGURE NO.	(b) ITEM NO.	NATIONAL STOCK NUMBER	PART NO & FSCM	DESCRIPTION	LOCATION	USABLE ON CODE	QTY REQ'D	RCV'D	DATE	DATE	DATE
C-21		6665-00-682-4765	XX63-001-00 (80701)	Water Test Kit, Bacteriological		3	1				
C-21	1		XX63-000-01 (80701)	• Case, Carrying		3	1				
C-21	2		XX65-047-05 (80701)	• Bottle, Alcohol, 120 ml		3	1				
C-21	3		XX62-000-06 (80701)	• Forceps		3	1				
C-21	4		XX62-000-03 (80701)	• Cup, Sample, Graduated		3	1				
C-21	5		XX62-000-35 (80701)	• Syringe, Vacuum		3	1				
C-21	6		XX63-000-58 (80701)	• Tubing, Plastic		3	2				
C-21	7		XX63-001-20 (80701)	• Filter Holder Assembly		3	1				
			XX63-001-21 (80701)	•• Funnel, 100 ml		3	1				
			XX63-001-24 (80701)	•• Base, Sterilizing, Alum		3	1				
			XX20-047-01 (80701)	•• Ring, Funnel Locking		3	1				
			XX40-047-14 (80701)	•• Gasket, Locking Ring		3	1				
			XX20-047-08 (80701)	•• Support Screen, Stainless		3	1				
			XX20-047-03 (80701)	•• Gasket, Support Screen		3	1				
			XX20-047-07 (80701)	•• Lockwheel Set		3	1				
			XX63-001-25 (80701)	•• Support Holder, w/Ring		3	1				
		YY40-142-67 (80701)	•• O-Ring, Support		3	1					
		XX63-001-23 (80701)	•• O-Ring, Base		3	2					
		XX63-001-28 (80701)	•• Wick, Sterilizing, Base		3	1					
		XX63-001-35 (80701)	• Pipettes, Plastic		3	25					

(1) ILLUSTRATION		(2)	(3)	(4)	(5)	(6)	(7)	(8)			
(a) FIGURE NO.	(b) ITEM NO.	NATIONAL STOCK NUMBER	PART NO. & FSCM	DESCRIPTION	LOCATION	ISSUABLE ON CODE	QTY REQ'D	RCV'D	QUAN DATE	TY DATE	DATE
			XX63-000-54 (80701)	•• Fuse, AGC5  In Spare Parts Container		3	5				
			XX63-000-55 (80701)	•• Wrench, Allen  In Spare Parts Container		3	1				
			XX63-000-56 (80701)	•• Adapter, Alligator  In Spare Parts Container		3	1				
			XX63-000-51	•• Adapter, Receptacle In Spare Parts Container		3	1				
		6505-00-687-8436	M0000002E (80701)	•• Ampoule, Endro- Broth 24 ea.		3	1				
		6540-00-299-8689	PD1004700 (80701)	•• Petri Dish, Plastic, 100 ea.		3	1				
		6540-00-299-8692	HAWG0475 (80701)	•• Disc, Filter, 100 ea.		3	1				

## GLOSSARY

## Section I. ABBREVIATIONS

ACS	American Chemical Society-reagent grade purity
APHA Standard methods	Standard Methods for the Examination of Water and Wastewater, published jointly by the American Public Health Association (APHA), the American Water Works Association (AWWA), and the Water Pollution Control Federation (WPCF). It is available through the Publication Office of the American Public Health Association, Inc., 1740 Broadway, New York, New York 10019. This book is the standard reference work for water analysis. Most procedures contained in this manual are based on Standard Methods.
<b>conc.</b>	Concentrated
<b>DB</b>	Dropping Bottle
<b>°C</b>	Degree(s) Centigrade (Celsius)
<b>°F</b>	Degree(s) Fahrenheit
EPA	Environmental Protection Agency
FTU	Formazin Turbidity Units. Turbidity units of measure based on a Formazin stock suspension.
g	grams
gr/gal	Grains per gallon (1 gr/gal = 17.16 mg/l (1 gr/gal = 17.1 ppm)
l	Liter
MDB	Marked dropping bottle
mg/l	Milligrams per liter - procedures in this manual use the currently acceptable expression of 'milligram' per liter rather than parts per million (ppm)
ml	Milliliter - approximately the same as a cubic centimeter
<b>nm</b>	Nanometer
<b>SCDB</b>	Self-contained dropping bottle
<b>ppm</b>	Parts per million, used interchangeably with milligrams per liter (mg/l) for solutions less concentrated than 700 ppm (17.16 mg/l = 17.1 ppm)
WQAS	Water Quality Analysis Set
WQAS - PM	Water Quality Analysis Set - Preventive Medicine
WQAS - E	Water Quality Analysis Set - Engineer

## Section II. DEFINITION OF UNUSUAL TERMS

**Adjust:** To rectify to the extent necessary to bring into proper operating range.

**Aerobic:** Expose water to air by spraying or fountain methods.

**Align:** To adjust specified variable elements of an item so as to bring to optimum performance.

**Buffer (reagent) solutions:** Buffer solutions are equilibrium systems containing substances which, within limits, neutralize added acids or bases.

**Burette (Buret):** This is a graduated tube for measuring liquid volumes or granular substances.

**Calibrate:** To determine the corrections to be made in the readings of instruments or test equipment used in precise measurements. Consists of the comparison of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared with the certified standard.

**Coagulate:** To produce agglomeration of suspended solids in water in order to induce faster settling or more efficient filtration through addition of such chemicals as Ferric Chloride, Alum or Polyelectrolytes.

**End Points:** That instance at which an anticipated chemical change or reaction takes place because of a change in conditions or because of the addition of chemical solutions.

**Ground Water:** Surface water which filters through the upper layers of earth to collect at a lower layer. Commonly collected from a shallow well, using a pump.

**Indicator:** A Chemical Solution added to water which changes color to indicate a change in the condition of the water, e.g. during a titration procedure.

**Inspect:** To determine serviceability of an item by comparing the physical, mechanical, and electrical characteristics with established standards.

**Interferences:** When testing for a particular element, another element or compound present in the sample will cause an error in the result.

**Lacrimal (Lacrymal):** Relating to, or being, the glands that produce tears.

**Meniscus:** A curvature in a liquid top level in a measuring tube caused by an affinity to the tube material by the liquid. See figure 2-2.

**Organic Growth:** Usually simple life forms which multiply under favorable environmental conditions when the water is not sterile. Examples lichens, moss, grass.

**Precipitate:** A solid which forms when a substance held in solution passes out of solution into a solid form.

**Raw Water:** Any water convenient to troops in the field being considered for their use. Its source may be a lake, stream, well, cistern or other.

**Replace:** To replace unserviceable items with serviceable like items.

**Repair:** Those maintenance operations necessary to restore an item to serviceable condition through correction of material damage or a specific failure.

**Reagent Powder Pillows:** These are chemicals in dry powder form usually premeasured and packaged individually to service one test.

**Service:** To clean, to preserve, to charge, and to add fuel, lubricants, cooling agents, and air. (If it is desired that elements, such as painting and lubricating, be defined separately, they may be so listed).

**Shelf Life:** Shelf life is the expected duration of time, under specified conditions, in which a chemical substance will react with a predetermined result.

**Standard Additions:** This is when a known value in a solution is added to the sample being tested as a check on previous test results.

**Standard Solutions:** A standard solution is a known concentration of an element in water. Standard Solutions may be furnished as part of a kit or made up prior to the test.

**Stoichiometric Point:** That point in a solution when chemical equivalent quantities are present and balanced.

**Test:** To verify serviceability and to detect electrical, mechanical or chemical failure by use of test equipment or chemical evaluation.

**Thermoset:** This is a term used to indicate an end point in chemical manufacturing of plastics. Its shape cannot be changed, stretched, diluted, or softened without breakage or destruction.

**Titration:** Titration is the process of determining the constituent in a known volume of solution by the measured addition of a reacting chemical solution of known concentration to completion of the reaction as signalled by observation of an end point.

**Turbidity:** The cloudy or opaque appearance of water due to particles in suspension.

**Untreated Water Sample:** The term "Untreated Water" or "Original Water Sample" appearing in some procedures indicates that the raw water is to be used without the addition of chemicals.

**Volumetric Measurement:** The determination of the concentration of an unknown solution by the addition of measured volumes of a chemical solution of known concentration.

**Water Samples:** This is a measured amount of raw water which is to be analyzed.



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# The Metric System and Equivalents

## Linear Measure

1 centimeter = 10 millimeters = .39 inch  
 1 decimeter = 10 centimeters = 3.94 inches  
 1 meter = 10 decimeters = 39.37 inches  
 1 dekameter = 10 meters = 32.8 feet  
 1 hectometer = 10 dekameters = 328.08 feet  
 1 kilometer = 10 hectometers = 3,280.8 feet

## Weights

1 centigram = 10 milligrams = .15 grain  
 1 decigram = 10 centigrams = 1.54 grains  
 1 gram = 10 decigrams = .035 ounce  
 1 dekagram = 10 grams = .35 ounce  
 1 hectogram = 10 dekagrams = 3.52 ounces  
 1 kilogram = 10 hectograms = 2.2 pounds  
 1 quintal = 100 kilograms = 220.46 pounds  
 1 metric ton = 10 quintals = 1.1 short tons

## Liquid Measure

1 centiliter = 10 milliliters = .34 fl. ounce  
 1 deciliter = 10 centiliters = 3.38 fl. ounces  
 1 liter = 10 deciliters = 33.81 fl. ounces  
 1 dekaliter = 10 liters = 2.64 gallons  
 1 hectoliter = 10 dekaliters = 26.42 gallons  
 1 kiloliter = 10 hectoliters = 264.18 gallons

## Square Measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch  
 1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches  
 1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet  
 1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet  
 1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres  
 1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

## Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch  
 1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches  
 1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

# Approximate Conversion Factors

To change	To	Multiply by	To change	To	Multiply by
inches	centimeters	2.540	ounce-inches	newton-meters	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29.573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound-feet	newton-meters	1.365	metric tons	short tons	1.102
pound-inches	newton-meters	.11375			

# Temperature (Exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C
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DEPARTMENT OF THE ARMY