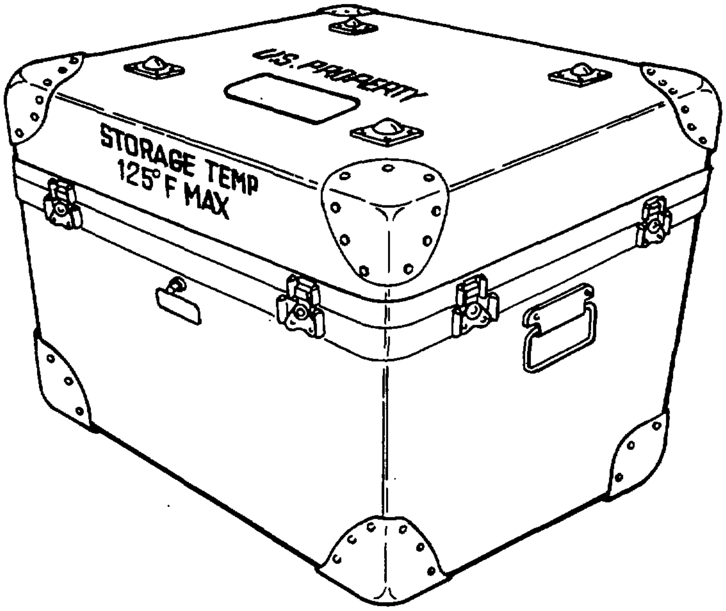
TECHNICAL MANUAL

OPERATOR, UNIT, AND DIRECT SUPPORT MAINTENANCE (INCLUDING REPAIR PARTS AND SPECIAL TOOLS LIST)

FOR

WATER QUALITY ANALYSIS SET PREVENTIVE MEDICINE

NSN 6630-01-367-9402
(EIC) ZGF



HEADQUARTERS, DEPARTMENT OF THE ARMY
8 MARCH 1996

CHANGE

NO. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 2 MARCH 1997

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DISTRIBUTION:
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WARNING

HIGH VOILAGE is used during the AC operation of the spectrophotometer in the WQAS-PM. ELI.CTRICAL SHOCK or DEATH ON CONTACT may result if operator fails to observe safety precautions.

Learn the areas containing high voltage in the equipment Before working inside this equipment, turn power off.

WARNING

DANGEROUS CHEMICALS

Dangerous chemicals are provided in this equipment. Death, health hazards or injuries such as severe bums, impaired vision and internal tissue destruction may be experienced if operator fails 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 labware. Do not inhale fumes from products or mixing reactions.

Most acids are corrosive and can cause severe bums.

Keep all bottles and containers capped and sealed to prevent accidental spillage and to increase shelf-life.

Never pipet chemical reagent solutions or water samples by mouth.

For first aid, refer to FM 21-11. First Aid for Soldiers.

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Current as of 14 January 1997.

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-IMP, 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 may be found at the back of this manual immediately preceding the hard copy 2028.

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LIST OF TABLES

HOW TO USE THIS MANUAL

This manual describes physical and chemical processes which require the use of chemicals and solvents to perform tests which detect chemical contamination of water in the field. The user must become completely familiar with the manufacturer/supplier information and adhere to the procedures, recommendations, warnings and cautions of the manufacturer/supplier for the safe use, handling, storage and disposal of these materials.

WARNING AND CAUTION STATEMENTS

WARNING and CAUTION statements have been strategically placed throughout this text prior to operating or maintenance procedures, practices or conditions considered essential to the protection of personnel (WARNING) or equipment and property (CAUTION). A WARNING or CAUTION will apply each time the related step is repeated. Prior to starting any task, the WARNINGS or CAUTIONS included in the text for that task will be reviewed and understood.

HAZARDOUS MATERIALS

Warnings for hazardous material in this manual are designed to warn personnel of hazards associated with such items when they come in contact with them during actual use.

MANUAL OVERVIEW

This manual has been prepared to teach you how to easily and effectively use the equipment supplied in the Water Quality Analysis Set Preventive Medicine to perform tests which detect chemical contamination of water in the field. The manual does not, however, set standards for water quality, or the amount of contamination which makes water unusable. You should refer to unit procedures and applicable specifications for that information.

FINDING INFORMATION

Indexing and access features used in this manual let you find information quickly:

a. Use the front cover index to find major sections of the manual. The bleed-to-edge(black box) locators are aligned with the sections to which they apply.

b. At the front of the manual there is an overall table of contents that shows you major areas of information found in the manual. The major areas are boxed to match the front cover index.

c. In the front of each chapter, there is a detailed section table of contents for easy local use with each section.

d. In the back of the manual there is an alphabetical key word index to help you find specific information.

e. In the back of the manual there is a glossary with abbreviations specific to this manual and definitions of words used in the manual.

f. Pages are numbered to identify each page with chapter number and page number.

Documents referenced in this manual are listed in Appendix A.

GENERAL TECHNIQUES

Before using the equipment, read and understand the general techniques explained and illustrated in para 2.6. Be sure you are familiar with the equipment, chemicals and lab ware you will be using. There is a diagram in Chapter 1 to help you locate and identify specific pieces of equipment.

WATER QUALITY ANALYSIS PROCEDURES

The water quality analysis procedures are in Chapter 2, para 2.6.8. Notes have been provided to help explain and clarify specific procedures. Be sure you follow and understand the information contained in the notes.

Be sure to heed all WARNINGS and CAUTIONS which accompany each test procedure.

MAINTENANCE

The preventive maintenance checks and services you will be expected to perform to keep your equipment in good operating condition are explained in Chapter 2. Section II. Be sure to perform these tasks at the intervals shown in the table.

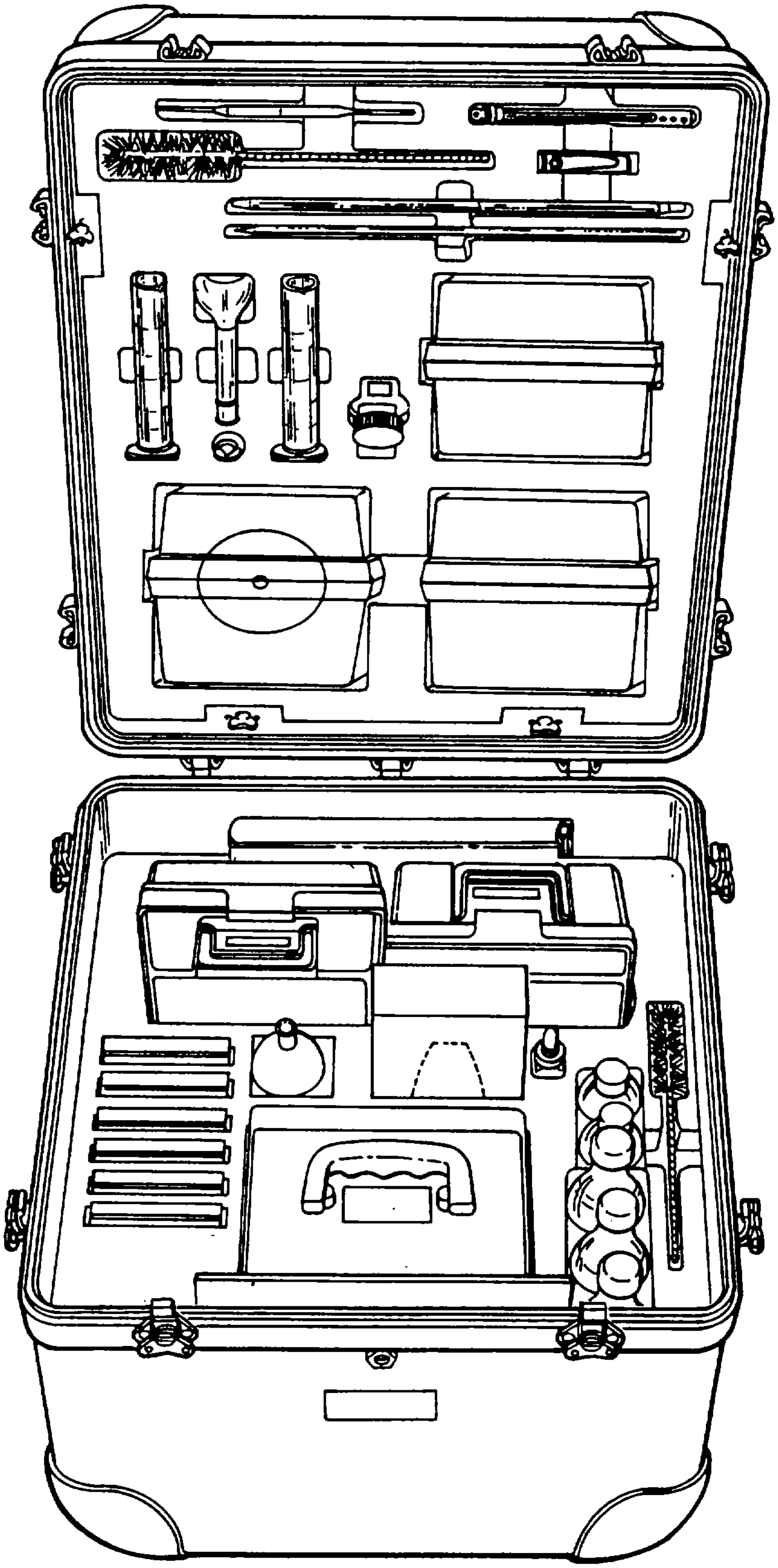
Operator troubleshooting and maintenance procedures are explained in Chapter 3.

Unit troubleshooting and maintenance procedures are explained in Chapter 4.

There are no direct support maintenance procedures for the WQAS-PM.

Appendix B contains the Maintenance Allocation Chart (MAC) which defines the functional groups which make up the equipment. It also contains maintenance levels and approximate times it will take you to perform specific tasks.

Appendix C contains the Repair Parts and Special Tools List (RPSTL). The RPSTL includes illustrations and tabular lists of all repair parts for the set. Source, Maintenance and Recoverability (SMR) codes are included in the tables to help you identify who can use, repair, replace and dispose of parts. Required quantities of each item are also listed. There are three cross-reference indexes for National Stock Numbers (NSN), Part Numbers and Commercial and Government Entity Cod e (CAGEC) vs illustrated parts lists. When you need to replace a part, use the RPSTL "How to Locate Repair Parts" section



CHAPTER 1.
INTRODUCTION

SECTION I. GENERAL INFORMATION

1.1. SCOPE.

a. Type of Manual: Operator's, Unit, and Direct Support Maintenance (Including Repair Parts and Special Tools List)

b. Model Number and Equipment Name: Water Quality Analysis Set - Preventive Medicine (WQAS-PM) NSN 6630-01-367-9402.

c. Purpose of Equipment: To immediately detect chemical contamination of water. This information can be used to decide what kind of purification equipment is needed. The information is also used to decide how to monitor purification equipment after it is installed.

1.2. MAINTENANCE FORMS AND RECORDS.

Department of the Army forms and procedures used for equipment maintenance will be those prescribed by (as applicable):

DA Pam 738-750	The Army Maintenance Management System (TAMMS);
DA Pam 738-751	Functional Users Manual for the Army Maintenance Management System - Aviation (TAMMS-A); or
AR 700-138	Army Logistics Readiness and Sustainability.

1.3. CORROSION PREVENTION AND CONTROL (CPC).

Corrosion Prevention and Control (CPC) of Army materiel is a continuing concern. It is important that any corrosion problems with this item be reported so that the problem can be corrected and improvements can be made to prevent the problem in future items.

While corrosion is typically associated with rusting of metals, it can also include deterioration of other materials, such as rubber and plastic. Unusual cracking, softening, swelling or breaking of the materials may be a corrosion problem.

If a corrosion problem is identified, it can be reported using Standard Form 368, Product Quality Deficiency Report. Use of key words such as "rust", "deterioration", "corrosion" or "cracking" will insure that the information is identified as a CPC problem. The form should be submitted to the address specified in DA Pam 738-750.

1.4. DESTRUCTION OF ARMY MATERIEL TO PREVENT ENEMY USE.

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

Dispersal. Widely dispersed scattering of materiel, 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.

TM 750-244-3, Procedure for Destruction of Equipment to Prevent Enemy Use, contains further instructions for destruction of equipment to prevent enemy use.

1.5. REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIR).

If your WQAS-PM needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design or performance. Put it on an SF 368 (Product Quality Deficiency Report). Mail it to us at: Commander, U.S. Army Aviation and Troop Command, ATTN: AMSAT-I-MP, 4300 Goodfellow Blvd., St. Louis, MO 63120-1798. We will send you a reply.

1.6. NOMENCLATURE CROSS-REFERENCE LIST.

Common Name	Official Nomenclature
FerroVer® pillows, 5 ml sample	Iron reagent powder pillows for 5 ml sample
FerroVer® iron reagent powder pillows, 25 ml Sample	Phenanthroline reagent 25 ml sample
Nessler reagent	Mercuric potassium Nessler reagent
Micro pipet	Volumetric micro pipet
Mini burette	Laboratory buret
Volumetric pipet, 1.0 ml	Measuring pipet 1.0 ml
Iron Test Kit	Iron Deter Test Kit
Main carrying case	Case, transit and storage

SECTION II. EQUIPMENT DESCRIPTION

1.7. EQUIPMENT CHARACTERISTICS, CAPABILITIES, AND FEATURES.

CHARACTERISTICS

- Self sufficient, contains all equipment and supplies needed to test water for a number of different chemicals.
- Individual items are packed in a foam insert.
- Water tight case
- Shock resistant
- Can be carried short distances by one person.

FEATURES

- Includes spectrophotometer for colorimetric testing.
- Five individually packaged test kits.
- Can be used in the field or remote sites.
- Air release valve on front of case for air flight.
- Spectrophotometer can be used with either batteries or ac line power. Ac line power may be 115V or 220V.

CAPABILITIES

Can be used to monitor quality of raw water sources, waste water, and drinking water by performing the following tests:

Test Performed	Range	Test Kit Used
1. Acidity, free, high range	0 to 500 mg/l	Acidity Test Kit
2. Acidity, free, low range	0 to 150 mg/l	Acidity Test Kit
3. Acidity, total, high range	0 to 500 mg/l	Acidity Test Kit
4. Acidity, total, low range	0 to 150 mg/l	Acidity Test Kit
5. Chlorides	1,000 to 20,000 mg/l	Chloride Test Kit High Range
6. Dissolved oxygen	0.2 mg/l and above	Dissolved Oxygen Test Kit
7. Fluorides	0.0 to 2.0 mg/l	Spectrophotometer
8. Iron, ferrous	0.0 to 2.0 mg/l	Spectrophotometer
9. Iron, ferric, high range	0.0 to 10.0 mg/l	Ferric Iron Test Kit
10. Iron, ferric, low range	0.0 to 1.0 mg/l	Ferric Iron Test Kit
11. Iron, total	0.0 to 2.0 mg/l	Spectrophotometer
12. Nitrogen, ammonia	0.0 to 2.0 mg/l	Spectrophotometer
13. Nitrogen, nitrate	0.0 to 30.0 mg/l	Spectrophotometer
14. pH	4 to 10 pH units	Spectrophotometer
15. Turbidity	0 to 500 FTU	Spectrophotometer
16. Zinc, high range	2.0 to 20.0 mg/l	Zinc Test Kit
17. Zinc, low range	1.0 to 10.0 mg/l	Zinc Test Kit
18. Sulfate	0.0 to 150.0 mg/l	Spectrophotometer

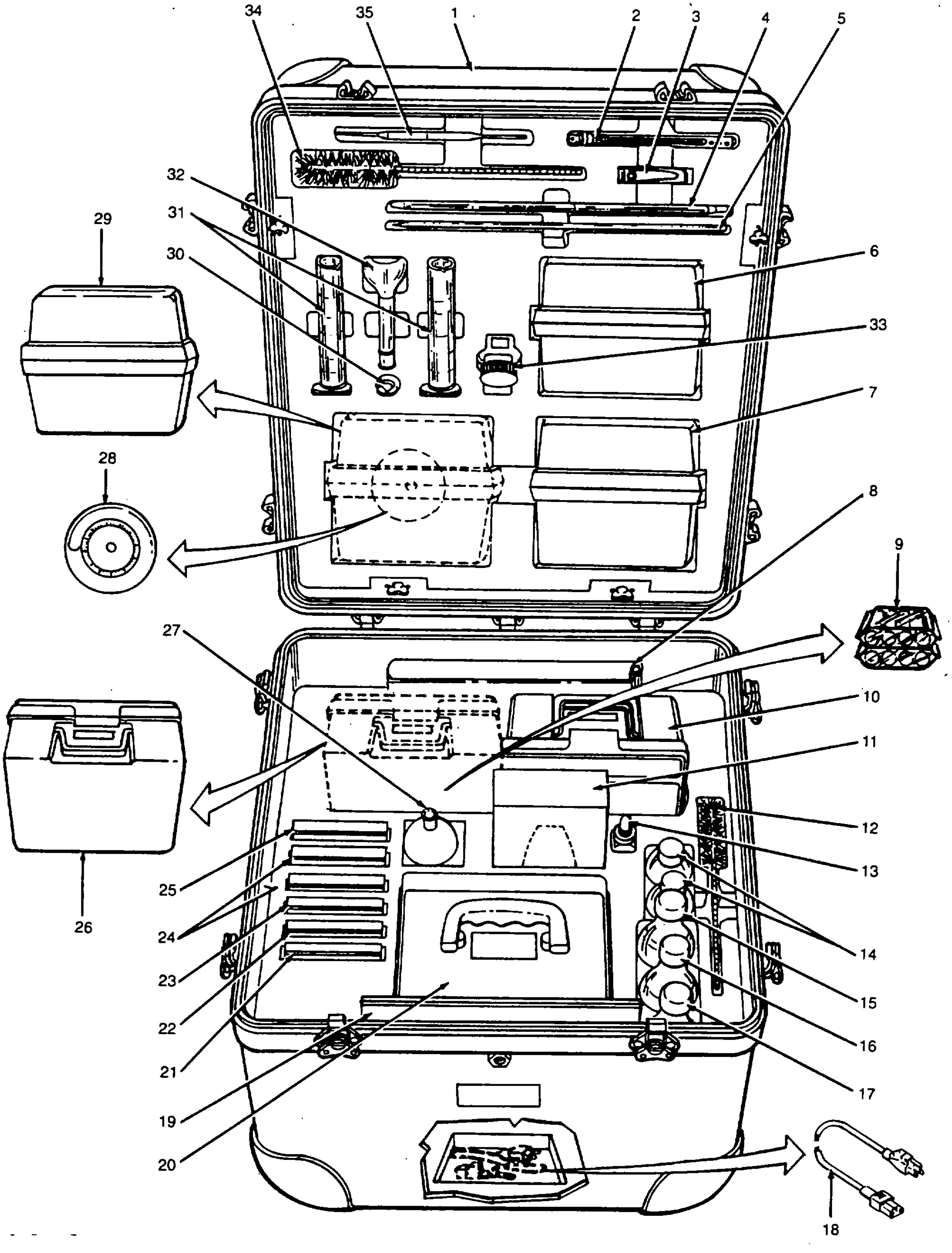


Figure 1-1. WQAS-PM Major Components.

1.8. LOCATION AND DESCRIPTION OF MAJOR COMPONENTS.

1. TRANSIT AND STORAGE CASE: Rugged, shock resistant and water proof main carrying case.
2. ARMORED THERMOMETER: Used to measure temperature.
3. CLIPPERS: Used to open powder pillows.
4. VOLUMETRIC PIPET, 5 ml: Used to transfer accurately measured amounts of liquids.
5. VOLUMETRIC PIPET, 1 ml: Used to transfer accurately measured amounts of liquids.
6. HIGH RANGE CHLORIDE TEST KIT: An individually packaged test kit used to test for the amount of chlorides in a water sample.
7. ACIDITY TEST KIT: An individually packaged test kit used to measure the acidity of a water sample.
8. TECHNICAL MANUAL: Instructions and maintenance for set.
9. BATTERIES: Used with the Spectrophotometer when running on dc power.
10. ZINC TEST KIT: An individually packaged kit that is used to measure the amount of zinc in a water sample.
11. TISSUE, FACIAL: Used to clean spills and glass.
12. SAMPLE CELL BRUSH: Used to clean sample cells in spectrophotometer.
13. SALT SOLUTION, ROCHELLE: A reagent used with the spectrophotometer test for ammonia nitrogen.
14. pH INDICATOR SOLUTION, WIDE RANGE (2 each): A reagent used with the spectrophotometer pH test.
15. FLUORIDE SOLUTION, STANDARD: A reagent used with the spectrophotometer test for fluorides.
16. FLUORIDE SOLUTION, SPADNS METHOD: A reagent used with the spectrophotometer test for fluorides.
17. NESSLER REAGENT TEST SOLUTION: A reagent used with the spectrophotometer test for ammonia nitrogen.
18. POWER CORD: Used with the Spectrophotometer when running on ac power.
19. INSTRUCTION CARDS: Three cards (1) A loading plan showing where and how items are stored in the WQAS-PM, (2) instructions for spectrophotometer use, and (3) instructions for the other test kits.
20. SPECTROPHOTOMETER: An optical instrument used to test for several substances by measuring how light passes through a vial of the sample after it has been treated with a reagent that reacts with the chemical being tested for.
21. FERROVER0 IRON REAGENT POWDER PILLOWS, 5 ml SAMPLE: Phenanthroline reagent used to test for iron, used with Iron Test Kit and Spectrophotometer.
22. FERROVER® IRON REAGENT POWDER PILLOWS, 25 ml SAMPLE: Phenanthroline reagent used with the spectrophotometer test for iron.
23. FERROUS IRON REAGENT POWDER PILLOWS: A reagent used with the spectrophotometer test for ferrous iron.
24. NITRATE TEST REAGENT POWDER PILLOWS (2 each): NitraVer® reagent used with the spectrophotometer test for nitrates.
25. SULFATE TEST REAGENT POWDER PILLOWS: SulfaVer® reagent used with the spectrophotometer test for sulfates.
26. DISSOLVED OXYGEN TEST KIT: An individually packaged test kit used to determine how much oxygen is dissolved in water.
27. PIPET FILLER: A rubber squeeze bulb used to fill and discharge fluid from pipets.
28. COLOR-STANDARD DISK, 0 to 1.0mg/l: A color standard used to determine the color of solutions as part of high range ferric iron tests performed with the Iron Test Kit.
29. IRON TEST KIT: An individually packaged kit that used to find out how much iron is in a water sample.
30. STOPPER, VOLUMETRIC FLASK, 25 ml: Used to seal the volumetric flask.
31. GRADUATED CYLINDER, 2 each 25 ml: A container used to measure liquids.
32. VOLUMETRIC FLASK, 25 ml: A container used to accurately measure 25 ml of liquid.
33. DETERGENT: Used to clean labware.
34. TEST TUBE BRUSH: Used to clean glassware.
35. VOLUMETRIC PIPET, MICRO: Used to transfer liquids.

1.9. EQUIPMENT DATA.

WEIGHTS AND DIMENSIONS	
Weight	55 lbs (25 kg)
Length	21.12 in. (53.65 cm)
Width	20.12 in. (51.11 cm)
Height	16.34 in. (41.50 cm)
BEST OPERATING TEMPERATURE	+68 °F to +77 °F (+20 °C to +25 °C)
POWER SPECIFICATIONS (Spectrophotometer)	115/220 volt ac or dc battery
WAVELENGTH (Spectrophotometer)	400 to 700 nanometers (nm), accuracy ±2.5 nm

SECTION III. PRINCIPLES OF OPERATION

1.10. PURPOSE OF EQUIPMENT.

The Water Quality Test Set, Preventive Medicine (WQAS-PM) is used to test for the presence and amount of several chemical substances in water. The substances that can be detected and measured with the WQAS-PM are listed in paragraph 1.7. The WQAS-PM contains all the chemicals, labware, supporting items, and a spectrophotometer as needed to perform the tests described in this manual.

1.10.1. Test Kits.

Substances are tested for by using either the Spectrophotometer or one of the five individually packaged test kits. Each test kit contains chemicals and equipment necessary to perform its particular tests. The tests performed with the test kits are of two general types (1) titration tests and (2) color matching tests.

1.10.2. Titration Tests.

Titration tests are used with the Acidity Test Kit, the Chloride Test Kit, and the Dissolved Oxygen Test Kit. Titration is based on a chemical reaction that produces a change in color in the test sample if the substance being tested for is present. Sometimes the test sample is first treated with a chemical reagent in order to make the desired color-producing reaction occur in the next step. Then a reagent called the titrant is added to the test sample until color change occurs. The amount of titrant needed to change the color is related directly to the amount of substance being tested for.

1.10.3. Color Matching Tests.

Color matching tests are used in the Iron Test Kit and the Zinc Test Kit. Color matching tests are based on adding a specific fixed amount of a test reagent to a water sample. If the substance being tested for is present, a color change will occur. The exact shade or color formed will depend on how much of the test substance was present in the water sample. A color reference is provided and used to compare the color of the treated sample to standard reference colors.

1.10.4. Colorimetric Tests Using a Spectrophotometer.

Colorimetric tests in the WQAS-PM are similar to color matching tests. Specific fixed amounts of chemicals are added to the water sample to produce a color change if the substance being tested for is present. However, in the colorimetric test, the color intensity is measured using an optical instrument called a spectrophotometer. The intensity of the color is related to the concentration of the substance being tested for.

1.10.4.1. Colorimetric Blank.

Visible color in any liquid is due to light being absorbed by the liquid. The WQAS-PM Spectrophotometer is an optical and electronic test instrument that is used to measure the amount of light absorbed by a treated water sample. An untreated sample of water is placed in a special container called a reference cell. The reference cell is then placed in the spectrophotometer. Light is shined through the reference cell. The intensity of the light passing through moves a meter needle. The spectrophotometer is electronically adjusted so that the reading on the meter scale corresponds to a zero concentration of the substance being tested for. This is called adjusting to the blank.

1.10.4.2. Sample Measurement.

Another container identical to the reference cell is called the sample cell. It is filled with the water sample after treating it to produce the color change. The sample cell is placed in the spectrophotometer, and light is shined through the cell. The intensity of light passing through the cell is electronically measured. Electronics move the meter needle an amount depending on the intensity of the light. The spectrophotometer must be adjusted so that light absorbed by the blank cell produced a "zero" reading on the meter scale. Therefore the reading on the meter scale with the sample cell is due only to the light absorbed by the colored substance in the sample cell and not by the sample cell itself or the pure water.

1.10.4.3. Meter Readings.

The spectrophotometer has several cards that can be placed behind the meter needle. On each are printed scale markings for a particular test. These markings have been developed so that the meter needle position will correspond to the concentration of the substance being tested for. In addition one card is marked in units of pH. These are units for measuring the acidity of water. Another card is marked in units for turbidity, and yet another in units of the percent of the light that is transmitted. The correct meter card is specified for each test procedure.

1.10.4.4. Wavelength.

Different colors seen by the eye are due to different wavelengths of light. The spectrophotometer filters out wavelengths of light other than the one needed for the color being measured in a particular test. This is done to prevent absorption at other wavelengths (colors) from interfering with the test. Each test procedure specifies the correct wavelength for that test, which is then set before performing the test.

CHAPTER 2.

OPERATING INSTRUCTIONS

SECTION I.
DESCRIPTION AND USE OF OPERATOR'S CONTROLS AND INDICATORS

2.1. SPECTROPHOTOMETER CONTROLS AND INDICATORS.

The only controls and indicators in the Water Quality Analysis Set-Preventive Medicine (WQAS-PM) are those on the Spectrophotometer. They are all located on the front panel of the instrument (fig. 2-1).

(1) METER: An analog needle moves in response to the amount of light transmitted through a sample cell. The meter is read from the printed scale in the background. Different meter scale cards are used for different tests.

(2) METER SCALE CARDS: A set of 16 cards have various scales for the meter. They are stored in a well to the right of the meter. When using the Spectrophotometer, select the card indicated in the test procedure instructions and slide it in the slot on the left side of the meter.

(3) WAVELENGTH DIAL: Both a control and an indicator, includes a notched wheel that the operator moves back and forth to select the wavelength. The scale showing the selected wavelength is a built-in part of the dial. The scale is read through the clear window to the right of the notched wheel. The selected wavelength is marked by the position of the indicator line on the clear window. The adjustable wavelength range is 400 to 700 nm.

(4) LIGHT CONTROL KNOB: A rotary knob used to set the light intensity.

(5) ZERO ADJUST KNOB: A rotary knob used to adjust the meter to zero when the light switch is in the ZERO CHECK position.

(6) LIGHT SWITCH (ON/OFF SWITCH): A three-position toggle switch. The leftmost position is ON. The center position (straight up) is OFF. The third, rightmost position, is a spring-loaded ZERO CHECK position used when zeroing the meter.

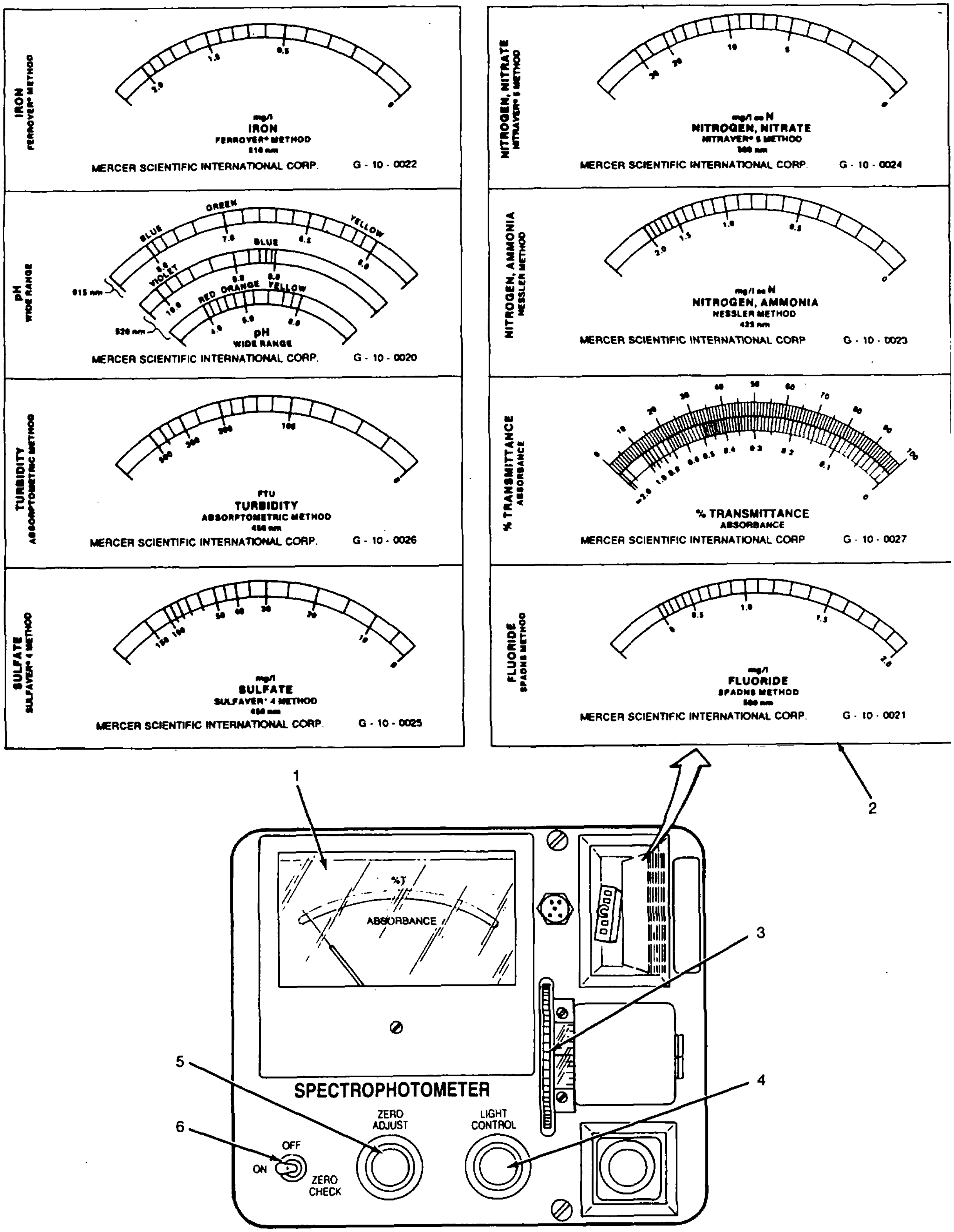


Figure 2-1. Spectrophotometer Controls and Indicators.

SECTION II.
PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS)

2.2. GENERAL.

Preventive Maintenance Checks and Services (PMCS) means the systematic inspecting and servicing of your equipment, so that any defects will be found and corrected before they result in serious damage or failure.

a. Always do your PMCS in the same order, so it gets to be a habit.

b. You should note defects found during operation of the set for future correction, to be made as soon as an operation has ended. Stop an operation that would damage the equipment if use were to continue.

c. Do your AFTER PMCS just after using the set.

d. Do your WEEKLY PMCS once a week.

e. Do your MONTHLY PMCS once a month.

f. Use DA Form 2404 (Equipment Inspection and Maintenance Worksheet) to record any faults or deficiencies that you find before, during, or after operation, unless you can fix them. You DO NOT need to record faults that you fix.

2.3. PMCS PROCEDURES.

Your Preventive Maintenance Checks and Services (Table 2-1), lists inspections and care required to keep your set in good operating condition.

a. In the ITEM NO. column, checks and services are numbered in chronological order regardless of interval. The ITEM NO. column is used as the source of item numbers for DA Form 2404 when recording results of PMCS.

b. The INTERVAL column tells you when to do a certain check or service.

c. The ITEM TO CHECK/SERVICE column identifies which items you have to inspect.

d. The PROCEDURE column tells you how to do required checks and services.

e. The NOT FULLY MISSION CAPABLE IF column tells you when your set is not mission capable. It contains the criteria that make your equipment unable to perform its primary mission.

f. If anything looks wrong and you can't fix it, write it on your DA Form 2404 and report it to your supervisor.

g. Keep all lab ware as clean as possible. Clean with mild soap and water and dry with a clean, lint-free cloth or paper towel.

h. Many chemicals and reagents have a limited useful lifetime. Each bottle or container has an expiration date printed on the label showing its shelf life. Items with an expired shelf life should be replaced.

i. Keep all containers capped and sealed to prevent accidental spillage/leakage and to increase shelf life.

Table 2-1. Preventive Maintenance Checks and Services for WQAS-PM.

WARNING

Dangerous chemicals are found in this equipment. Do not allow reagents or acids to come in contact with skin or eyes. In case of contact, immediately flush eyes and skin with water. Call medic. Do not ingest. In case of ingestion, call medic.

Item No.	Interval	Location Item To Be Check/Service	Procedure	Not Fully Mission Capable If:
1	After	Case, Transit and Storage	Inspect case, fittings and foam inserts for function. Inspect that air valve is closed.	Use or environmental exposure has made case or contents unreliable.
2	After	Chemicals and Supplies	a. Inspect micro pipet, 1 ml pipet, 5 ml pipet, armored thermometer, flask with stopper, two graduated cylinders, color disc, and pipet filler for cracks, breakage, damaged measurement markings. Make sure labware is clean and dry.	a. Labware is damaged or missing to the extent that you can't make accurate measurements.
			b. Inspect test tube brush, sample cell brush, clippers, and facial tissues for damage.	b. Labware is damaged or missing.
			c. Inspect loading diagram, test kit instruction card, multi-purpose test instruction card and manual for legibility and completeness.	c. Loading diagram, instruction cards or manual missing or illegible.
			d. Inspect pH Wide Range Indicator Solution for quantity, current shelf life, leaking container, readable label.	d. Less than one half-full bottle. Shelf life expired. Leakage is evident (until cleaned up and replaced). Contents unidentifiable.
			e. Inspect Fluoride Standard Solution for quantity, current shelf life, leaking container, readable label.	e. Bottle less than 25% full. Shelf life expired. Leakage is evident (until cleaned up and replaced). Contents unidentifiable.
			f. Inspect SPADNS Fluoride Reagent Solution for quantity, current shelf life, leaking container, readable label.	f. Bottle less than 25% full. Shelf life expired. Leakage is evident (until cleaned up and replaced). Contents unidentifiable.
			g. Inspect Mercuric Potassium (Nessler Reagent) Solution for quantity, current shelf life, leaking container, readable label.	g. Bottle less than 25% full. Shelf life expired. Leakage is evident (until cleaned up and replaced). Contents unidentifiable.
			h. Inspect Rochelle Salt Solution for quantity, current shelf life, leaking container, readable label.	h. Bottle less than 25% full. Shelf life expired. Leakage is evident (until cleaned up and replaced). Contents unidentifiable.
			i. Inspect Sulfate Test Reagent powder pillows for current shelf life, damaged pillows, readable label.	i. Shelf life expired. Leakage of pillows is evident (until cleaned up and replaced). Contents unidentifiable.

Table 2-1. Preventive Maintenance Checks and Services for WQAS-PM - Continued.

Item No.	Interval	Location Item To Be Check/Service	Procedure	Not Fully Mission Capable If:
2	After	Chemical and Supplies (continued)	j. Inspect Nitrate Test Reagent powder pillows for current shelf life, damaged pillows, readable label.	j. Shelf life expired. Leakage of pillows is evident (until cleaned up and replaced). Contents unidentifiable.
			k. Inspect Ferrous Iron Reagent powder pillows for current shelf life, damaged pillows, readable label.	k. Shelf life expired. Leakage of pillows is evident (until cleaned up and replaced). Contents unidentifiable.
			l. Inspect Iron Reagent powder pillows (for 5 ml sample) for current shelf life, damaged pillows, readable label.	l. Shelf life expired. Leakage of pillows is evident (until cleaned up and replaced). Contents unidentifiable.
			m. Inspect Phenanthroline Reagent (FerroVer Iron powder pillows for 25 ml sample) for current shelf life, damaged pillows, readable label.	m. Shelf life expired. Leakage of pillows is evident (until cleaned up and replaced). Contents unidentifiable.
			n. Inspect detergent for quantity, leaking container.	n. Bottle less than 25% full. Leakage is evident (until cleaned up and replaced). Contents unidentifiable.
3	After	Test Kit, Acidity	a. Inspect case for function.	a. Use or environmental exposure has made case or contents unreliable.
			b. Inspect test tube and mixing bottle for cracks, breakage, damaged measurement markings. Make sure labware is clean and dry.	b. Labware is broken or missing to the extent that you can't make accurate measurements.
			c. Inspect Bromcresol Green-Methyl Red Indicator powder pillows for current shelf life, damaged pillows, readable label.	c. Shelf life expired. Leakage of pillows is evident (until cleaned up and replaced). Contents unidentifiable.
			d. Inspect Phenolphthalein Solution for quantity, current shelf life, leaking container, readable label.	d. Bottle less than 25% full. Shelf life expired. Leakage is evident (until cleaned up and replaced). Contents unidentifiable.
			e. Inspect Sodium Hydroxide Solution for quantity, current shelf life, leaking container, readable label.	e. Bottle less than 25% full. Shelf life expired. Leakage is evident (until cleaned up and replaced). Contents unidentifiable.
4	After	Test Kit, Ferric Iron	a. Inspect case for function.	a. Use or environmental exposure has made case or contents unreliable.
			b. Inspect color comparator, viewing adapter, two viewing tubes and color disc for cracks, breakage, damaged measurement markings. Make sure labware is clean and dry.	b. Labware is broken or missing to the extent that you can't make accurate measurements.

Table 2-1. Preventive Maintenance Checks and Services for WQAS-PM - Continued.

Item No.	Interval	Location Item To Be Check/Service	Procedure	Not Fully Mission Capable If:
4	After	Test Kit, Ferric Iron (continued)	c. Inspect Phenanthroline Reagent (FerroVer Iron Powder Pillows for 25 ml sample) for current shelf life, damaged pillows, readable label.	c. Shelf life expired. Leakage of pillows is evident (until cleaned up and replaced). Contents unidentifiable.
5	After	Test Kit, Chloride, High Range	a. Inspect case for function.	a. Use or environmental exposure has made case or contents unreliable.
			b. Inspect test tube and mixing bottle for cracks, breakage, damaged measurement markings. Make sure labware is clean and dry.	b. Labware is broken or missing to the extent that you can't make accurate measurements.
			c. Inspect Chloride Titrant Solution (Silver Nitrate) for quantity, current shelf life, leaking container, readable label.	c. Bottle less than 25% full. Shelf life expired. Leakage is evident (until cleaned up and replaced). Contents unidentifiable.
			d. Inspect Chloride Test powder pillows for current shelf life, damaged pillows, readable label.	d. Shelf life expired. Leakage of pillows is evident (until cleaned up and replaced). Contents unidentifiable.
6	After	Test Kit, Dissolved Oxygen	a. Inspect case and foam for function.	a. Use or environmental exposure has made case or contents unreliable.
			b. Inspect flask/stopper, two pipets, burette, and sample bottle for cracks, breakage, damaged measurement markings. Make sure labware is clean and dry.	b. Labware is broken or missing to the extent that you can't make accurate measurements.
			c. Inspect Sulfuric Acid Reagent for quantity, current shelf life, leaking container, readable label.	c. Bottle less than 25% full. Shelf life expired. Leakage is evident (until cleaned up and replaced). Contents unidentifiable.
			d. Inspect Manganese Sulfate Reagent for quantity, current shelf life, leaking container, readable label.	d. Bottle less than 25% full. Shelf life expired. Leakage is evident (until cleaned up and replaced). Contents unidentifiable.
			e. Inspect Potassium Iodide Solution for quantity, current shelf life, leaking container, readable label.	e. Bottle less than 25% full. Shelf life expired. Leakage is evident (until cleaned up and replaced). Contents unidentifiable.
			f. Inspect Starch Indicator Reagent for quantity, current shelf life, leaking container, readable label.	f. Bottle less than 25% full. Shelf life expired. Leakage is evident (until cleaned up and replaced). Contents unidentifiable.

Table 2-1. Preventive Maintenance Checks and Services for WQAS-PM - Continued.

Item No.	Interval	Location Item To Be Check/Service	Procedure	Not Fully Mission Capable If:
6	After	Test Kit, Dissolved Oxygen (continued)	g. Inspect Thiosulfate Standard Solution for quantity, current shelf life, leaking container, readable label.	g. Bottle less than 25% full. Shelf life expired. Leakage is evident (until cleaned up and replaced). Contents unidentifiable.
7	After	Test Kit, Zinc	a. Inspect case and foam for function.	a. Use or environmental exposure has made case or contents unreliable.
			b. Inspect color comparator, two measuring spoons, two comparison tubes, and pipet for cracks, breakage, damaged measurement markings. Make sure labware is clean and dry.	b. Labware is broken or missing to the extent that you can't make accurate measurements.
			c. Inspect Zinc Conditioning Reagent for quantity, current shelf life, leaking container, readable label.	c. Bottle less than 25% full. Shelf life expired. Leakage is evident (until cleaned up and replaced). Contents unidentifiable.
			d. Inspect Zinc Reagent for quantity, current shelf life, leaking container, readable label.	d. Bottle less than 25% full. Shelf life expired. Leakage is evident (until cleaned up and replaced). Contents unidentifiable.
			e. Inspect Deionized Water for quantity, current shelf life, leaking container, readable label.	e. Less than one full bottle. Shelf life expired. Leakage is evident (until cleaned up and replaced). Contents unidentifiable.
8	After	Spectrophotometer	a. Inspect case and fittings for function.	a. Use or environmental exposure has made equipment unreliable.
			b. Make sure unit is clean and dry.	
			c. Make sure sample cells are clean and dry.	
			d. Inspect meter for damage, function.	d. Meter not intact or meter not operating.
			e. Inspect pH wide range meter cards for damage.	e. There is not at least one unmarred, undamaged scale.
			f. Inspect fluoride meter cards for damage.	f. There is not at least one unmarred, undamaged scale.
			g. Inspect iron meter cards for damage.	g. There is not at least one unmarred, undamaged scale.
			h. Inspect nitrogen ammonia meter cards for damage.	h. There is not at least one unmarred, undamaged scale.
			i. Inspect nitrogen nitrate meter cards for damage.	i. There is not at least one unmarred, undamaged scale.
			j. Inspect sulfate meter cards for damage.	j. There is not at least one unmarred, undamaged scale.

Table 2-1. Preventive Maintenance Checks and Services for WQAS-PM - Continued.

Item No.	Interval	Location Item To Be Check/Service	Procedure	Not Fully Mission Capable If:
8	After	Spectrophotometer (continued)	k. Inspect turbidity meter cards for damage. l. Inspect percent transmittance absorbance meter cards for damage. m. Inspect batteries for quantity, damage. Remove batteries if reuse of unit is not planned within two weeks. n. Make sure battery pack cable is disconnected (para 2.6.2.3.b). o. Make sure that alternate line voltage plug is in storage well.	k. There is not at least one unmarred, undamaged scale. l. There is not at least one unmarred, undamaged scale. m. Less than quantity of eight. Batteries not sealed, batteries deteriorated.
9	Monthly	Chemicals and Supplies	a. Inspect pH Indicator Solution for quantity, current shelf life, leaking container, readable label. b. Inspect Fluoride Standard Solution for quantity, current shelf life, leaking container, readable label. c. Inspect SPADNS Fluoride Reagent Solution for quantity, current shelf life, leaking container, readable label. d. Inspect Mercuric Potassium (Nessler Reagent) Solution for quantity, current shelf life, leaking container, readable label. e. Inspect Rochelle Salt Solution for quantity, current shelf life, leaking container, readable label. f. Inspect Sulfate Test Reagent powder pillows for current shelf life, damaged pillows, readable label. g. Inspect Nitrate Test Reagent powder pillows for current shelf life, damaged pillows, readable label. h. Inspect Ferrous Iron Reagent powder pillows for current shelf life, damaged pillows, readable label. i. Inspect Iron Reagent powder pillows (for 5 ml sample) for current shelf life, damaged pillows, readable label.	a. Less than one half-full bottle. Shelf life expired. Leakage is evident (until cleaned up and replaced). Contents unidentifiable. b. Bottle less than 25% full. Shelf life expired. Leakage is evident (until cleaned up and replaced). Contents unidentifiable. c. Bottle less than 25% full. Shelf life expired. Leakage is evident (until cleaned up and replaced). Contents unidentifiable. d. Bottle less than 25% full. Shelf life expired. Leakage is evident (until cleaned up and replaced). Contents unidentifiable. e. Bottle less than 25% full. Shelf life expired. Leakage is evident (until cleaned up and replaced). Contents unidentifiable. f. Shelf life expired. Leakage of pillows is evident (until cleaned up and replaced). Contents unidentifiable. g. Shelf life expired. Leakage of pillows is evident (until cleaned up and replaced). Contents unidentifiable. h. Shelf life expired. Leakage of pillows is evident (until cleaned up and replaced). Contents unidentifiable. i. Shelf life expired. Leakage of pillows is evident (until cleaned up and replaced). Contents unidentifiable.

Table 2-1. Preventive Maintenance Checks and Services for WQAS-PM - Continued.

Item No.	Interval	Location Item To Be Check/Service	Procedure	Not Fully Mission Capable If:
9	Monthly	Chemicals and Supplies (continued)	j. Inspect Phenanthroline Reagent (FerroVer Iron powder pillows for 25 ml sample) for current shelf life, damaged pillows, readable label.	j. Shelf life expired. Leakage of pillows is evident (until cleaned up and replaced). Contents unidentifiable.
10	Monthly	Test Kit, Acidity	a. Inspect Bromcresol Green-Methyl Red Indicator powder pillows for current shelf life, damaged pillows, readable label.	a. Shelf life expired. Leakage of pillows is evident (until cleaned up and replaced). Contents unidentifiable.
			b. Inspect Phenolphthalein Solution for quantity, current shelf life, leaking container, readable label.	b. Bottle less than 25% full. Shelf life expired. Leakage is evident (until cleaned up and replaced). Contents unidentifiable.
			c. Inspect Sodium Hydroxide Solution for quantity, current shelf life, leaking container, readable label.	c. Bottle less than 25% full. Shelf life expired. Leakage is evident (until cleaned up and replaced). Contents unidentifiable.
11	Monthly	Test Kit, Ferric Iron	a. Inspect Phenanthroline Reagent (FerroVer Iron Powder Pillows for 25 ml sample) for current shelf life, damaged pillows, readable label.	a. Shelf life expired. Leakage of pillows is evident (until cleaned up and replaced). Contents unidentifiable.
12	Monthly	Test Kit, Chloride, High Range	a. Inspect Chloride Titrant Solution (Silver Nitrate) for quantity, current shelf life, leaking container, readable label.	a. Bottle less than 25% full. Shelf life expired. Leakage is evident (until cleaned up and replaced). Contents unidentifiable.
			b. Inspect Chloride Test powder pillows for current shelf life, damaged pillows, readable label.	b. Shelf life expired. Leakage of pillows is evident (until cleaned up and replaced). Contents unidentifiable.
13	Monthly	Test Kit, Dissolved Oxygen	a. Inspect Sulfuric Acid Reagent for quantity, current shelf life, leaking container, readable label.	a. Bottle less than 25% full. Shelf life expired. Leakage is evident (until cleaned up and replaced). Contents unidentifiable.
			b. Inspect Manganese Sulfate Reagent for quantity, current shelf life, leaking container, readable label.	b. Bottle less than 25% full. Shelf life expired. Leakage is evident (until cleaned up and replaced). Contents unidentifiable.
			c. Inspect Potassium Iodide Solution for quantity, current shelf life, leaking container, readable label.	c. Bottle less than 25% full. Shelf life expired. Leakage is evident (until cleaned up and replaced). Contents unidentifiable.
			d. Inspect Starch Indicator Reagent for quantity, current shelf life, leaking container, readable label.	d. Bottle less than 25% full. Shelf life expired. Leakage is evident (until cleaned up and replaced). Contents unidentifiable.

Table 2-1. Preventive Maintenance Checks and Services for WQAS-PM - Continued.

Item No.	Interval	Location Item To Be Check/Service	Procedure	Not Fully Mission Capable If:
13	Monthly Oxygen (continued)	Test Kit, Dissolved	e. Inspect Thiosulfate Standard Solution for quantity, current shelf life, leaking container, readable label. unidentifiable.	e. Bottle less than 25% full. Shelf life expired. Leakage is evident (until cleaned up and replaced). Contents
14	Monthly	Test Kit, Zinc	a. Inspect Zinc Conditioning Reagent for quantity, current shelf life, leaking container, readable label. unidentifiable.	a. Bottle less than 25% full. Shelf life expired. Leakage is evident (until cleaned up and replaced). Contents
			b. Inspect Zinc Reagent for quantity, current shelf life, leaking container, readable label. unidentifiable.	b. Bottle less than 25% full. Shelf life expired. Leakage is evident (until cleaned up and replaced). Contents
			c. Inspect Deionized Water for quantity, current shelf life, leaking container, readable label. unidentifiable.	c. Less than one full bottle. Shelf life expired. Leakage is evident (until cleaned up and replaced). Contents
15	Monthly	Spectrophotometer	a. Inspect batteries for quantity, damage.	a. Less than quantity of eight. Batteries not sealed, batteries deteriorated.
16	Monthly	Case, Transit and Storage	Inspect case, fittings and inserts for function.	Use or environmental exposure has been such that case or contents are unreliable.

SECTION III. OPERATION UNDER USUAL CONDITIONS

2.4. ASSEMBLY AND PREPARATION FOR USE.

The WQAS-PM is portable and ready to use. No special assembly and preparation are required before use.

2.5. INITIAL ADJUSTMENTS, CHECKS AND SELF-TESTS.

Before using the WQAS-PM ensure that the after and monthly checks and services specified in the PMCS in table 2-1 have been performed on schedule.

2.6. OPERATING PROCEDURES.

2.6.1. General Techniques for Test Procedures.

Several techniques and concepts are very important in obtaining accurate results using the WQAS-PM. These are explained in this section and referenced in the test procedures in para 2.6.8. Read and learn these procedures before using the WQAS-PM.

2.6.1.1. Planning the Test.

a. Read the Test Procedure. Read the test procedure all the way through before conducting a test. Check to see that all the needed equipment and reagents are readily available.

b. Multiple Samples of Water. Best results are obtained by testing samples from several locations and depths and at different times. A single sample of water may not truly represent the body of water being tested.

c. Repeat Tests for Accuracy. Greater accuracy and confidence in results can be had by testing each sample two or three times. If a second test on the same sample or sample taken from the same location at the same time produces results identical to the first test, this is a good indication that the results are valid. If the second test differs significantly from the first test, perform additional tests until a consistent result is obtained.

d. Time Lapse. As little time as possible should lapse between collecting the sample and making the analysis.

e. Test Temperatures. Ideally the tests should be done with sample temperature between 68°F (20°C) and 77°F (25 °C). If a test requires closer temperature control, it will be noted in the procedure.

f. Be Accurate. Be careful with measurements and handling of reagents and sample. Spilling even a small amount of measured sample or reagent may cause major errors.

g. Make Records. Test results should be recorded as they are determined. It is a good idea to record where the sample was taken, the day and time, the temperature, and name of the person making the tests.

h. Check Reagents. Check reagents before use for any visible sign of contamination. Check the expiration dates.

i. Use Clean Labware. Only clean and dry labware should be used. If in doubt, clean all labware before performing a test. (See para 2.6.1.2 below.) j. Test Ranges. WQAS-PM low-range tests are generally more accurate than high-range tests. Sometimes the approximate result of a test will be known ahead of time. If this expected result is within the low range, try that test first. If the actual result of a low-range test is at the upper end of the range, it is a good idea to confirm with a high-range test. If there is no advance information, it is usually better to do the high-range test first. Then, if the measured results are low enough, perform the low-range test.

2.6.1.2. Cleaning Glassware.

Cleaning labware is a very important part of using the WQAS-PM. All labware should be cleaned immediately after use and before storing the equipment.

NOTE
Dirty glassware may cause inaccurate test results.

a. Use clean water and the detergent and brushes provided in the WQAS-PM to clean labware.

b. Ensure that all glassware is thoroughly clean after each use and before putting it back in the WQAS-PM.

c. Clean immediately after use. Do not let chemicals dry on labware. It is much more difficult to clean equipment, if not cleaned immediately after use.

NOTE
Use deionized water if available.

d. Detergent. Wash with detergent. Use a test-tube brush where possible. When not possible to use a brush, fill labware with detergent solution and agitate by shaking.

e. Rinsing. Rinse at least two times with clean water, until there are no visible suds. Then rinse once more with clean water.

2.6.1.3. Handling and Storing Reagents.

a. Shelf-life, Stability. There is a limited useful lifetime (shelf life) for most reagents in the WQAS-PM. An expiration date is printed on the label of each container. If this date has passed, the reagent may no longer be useful and should be replaced.

b. Powder Pillows. Where possible dry powdered reagents are packaged in polyethylene or foil packages called powder pillows. Each contains the proper amount of reagent for one test. Open the polyethylene pillows with the nail clippers provided in the WQAS-PM. Open the foil pillows by tearing the foil along the tear line.

c. Storing. Store reagents in the designated areas within the WQAS-PM. Do not store them in direct sunlight or extremes of heat and cold, as this will shorten their useful life (shelf life).

d. Avoid Contamination. Do not leave a reagent bottle open when it is in use. This may cause the reagent to degrade due to reaction with the air. Do not remove reagent from a bottle with a dropper or pipet that has not been thoroughly cleaned and dried. This may contaminate the reagent.

2.6.1.4. Collecting Water Samples.

Proper technique is important in getting a representative water sample that is not contaminated. The following techniques are recommended.

a. Use a clean sample container.

b. Whenever possible take samples from the center of the vessel or duct, or away from shorelines, as applicable.

c. Take samples from below the water surface.

d. Take samples as close to the source as possible to avoid contamination by pipes etc.

e. Before taking a sample, rinse the sample bottle or container three times with water from the source to be tested.

f. Avoid contaminating the sample with hands or fingers.

g. Enclosed water systems should be allowed to run for a sufficient time to flush the system.

h. The sample container should be filled slowly with a gentle stream to avoid turbulence and air bubbles.

i. 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.

j. Multiple samples from different depths and locations within a water source will more truly represent the condition of the body of water to be tested.

2.6.1.5. Mixing.

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")(fig. 2-2).

a. Mixing in a Square Sample Cell: Grasp the neck of the sample cell(l) with the thumb and index finger of one hand. Rest the 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.

b. Mixing in a Graduated Cylinder or a Flask: Grip the cylinder(2) (or flask) firmly with the tips of three fingers. Hold the cylinder at a 45 degree angle and rotate the wrist several times as though stirring a pot. Reverse the direction of rotation. Repeat a few times.

Figure 2-2. Mixing Solutions.

2.6.1.6. Using Graduated Cylinders.

a. General. There are two identical 25 ml graduated cylinders in the WQAS-PM. They are used to measure water samples for tests. Only clean dry cylinders should be used for any test procedure. Before using a graduated cylinder, rinse it two or three times with a small quantity of the fluid to be measured. After use the cylinders should be cleaned thoroughly before returning them to the WQAS-PM.

b. Reading the Cylinder. The wall of the cylinder is marked in millimeters. For accuracy, the level of the liquid in the cylinder should be determined by reading the meniscus at the top of the liquid level.

c. Reading the Meniscus (fig. 2-3). The top surface of the water in a container or tube is not flat. Some of the water is pulled-up against the inside walls of the tube. This makes the surface concave. This curved water surface inside the tube is called the meniscus(l). For accurate measurements, the surface level must be read at the bottom of the meniscus. To do this hold the flask or cylinder so the water surface is at eye level. Hold it up against a uniform bright background. (A good technique is to hold a piece of white paper at a slight angle behind cylinder to help highlight the meniscus.) The meniscus will appear as a region at the top of the fluid with a thickness equal to the amount the water is pulled up the sides of the tube. Read the water level at the bottom of this region.

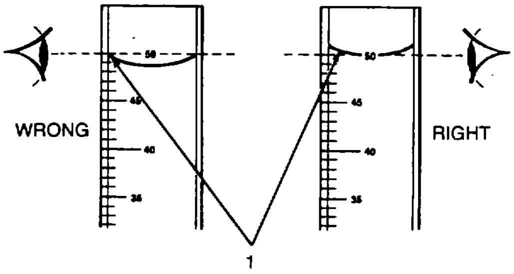


Figure 2-3. Reading the Meniscus.

2.6.1.7. Using Pipets.

Pipets are used to accurately measure a volume of liquid and then to transfer it to a vial or other container. There are two general types of pipets in the WQAS-PM: dropping pipets and standard volumetric pipets (including one micro pipet).

a. Dropping Pipets.

(1) Use: Dropping pipets are found in several of the individually packaged test kits within the WQAS-PM. They are simply eyedroppers with a liquid-level line marked on them. They are used to measure and transfer liquid when only a reasonable amount of accuracy is necessary. They are also used to add reagents to a solution drop by drop (titrating).

(2) Drop Size: The size of a drop from a dropping pipet may vary depending on how the dropper is held. For accurate results with the WQAS-PM drops should be kept the same size. Two things are most important in producing drops of the same size.

(a) The angle at which the dropper is held: The dropper should be held vertically, that is straight up and down, when expelling drops.

(b) How hard the rubber bulb is squeezed: The rubber bulb should be squeezed firmly, slowly, and steadily, until a drop is formed at the tip and falls into the container. Some practice is required to be able to consistently produce drops of the same size.

b. Standard Volumetric Pipets: Volumetric pipets are used to measure and transfer liquids when great accuracy is needed. There are three volumetric pipets in the WQAS-PM. They are found in the main carrying case. Use of all three is similar.

(1) Rinse: Rinse the pipet two or three times with the sample to be tested before filling. Always use a pipet filler to draw the sample into the pipet (fig. 24).

WARNING

Never pipet chemical solutions or water samples by mouth. May be harmful if swallowed. Use the pipet filler. In the event a reagent is accidentally swallowed, follow the directions in the warning statement for that reagent.

(2) Fill: Fill the pipet(l) using the pipet filler(2). The pipet filler is a rubber bulb with several valves. It is used to draw liquid into the pipet and to expel the liquid into a container. It is used as follows:

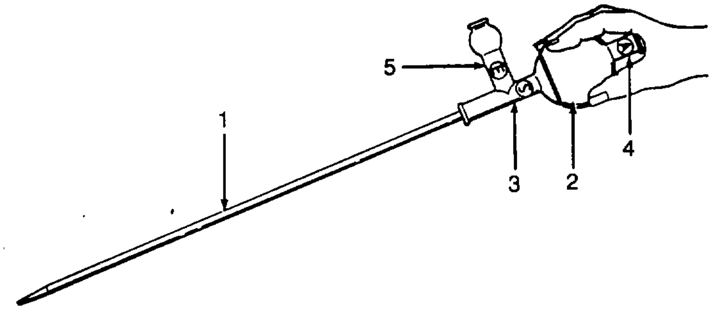


Figure 2-4. Using the Pipet Filler.

(a) Insert the pipet(l) into the tube on the pipet filler(2) containing Valve S(3) until it is firmly seated. If necessary use a twisting motion to firmly seat the pipet(l) within the tube.

(b) Squeeze Valve A(4) while squeezing the rubber bulb. Lower the tip of the pipet(l) into the liquid.

(c) Gently squeeze Valve S(3) to allow liquid to slowly fill the pipet(1) to the level mark on the pipet. Keep the tip of the pipet(1) below the surface of the sample. Otherwise, you will lose the suction and possibly introduce surface particles.

(3) Expel Liquid:

(a) Hold the tip of the pipet(l) at a slight angle against the container wall.

(b) Press Valve E(5) to allow the liquid to drain from the pipet(l).

NOTE

Do not attempt to discharge that portion of the sample of reagent that remains in the tip of the pipet after draining. Pipets are manufactured so that a reproducible amount of sample always remains in the tip of the pipet.

2.6.1.8. Titrating.

a. Purpose. In the WQAS-PM, titrating is a technique used to find out how much of a specific chemical is in water. In some cases, the water may first be treated with one or more reagents. Then a special reagent called the titrating reagent, or titrant, is added to the solution in small measured amounts. The amount of titrant added indicates the amount of the test chemical present in the water.

b. Method. The titrant is added a little bit at a time until a visible chemical change occurs in the solution. Two methods of adding titrant are used in the WQAS-PM: (1) The drop count method in which a dropping pipet is used to add titrant drop by drop, and the drops are counted to determine the amount of titrant used, and (2) with the mini burette where the volume added is read from the burette as described in the test procedure in para 2.6.8.8.

c. End Point. The titration end point, or end of the titration, happens when just enough titrant has been added to turn the water test sample to the color indicated in the procedure. Sometimes a little bit of color will form and then disappear. This means the end point is near but has not yet been reached. The color change must occur and remain after mixing for the true end point to have been reached.

2.6.1.9. Sources of Error.

Knowing things that might cause errors in tests can help the operator to develop good test habits. This knowledge can also be useful in deciding whether to repeat tests and how much to rely upon the results. Several events and conditions that might cause errors in the results are explained below.

a. Temperature. Very hot or very cold temperatures can lower the accuracy of results, can lead to false results, or can prevent the test from working at all. The best temperature (unless otherwise specified in the test procedure) for tests is between 68°F (20°C) and 77°F (25°C). The further from this temperature the less reliable the test is.

b. Chemical Interferences. When testing for one chemical, the presence of another chemical can interfere with the test. It can block the test from working, or it can falsely indicate the presence of something that is not there. Individual test procedures describe common chemicals that interfere with the test. If there is a method of by-passing the interference using the WQAS-PM, it will be described in the test procedure.

c. Too Much Elapsed Time. If too long is taken in performing the test, results can be compromised. Except where specifically noted in the test procedure it is not necessary to rush the tests. However, once the test is begun, it should be completed without stopping for other tasks. With the exception of the Dissolved Oxygen Test (para 2.6.8.8) water samples can be held for several hours after they are taken before beginning a test.

d. Contamination. A common source of error is contamination from dirty labware or foreign matter getting into a reagent. This can be avoided by using only clean dry labware, cleaning all items before storing, and keeping lids securely on all reagents.

e. Aged Chemicals. Some of the reagents have limited shelf lives and are not useful after their expiration date. Check reagents according to the PMCS to avoid this problem.

2.6.2. Operation of Spectrophotometer.

2.6.2.1. Tests Using Spectrophotometer.

The Spectrophotometer is used for the following tests. These tests also require reagents and equipment which are stored in the main carrying case of the WQAS-PM.

SPECTROPHOTOMETER TESTS

TEST	RANGE	TEST	RANGE
Fluorides	0.0 to 2.0 mg/l	Nitrogen, ammonia	0.0 to 2.0 mg/l
Iron, ferrous	0.0 to 2.0 mg/l	Nitrogen, nitrate	0.0 to 30.0 mg/l
Iron, ferric	0.0 to 2.0 mg/l	pH	4 to 10 pH units
Iron, total	0.0 to 2.0 mg/l	Sulfate	0.0 to 150.0 mg/l
Turbidity	0 to 500 FTU		

2.6.2.2. Spectrophotometer Features.

In addition to the controls and indicators described in paragraph 2.1, the Spectrophotometer has several features that the operator must be familiar with to operate the instrument. They are discussed below (fig 2-5).

a. Sample Cells. Two identical sample cells(7) are used to hold treated and untreated water samples on which measurements will be taken. The cells hold approximately 25 ml of water. Two opposite sides of the cells are frosted. The other two opposing sides are clear. When handling the cells hold them by the lip or the frosted sides. Touching the clear sides will leave finger prints that will interfere with measurements. In most test procedures one sample cell well is used to hold a reference blank, usually untreated sample water. The other cell is used to hold the treated sample water. The cells are optically identical and can be used interchangeably. However, if one cell becomes damaged or scratched, they will no longer be identical and should be replaced.

b. Storage Well for Meter Scale Cards. A storage well in the upper right corner(3) of the front panel is used to store meter scale cards(2). This well is also used to store one of the two ac line-voltage-select plugs(l) that is not installed within the unit.

c. Sample Cell Well. The sample cell well(5) is the middle well of three wells on the right of the front panel, next to the wavelength dial(8). Sample cells are put here for measurements and to set the meter for the reference blank. Inside the sample cell well there are two optical windows. In one of these in the center of the left hand side of the sample well is a vertical slit. The light source shines through this window. It then passes through the sample cell. The second window is a round window on the right hand wall of the cell. This is the photocell window. The photocell electronically measures the amount of light passing through the sample cell. The sample cell should always be placed in the well with the two clear sides of the cell on the left and right. When not in use one of the sample cells is stored in the sample cell well.

d. Light Shield. A black lid(4) is hinged to the sample cell well(5). It is called the light shield lid. This lid should be closed when taking readings or when adjusting the meter.

e. Second Cell-Storage Well. This storage well (6) is at the lower right hand comer of the front panel. It is used to store one of the sample cells when not in use.

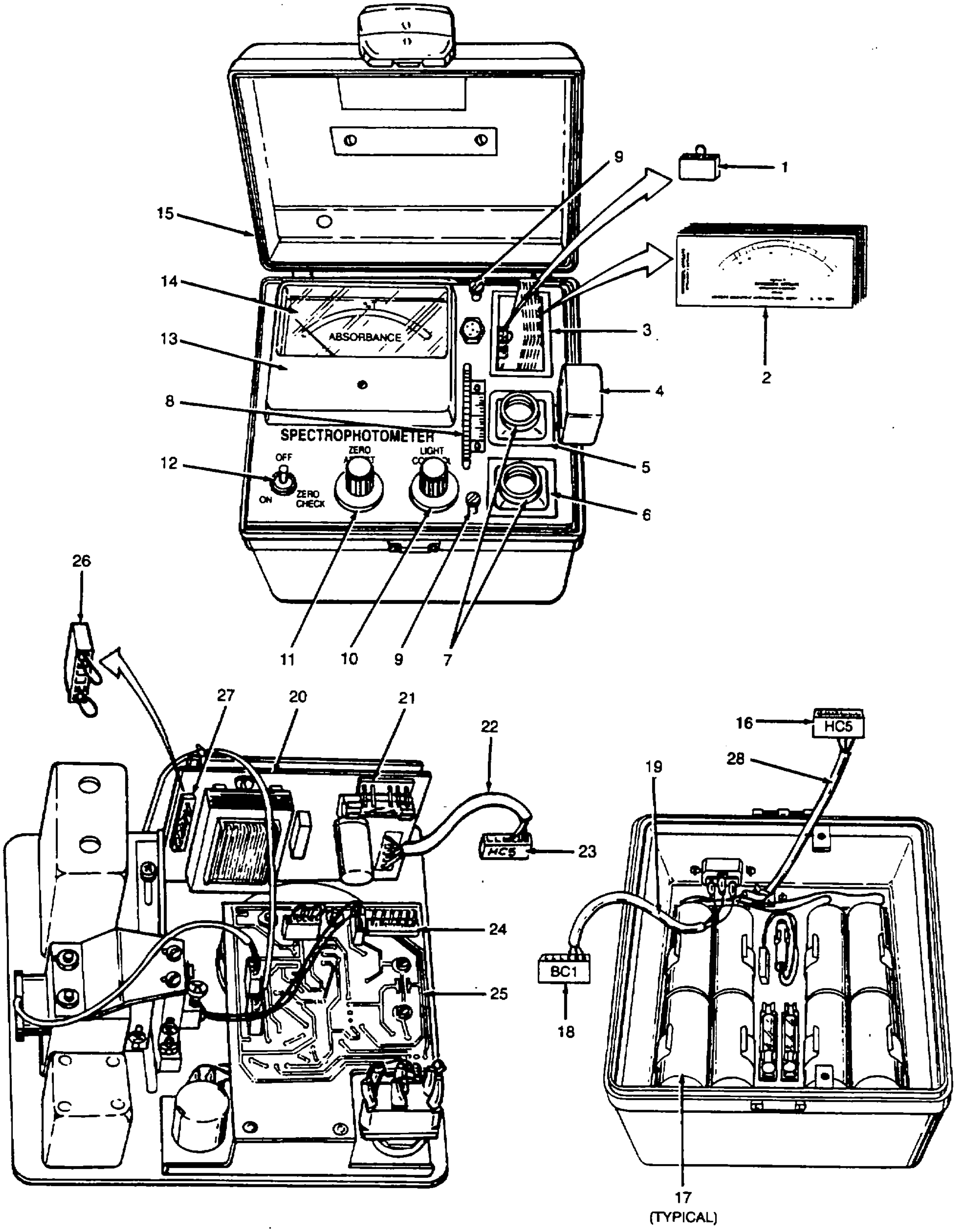


Figure 2-5. Spectrophotometer Features and Power Conversion.

2.6.2.3. Power Conversion.

The Spectrophotometer can be used with 115 Vac line power, 220 Vac line power, and with batteries. The unit must be set up for the type of power that is going to be used.

WARNING

Electrical shock may occur if Spectrophotometer front panel is opened while connected to ac power. Always unplug power cord from both spectrophotometer and external power source before removing front panel. Using the Spectrophotometer when not set up for the proper type of power may result in electrical shock. If electrical shock occurs, see medic.

CAUTION

Using the Spectrophotometer when not set up for the proper type of power may result in damage to equipment. Always check to ensure that the power connections are as specified below before use.

a. Ac Power. 115 Vac or 220 Vac: Follow the steps below to set the unit for use with either 115 Vac or 220 Vac external power sources (fig. 2-5).

(1) Unplug the power cord from the spectrophotometer and the external power source and open the case.

CAUTION

Wavelength dial should be set to 400 to avoid damage to equipment.

(2) Remove the sample cells(7) and meter scale cards(2). Set aside. Push the wavelength dial(8) as far forward as possible so that the indicator is below the lowest reading (400) on the wavelength scale(8).

(3) Loosen the two captive thumb screws(9) on the front panel. Lift the front panel and attached electronics up and out of the case. Turn the front panel upside down and gently lay it on a clean flat surface.

NOTE

An internal ac power cable is connected to the external power cord receptacle on the back wall of the case. It has a plastic plug marked BC1 on the opposite end. The battery power cable is connected to the bottom of the case. It has a plastic plug marked HC5 on the opposite end.

CAUTION

Before connecting, ensure that plug socket on cable and pins on circuit board are properly aligned.

(4) For ac power, connect the plug(18) on the internal ac power cable(19) to the power supply circuit board(20) at DC1(21).

(5) A short (about 4 in. long) internal power cable(22) is permanently attached to the power supply board(20). It has a plastic plug marked HC5(23) at the opposite end. Connect this cable to the amplifier circuit board(25) at location BC5(24).

(6) Change for 115 Vac or 220 Vac. The Spectrophotometer is supplied with two small, plastic, ac power-select plugs (line voltage plugs). One is stamped 115V(26) and has two wire loops. One is stamped 220V(1) and has one wire loop. One plug will be stored in the well(3) with the meter scale cards(2) and the other will be in place at BC4(27) on the power supply board(20). Insert the plug for the voltage to be used (115 Vac or 220 Vac) at BC4(27).

(7) Check all connections to ensure they are complete and plugs are fully seated. Replace the front panel and attached electronics in the case. Fasten the thumb screws(9). Replace the sample cells(7) and meter scale cards(2).

(8) Attach external power cord and plug the Spectrophotometer into the external power source.

WARNING

Electrical shock may occur if Spectrophotometer front panel is opened while connected to ac power. Always unplug power cord from both spectrophotometer and external power source before removing front panel.

Using the Spectrophotometer when not set up for the proper type of power may result in electrical shock. If electrical shock occurs, see medic.

CAUTION

Using the Spectrophotometer when not set up for the proper type of power may result in damage to equipment. Always check to ensure that the power connections are as specified below before use.

b. Battery Dc Power. Eight D-size dry cell batteries(17,fig. 2-5) are provided with the WQAS-PM. These are stored in the main case under the Zinc Test Kit. Follow the steps below to set up the unit for use with batteries.

(1) Unplug the power cord from the spectrophotometer and the external power source and open the case.

CAUTION

Wavelength dial should be set to 400 to avoid damage to equipment.

(2) Remove the sample cells(7) and meter scale cards(2). Set aside. Push the wavelength dial(8) as far forward as possible so that the indicator is below the lowest reading (400) on the wavelength scale(8).

(3) Loosen the two captive thumb screws(9) on the front panel. Lift the front panel and attached electronics up and out of the case. Turn the front panel upside down and gently lay it on a clean flat surface.

(4) Examine the ac power supply board(20) attached to the back of the Spectrophotometer panel. If the unit was previously set up for ac operation, an internal power cable(22) will connect the ac power supply board(20) to the amplifier board(25) at BC5(24). If this is the case unplug this cable(22).

NOTE

An internal ac power cable is connected to the external power cord receptacle on the back wall of the case. It has a plastic plug marked BC1 on the opposite end. The battery power cable is connected to the bottom of the case. It has a plastic plug marked HC5 on the opposite end.

(5) The battery power cable(28) is connected to the bottom of the case. It has a plastic plug marked HC5(16) on the opposite end. For dc power, connect the plug marked HC5(16) at the end of the battery power cable(28) to the amplifier board(25) at location BC5(24).

CAUTION

Installing batteries in the wrong orientation may damage the Spectrophotometer.

NOTE

Follow the polarity orientation shown on the case by the clips.

(6) Install the eight D-size batteries(17, fig. 2-5) in the clips at the bottom of the case as shown in the illustration.

(7) Check all connections and batteries to ensure they are complete and fully seated. Replace the front panel and attached electronics in the case. Fasten the thumb screws(9). Replace the sample cells(7) and meter scale cards(2).

CAUTION

If the Spectrophotometer is to be stored for a significant length of time, the batteries should be removed to avoid damage that may result from battery leakage.

(8) After use, disconnect the Spectrophotometer battery cable(28). Ensure the ac voltage plug(26) is installed on the power supply board(20).

2.6.2.4. Meter Scale Cards.

The Spectrophotometer includes two identical sets of eight meter scale cards(2, fig. 2-5 & fig. 2-1). Test procedures using the Spectrophotometer specify which meter scale card should be used for that test. The specified card is installed (fig. 2-6) by sliding it in the slot(2) at the left of the meter housing(l). Make sure the card is pushed as far to the right as it will go.

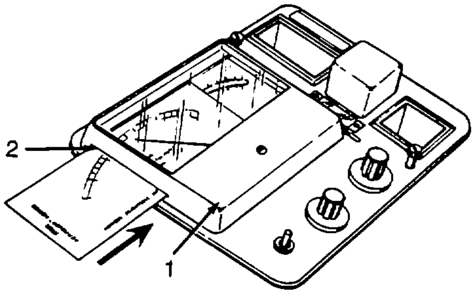


Figure 2-6. Meter Scale Card Insertion.

2.6.2.5. Warm Up.

CAUTION

Under ac power, leaving the unit on for extended periods of time will reduce bulb life and may damage optical elements.

a. The Spectrophotometer should be allowed to warm up for one minute before use. When operating on ac power the unit may be left on after warm up until all the planned tests are completed, to save time. When operating on battery power, the unit should be turned off after a test to conserve battery power.

b. To prolong bulb life and protect optical elements when not in use, set the light control(10, fig. 2-5) for approximately 20 on the %T meter scale(14). Set the wavelength dial(8) to 550 nm.

2.6.2.6. Zeroing the Spectrophotometer.

Before every test-the Spectrophotometer should be "zeroed." Follow these steps (fig. 2-5).

a. Remove any meter scale cards(2) from the meter. The permanent scale(l4) marked as "%T" at the top and "Absorbance" at the bottom should be visible. Make sure the light shield lid(4) over the sample cell well(5) is closed.

b. Turn the unit on by pushing toggle switch (12) to ON position. Let it warm up for one minute.

NOTE

When you release the ON/OFF toggle switch, it automatically returns to OFF position.

c. Push the on/off toggle switch(12) to the right to the ZERO CHECK position. Hold it there.

d. Turn the ZERO ADJUST knob(11) until the needle indicates 0.0 on the %T (percent transmittance) scale(14).

e. Release the on/off toggle switch(12). The procedure is complete.

2.6.2.7. Using the Spectrophotometer (fig. 2-5).

Individual test procedures (para 2.6.8) explain how the Spectrophotometer is used to measure the presence of specific substances in water. Most tests using the Spectrophotometer include two measurements of the light passing through a sample cell. The first measurement is made on a "blank." Typically a blank is an untreated sample of the water to be tested. Deionized water is specified as the blank in a few tests. A second measurement is made on the water sample after it has been treated to develop a color that is related to the concentration of the substance being tested for.

NOTE

The inside of the cell holder should be kept clean and dry at all times. 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.

a. Reference Cell Adjustment. Follow the individual test procedure for preparing a "blank" or reference sample.

(1) Zero adjust the unit. See para 2.6.2.6 above.

(2) Insert the meter scale card(2) specified in the test procedure instructions into the slot on the left of the meter housing(13).

NOTE

When handling clean sample cells do not touch the two clear sides of the cells. If it is necessary to hold the sample cells by the sides touch only the two opposite frosted-glass sides. Finger prints on the clear glass will cause errors in readings.

(3) Make sure the outsides of both sample cells(7) are clean and dry.

(4) Set the wavelength dial(8) as specified in the test procedure.

NOTE

The light shield lid must be closed for all measurements made with the Spectrophotometer. Otherwise, stray light will interfere with readings or cause errors.

(5) Lift the light shield lid(4). Hold the reference sample cell by the top lip and turn it so the clear sides of the sample cell are the left and right sides relative to the Spectrophotometer panel. Gently lower the sample cell into the well(5). Close the light shield lid(4).

(6) Turn the LIGHT CONTROL knob(l0) left or right until the meter needle points to the reference value on the scale(14). The reference value is usually, but not always, zero. See each procedure for the proper reference value.

b. Treated Sample Measurement.

(1) Zero and make reference cell adjustments with the blank or reference sample cell as described in para 2.6.2.7.a above.

(2) Follow steps in the applicable test procedure to treat test sample.

(3) Make sure the meter scale card(2) specified in the procedure is in place.

(4) Place the test sample in the sample well(5) and close the light shield lid(4).

(5) The meter needle position indicates the test results as shown on the meter scale card.

c. Shutdown of the Spectrophotometer.

(1) When testing is complete, push on/off toggle switch(12) to OFF position.

(2) Lift light shield lid(4) and remove sample cell from sample cell well(5).

(3) Remove meter scale card(2) from slot in meter scale housing(13).

WARNING

Electrical shock may occur if Spectrophotometer front panel is opened while connected to ac power. Always unplug power cord from both spectrophotometer and external power source before removing front panel. Using the Spectrophotometer when not set up for the proper type of power may result in electrical shock. If electrical shock occurs, see medic.

NOTE

If using external ac power, perform step (4). If using battery power, perform steps (5) through (7).

(4) Unplug power cord from external power source and from the Spectrophotometer.

(5) Loosen the captive thumb screws(9) on the front panel.

(6) Lift the front panel up and out of the case. Disconnect battery power cable(28) from the amplifier circuit board(25) at BC5(24).

(7) If Spectrophotometer will not be used for two weeks, remove batteries(17). If Spectrophotometer will be used, proceed to next step.

(8) Install front panel into case and secure with captive thumb screws(9).

(9) Insert meter scale cards(2) in storage well(3).

(10) Clean sample cells(7). See para 2.6.1.2.

(11) Insert one sample cell in the sample cell well(5) and the second into the cell storage well(6).

(12) Replace lid(15) on the Spectrophotometer case.

2.6.3 Acidity Test Kit.

a. The Acidity Test Kit is used for the following tests:

TEST	RANGE
Acidity, free, high range	0 to 500 mg/l
Acidity, free, low range	0 to 150 mg/l
Acidity, total, high range	0 to 500 mg/l
Acidity, total, low range	0 to 150 mg/l

b. The kit components and their use are:

(1) Standard Sodium Hydroxide Solution: Titrating reagent used for acidity tests.

(2) Bromcresol Green-Methyl Red Powder Pillows: Used as an indicator in the free acidity tests.

(3) Test Tube: A plastic test tube that is used to measure and to collect samples for high range free and total acidity tests.

(4) Phenolphthalein Indicator Solution: Reagent used as an indicator in the total acidity tests.

(5) Mixing Bottle: Container used to collect water sample.

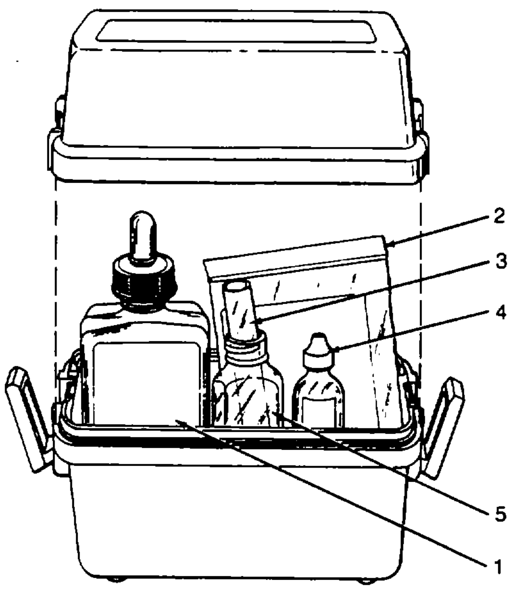


Figure 2-7. Acidity Test Kit.

2.6.4. Ferric Iron Test Kit.

a. The Ferric Iron Test Kit is used for the following tests:

TEST	RANGE
Iron, ferric, high range	0.0 to 10.0 mg/l
Iron, ferric, low range	0.0 to 1.0 mg/l

b. The kit components and their use are:

(1) FerroVer® Iron Reagent Powder Pillows for 25 ml sample: Reagent used to treat water samples for the low range test.

(2) Color-standard Disk, 0.0 to 10 mg/l: Used with color comparator for the low range ferric iron test.

(3) Viewing Tubes: Two identical test tubes with caps that are used to collect and to measure water samples, to treat water samples, and to contain samples while using the color comparator.

(4) Color Comparator: Used to compare the color of the treated water sample to a standard color.

(5) Viewing Adapter: Used with the color comparator to view color match.

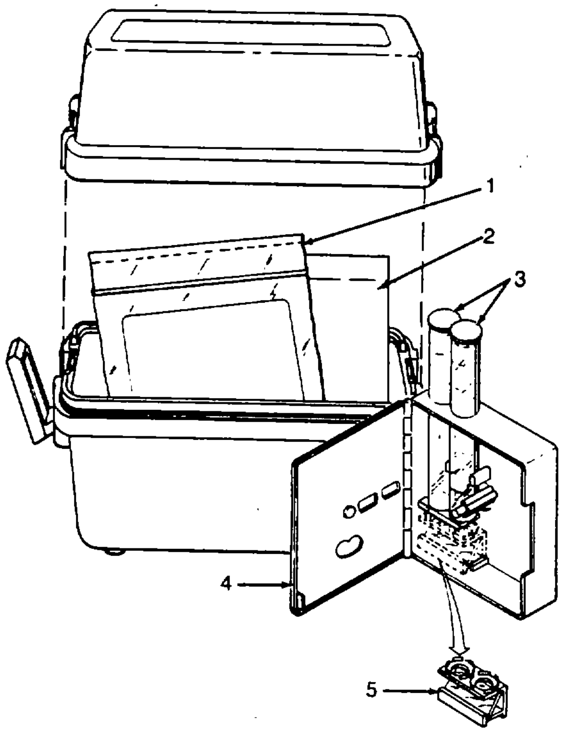


Figure 2-8. Ferric Iron Test Kit.

NOTE

The color-standard disk, 0 to 1 mg/l, used with the color comparator for the low range ferric iron test is stored separately in the main carrying case. The FerroVer® iron reagent for 5-mi samples used for the high range ferric iron test is also stored separately in the main carrying case.

2.6.5. Chloride Test Kit. High Range.

a. The Chloride Test Kit, High Range is used for the following test:

TEST	RANGE

b. The kit components and their use are:

(1) Chloride Titrant (Silver Nitrate): Titrant reagent for the chloride test.

(2) Test Tube: Plastic measuring tube used to collect measured water sample.

(3) Chloride 2 Indicator Powder Pillows: Used to treat water sample before titration.

(4) Mixing Bottle: Used to hold water sample for mixing and titration.

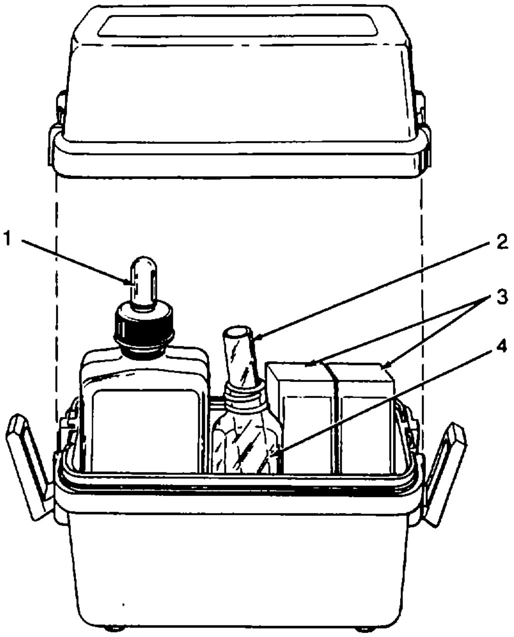


Figure 2-9. Chloride Test Kit, High Range.

2.6.6. Dissolved Oxygen Test Kit.

a. The Dissolved Oxygen Test Kit is used for the following test:

TEST	RANGE
Dissolved oxygen	0.2 mg/l and above

b. The kit components and their use are:

(1) Sample Bottle: An empty bottle holding approximately 60 mil. Used to collect water samples.

(2) Sulfuric Acid Reagent(l: 1): Reagent used as part of sample treatment to fix oxygen in sample.

(3) Titration Flask, 50ml, with Stopper: Used to hold the water sample while titrating.

(4) Sodium Thiosulfate Solution: Titrant reagent for the dissolved oxygen test.

(5) Manganese Sulfate Reagent: Reagent used as part of sample treatment to fix oxygen in sample.

(6) Mini Burette: A tube and plunger device used to deliver measured amounts of titrant.

(7) Starch Reagent Solution: Reagent used as end-point indicator in titration.

(8) Dropping Pipet, 1.0 ml: A rubber-bulb eyedropper-like pipet used to transfer manganese sulfate solution and alkaline potassium iodide solution when fixing oxygen in a water sample.

(9) Dropping Pipet, 0.5 ml: A rubber-bulb eyedropper-like pipet used to measure and transfer sulfuric acid solution when fixing oxygen in a water sample.

(10) Alkaline Potassium Iodide Solution: Reagent used as part of sample treatment to fix oxygen in sample.

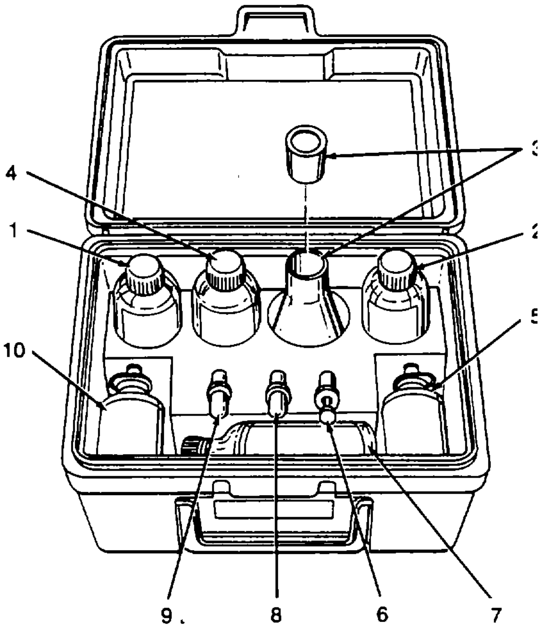


Figure 2-10. Dissolved Oxygen Test Kit.

2.6.7. Zinc Test Kit.

a. The Zinc Test Kit is used for the following tests:

TEST	RANGE
Zinc, high range	2.0 to 20.0 mg/l
Zinc, low range	1.0 to 10.0 mg/l

b. The kit components and their use are:

(1) Zinc Comparator: Used to match colors developed when the test sample is treated. The matched color defines the concentration of zinc in the water sample.

(2) Zinc Reagent: Used to treat sample water to develop color indicating presence of zinc.

(3) Measuring Spoon, 0.5g: Used to measure zinc reagent for the tests.

(4) Measuring Spoon, 0.05g: Used to measure zinc conditioning reagent when treating for copper interference.

(5) Zinc Conditioning Reagent: Used to treat water suspected to contain copper to eliminate interference with test.

(6) Graduated Test Tubes With Caps: Two identical graduated test tubes are used to collect water samples and to hold the samples while they are being treated.

(7) Dropping Pipet: A rubber-bulb eye dropper marked with 0.5 and 1.0 ml volume lines. Used to measure and transfer water samples to the test tubes.

(8) Deionized water: Four identical containers of purified water used for tests and to rinse test tubes prior to tests.

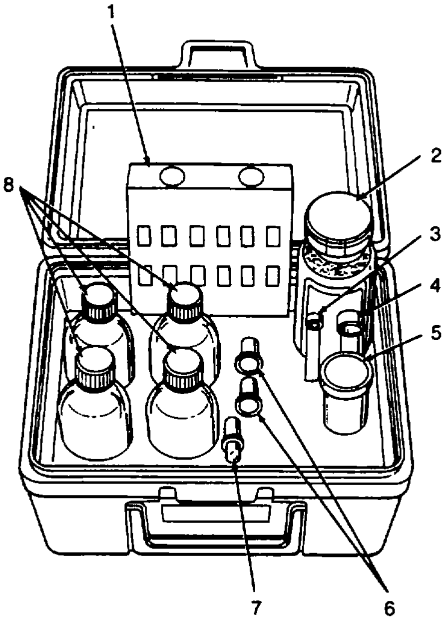


Figure 2-11. Zinc Test Kit.

2.6.8. Water Quality Analysis Procedures.

2.6.8.1. Free Acidity Test. High Range.

a. Purpose of Test: To determine the total acidity in a water sample in terms of the amount of calcium carbonate required to neutralize the sample.

b. Range: From 0 to 500 mg/l of calcium carbonate equivalents

c. Equipment Used: Found in *Acidity Test Kit*, para 2.6.3, fig. 2-7

Standard sodium hydroxide solution, (1), fig. 2-7
Bromcresol green-methyl red, (2), fig. 2-7
Test tube, (3), fig. 2-7
Mixing bottle, (5), fig. 2-7

d. General Techniques Used: Refer to paragraphs cited below as required by procedure.

Planning the Test, para 2.6.1.1
Cleaning Glassware, para 2.6.1.2
Handling and Storing Reagents, para 2.6.1.3
Collecting Water Samples, para 2.6.1.4
Mixing, para 2.6.1.5
Titrating, para 2.6.1.8

e. Test Procedure:

(1) Collect the water sample by filling the plastic measuring tube(3, fig. 2-7) to the brim. Pour the sample into the mixing bottle(5).

WARNING

BROMCRESOL GREEN-METHYL RED INDICATOR POWDER PILLOWS May cause eye, skin and respiratory tract irritation. Do not ingest, inhale, or allow contact with skin or eyes. In case of contact, immediately flush eyes and skin with water for 15 minutes. In case of ingestion, immediately give large quantities of water. In case of inhalation, remove victim to fresh air. Call medic in all cases.

(2) Add the contents of one bromcresol green-methyl red indicator powder pillow(2) to the water sample in the mixing bottle(5). Swirl to mix.

(3) If the water turns either gray-blue, blue, or green the free acidity is zero. Then the test is complete. If the water turns pink go to step (4).

WARNING

SODIUM HYDROXIDE STANDARD SOLUTION Causes burns. Harmful if swallowed. Do not ingest or allow contact with skin or eyes. In case of contact, immediately flush eyes and skin with water for 15 minutes. Remove contaminated clothing. In case of ingestion, DO NOT induce vomiting. Give large quantities of water. Give at least one ounce of vinegar in an equal amount of water. Call medic in all cases.

(4) If the water turns pink during step (3), add standard sodium hydroxide solution(l) drop by drop until the water just begins to turn gray-blue. Count the drops as they are added. Record the number of drops. Constantly swirl the mixing bottle(5) while adding the sodium hydroxide(l).

f. Interpretation of Results:

(1) If the water is gray-blue, blue or green at the end of step (3), the free acidity is zero.

(2) If not zero, the free acidity (in mg/l of calcium carbonate equivalents) is equal to 20 times the number of drops of sodium hydroxide standard solution used.

(3) If the results show that the free acidity is less than 150 mg/l, more accurate results may be obtained by performing the Free Acidity Test, Low Range (para 2.6.8.2) on another test sample.

2.6.8.2. Free Acidity Test. Low Range.

a. Purpose of Test: To determine the total acidity in a water sample in terms of the amount of calcium carbonate required to neutralize the sample.

b. Range: From 0 to 150 mg/l of calcium carbonate equivalents

c. Equipment Used: Found in *Acidity Test Kit*, para 2.6.3, fig. 2-7

Standard sodium hydroxide solution, (1), fig. 2-7	Bromcresol green-methyl red, (2), fig. 2-7
Test tube, (3), fig. 2-7	Mixing bottle, (5), fig. 2-7

d. General Techniques Used: Refer to paragraphs cited below as required by procedure.

Planning the Test, para 2.6.1.1	Cleaning Glassware, para 2.6.1.2
Handling and Storing Reagents, para 2.6.1.3	Collecting Water Samples, para 2.6.1.4
Mixing, para 2.6.1.5	Titrating, para 2.6.1.8

e. Test Procedure:

(1) Collect water sample by filling the mixing bottle (5, fig. 2-7) up to the 23 ml mark with the water to be tested.

WARNING

BROMCRESOL GREEN-METHYL RED INDICATOR POWDER PILLOWS May cause eye, skin and respiratory tract irritation. Do not ingest, inhale, or allow contact with skin or eyes. In case of contact, immediately flush eyes and skin with water for 15 minutes. In case of ingestion, immediately give large quantities of water. In case of inhalation, remove victim to fresh air. Call medic in all cases.

(2) Add the contents of one bromcresol green-methyl red indicator powder pillow(2) to the water sample in the mixing bottle(5). Swirl to mix.

(3) If the water turns either gray-blue, blue, or green the free acidity is zero. Then the test is complete. If the water turns pink go to step (4).

WARNING

SODIUM HYDROXIDE STANDARD SOLUTION Causes burns. Harmful if swallowed. Do not ingest or allow contact with skin or eyes. In case of contact, immediately flush eyes and skin with water for 15 minutes. Remove contaminated clothing. In case of ingestion, DO NOT induce vomiting. Give large quantities of water. Give at least one ounce of vinegar in an equal amount of water. Call medic in all cases.

(4) If the water turns pink during step (3), add standard sodium hydroxide solution(l) drop by drop until the water just begins to turn gray-blue. Count the drops as they are added. Record the number of drops. Constantly swirl the mixing bottle(5) while adding the sodium hydroxide(l).

NOTE

If after adding 30 drops of sodium hydroxide solution, the solution does not change back to gray-blue, stop the test and carry out the Free Acidity Test, High Range (para 2.6.8.1).

f. Interpretation of Results:

(1) If the water is gray-blue, blue or green at the end of step (3), the free acidity is zero.

(2) If not zero, the free acidity (in mg/l of calcium carbonate equivalents) is equal to 5 times the number of drops of sodium hydroxide standard solution used.

2.6.8.3. Total Acidity Test. High Range.

a. Purpose of Test: To determine the total acidity in a water sample in terms of the amount of calcium carbonate required to neutralize the sample.

b. Range: From 0 to 500 mg/l of calcium carbonate equivalents

c. Equipment Used: Found in Acidity Test Kit, para 2.6.3, fig. 2-7

Standard sodium hydroxide solution, (1), fig. 2-7
Phenolphthalein indicator solution, (4), fig. 2-7
Test tube, (3), fig. 2-7
Mixing bottle, (5), fig. 2-7

d. General Techniques Used: Refer to paragraphs cited below as required by procedure.

Planning the Test, para 2.6.1.1
Handling and Storing Reagents, para 2.6.1.3
Mixing, para 2.6.1.5
Cleaning Glassware, para 2.6.1.2
Collecting Water Samples, para 2.6.1.4
Titrating, para 2.6.1.8

e. Test Procedure:

(1) Collect the water sample by filling the plastic measuring tube(3, fig. 2-7) to the brim. Pour the sample into the mixing bottle(5).

WARNING

PHENOLPHTHALEIN INDICATOR SOLUTION May cause irritation if ingested. Do not ingest. In the event of accidental ingestion, give large quantities of water. Call medic.

(2) Add one drop of phenolphthalein indicator solution(4) to the water sample in the mixing bottle(5). Swirl to mix.

(3) If the water turns pink upon addition of indicator, the total acidity is zero.

WARNING

SODIUM HYDROXIDE STANDARD SOLUTION Causes burns. Harmful if swallowed. Do not ingest or allow contact with skin or eyes. In case of contact, immediately flush eyes and skin with water for 15 minutes. Remove contaminated clothing. In case of ingestion, DO NOT induce vomiting. Give large quantities of water. Give at least one ounce of vinegar in an equal amount of water. Call medic in all cases.

(4) If the water remains colorless during step (3), add standard sodium hydroxide solution(l) drop by drop until the water just begins to turn pink. Count the drops as they are added. Record the number of drops. Constantly swirl the mixing bottle(5) while adding the sodium hydroxide(l).

f. Interpretation of Results:

(1) If the water is pink at the end of step (3), the total acidity is zero.

(2) If not zero, the total acidity (in mg/l of calcium carbonate equivalents) is equal to 20 times the number of drops of sodium hydroxide standard solution used.

2.6.8.4. Total Acidity Test. Low Range.

a. Purpose of Test: To determine the total acidity in a water sample in terms of the amount of calcium carbonate required to neutralize the sample.

b. Range: From 0 to 150 mg/l of calcium carbonate equivalents.

c. Equipment Used: Found in *Acidity Test Kit*, para 2.6.3, fig. 2-7

Standard sodium hydroxide solution, (1), fig. 2-7
Phenolphthalein indicator solution, (4), fig. 2-7
Test tube, (3), fig. 2-7
Mixing bottle, (5), fig. 2-7

d. General Techniques Used: Refer to paragraphs cited below as required by procedure.

Planning the Test, para 2.6.1.1
Handling and Storing Reagents, para 2.6.1.3
Mixing, para 2.6.1.5
Cleaning Glassware, para 2.6.1.2
Collecting Water Samples, para 2.6.1.4
Titrating, para 2.6.1.8

e. Test Procedure:

(1) Collect the water sample by filling the plastic measuring tube(3, fig. 2-7) to the brim. Pour the sample into the mixing bottle(5).

WARNING

PHENOLPHTHALEIN INDICATOR SOLUTION May cause irritation if ingested. Do not ingest. In the event of accidental ingestion, give large quantities of water. Call medic.

(2) Add one drop of phenolphthalein indicator solution(4) to the water sample in the mixing bottle(5). Swirl to mix.

(3) If the water turns pink upon addition of indicator, the total acidity is zero.

WARNING

SODIUM HYDROXIDE STANDARD SOLUTION Causes bums. Harmful if swallowed. Do not ingest or allow contact with skin or eyes. In case of contact, immediately flush eyes and skin with water for 15 minutes. Remove contaminated clothing. In case of ingestion, DO NOT induce vomiting. Give large quantities of water. Give at least one ounce of vinegar in an equal amount of water. Call medic in all cases.

(4) If the water remains colorless during step (3), add standard sodium hydroxide solution(l) drop by drop until the water just begins to turn pink. Count the drops as they are added. Record the number of drops. Constantly swirl the mixing bottle(5) while adding the sodium hydroxide(l).

f. Interpretation of Results:

(1) If the water is pink at the end of step (3), the total acidity is zero.

(2) If not zero, the total acidity (in mg/l of calcium carbonate equivalents) is equal to 5 times the number of drops of sodium hydroxide standard solution used.

2.6.8.5. Ferric Iron Test. High Range.

a. Purpose of Test: To determine the amount of ferric iron in water sample.

b. Range: 0 to 10.0 mg/l

c. Equipment Used: Found in *Ferric Iron Test Kit*, para 2.6.4, fig. 2-8 and in *Main Carrying Case*, para 1.8, fig. 1-1

FerroVer® iron reagent for 5 ml sample, (21), fig. 1-1
Color-standard disk, 0 to 10.0 ml range, (2), fig. 2-8
Color comparator, (4), fig. 2-8
Graduated cylinder, (31), fig. 1-1
Viewing tubes, (3), fig. 2-8

d. General Techniques Used: Refer to paragraphs cited below as required by procedure.

Planning the Test, para 2.6.1.1
Handling and Storing Reagents, para 2.6.1.3
Mixing, para 2.6.1.5
Cleaning Glassware, para 2.6.1.2
Collecting Water Samples, para 2.6.1.4
Using Graduated Cylinders, para 2.6.1.6

e. Test Procedure:

WARNING

IRON REAGENT (FERROVER®) May cause eye and respiratory tract irritation. May cause allergic respiratory reaction if swallowed or inhaled. Harmful if swallowed. Do not ingest or allow contact with skin or eyes. Do not breath dust. In case of contact, immediately flush eyes with water for 15 minutes. Remove contaminated clothing. Wash skin with soap and plenty of water. In case of ingestion, DO NOT induce vomiting. Give one or two glasses of water. Never give anything by mouth to an unconscious person. In case of inhalation, remove victim to fresh air. Give artificial respiration if necessary. Call medic in all cases.

(1) Collect the water to be tested. Fill each viewing tube(3, fig. 2-8) with a 5 ml sample of the test water. Use the graduated cylinder(31, fig. 1-1) to measure the 5 ml amount. Add one FerroVer® iron reagent powder pillow(21) for 5 ml samples to one of the viewing tubes.

NOTE

The viewing adapter is not used for this test.

(2) Open the hinged door(4, fig. 2-12) on the color comparator and place the lengthwise viewing adapter in the storage position(3).

(3) Replace the cap(1) on the viewing tube to which the FerroVer® was added. Shake gently. Place this tube of FerroVer® treated sample in the opening in the top of the comparator that is nearest the middle(2). Place the capped tube with the untreated sample in the other hole(5).

(4) Wait 2 to 5 minutes. If ferric iron is present, the treated sample will turn orange. Wait until any bubbles have settled out.

(5) Insert the color-standard disk(2, fig. 2-8) with markings from 1 to 10.0 mg/l. Close the comparator door(4, fig. 2-12).

(6) Hold comparator up to a light (window, sky, lamp) and look through the two side-by-side openings(8) in the front. Rotate the color standard disk(6) until the colors seen through the two windows(8) match.

(7) Record the reading as seen through the scale window(7) in the front of the comparator.

f. Interpretation of Results: The reading through the scale window corresponds to mg/liter of iron in the sample.

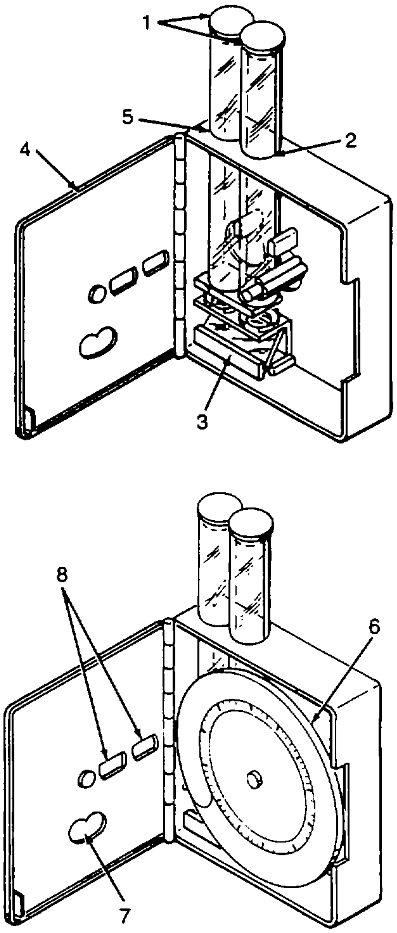


Figure 2-12. Color Comparator, High Range Test.

2.6.8.6. Ferric Iron Test. Low Range.

a. Purpose of Test: To determine the amount of ferric iron in water sample.

b. Range: 0 to 1.0 mg/l

c. Equipment Used: Found in *Ferric Iron Test Kit*, para 2.6.4, fig. 2-8 and in *Main Carrying Case*, para 1.8, fig. 1-1

Color-standard disk, 0 to 1.0 ml range, (28), fig. 1-1
Viewing tubes, (3), fig. 2-8
Viewing adapter, (5), fig. 2-8
FerroVer® iron reagent for 25 ml sample, (1), fig. 2-8
Color comparator, (4), fig. 2-8

d. General Techniques Used: Refer to paragraphs cited below as required by procedure.

Planning the Test, para 2.6.1.1
Handling and Storing Reagents, para 2.6.1.3
Mixing, para 2.6.1.5
Cleaning Glassware, para 2.6.1.2
Collecting Water Samples, para 2.6.1.4

e. Test Procedure:

(1) Open door(4, fig. 2-13) on color comparator and remove both viewing tubes(2 & 6). Position viewing adapter for vertical viewing(3).

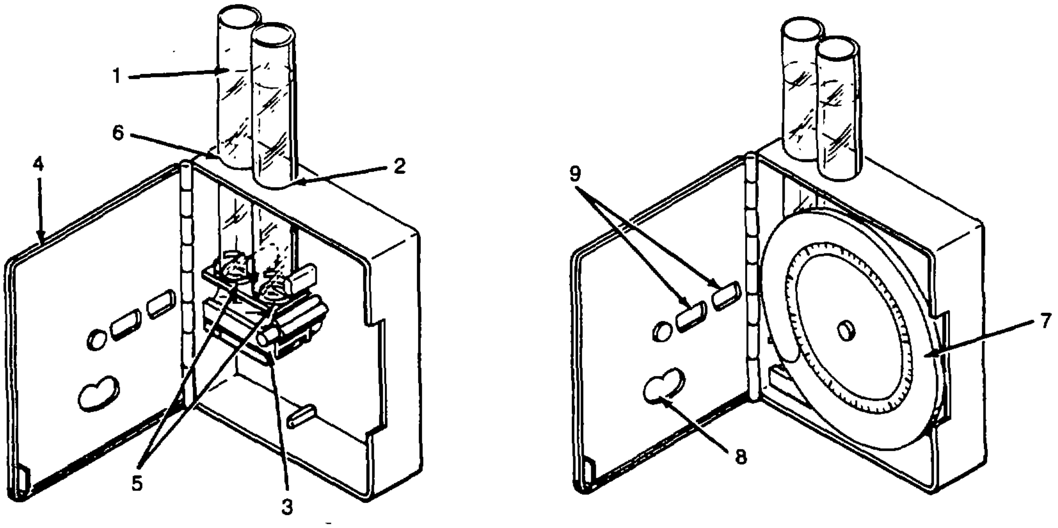


Figure 2-13. Color Comparator, Low Range Test.

WARNING

IRON REAGENT (FERROVER®) May cause eye and respiratory tract irritation. May cause allergic respiratory reaction if swallowed or inhaled. Harmful if swallowed. Do not ingest or allow contact with skin or eyes. Do not breathe dust. In case of contact, immediately flush eyes with water for 15 minutes. Remove contaminated clothing. Wash skin with soap and plenty of water. In case of ingestion, DO NOT induce vomiting. Give one or two glasses of water. Never give anything by mouth to an unconscious person. In case of inhalation, remove victim to fresh air. Give artificial respiration if necessary. Call medic in all cases.

(2) Fill both viewing tubes with water to be tested up to fill line(l) (about an inch from the top). To one tube, add one FerroVer" iron reagent powder pillow(l, fig. 2-8) for 25-ml samples.

(3) Replace the cap on the tube to which the FerroVer® was added. Turn the tube upside down while holding the cap firmly in place. Shake gently. Remove cap from tube.

(4) Check viewing adapter(3) to ensure that it is level and fully seated in the viewing position.

NOTE

Be sure to remove the caps from both tubes before placing them in the comparator. Best results are obtained by slightly tilting the comparator towards the light. Be careful not to spill any liquid from the tube. If liquid spills, repeat the test.

(5) Place the viewing tube with FerroVer® treated sample in comparator hole nearest the middle(2). Place the untreated sample in the other hole(6).

(6) Wait 2 to 5 minutes. If ferric iron is present, sample will turn orange. Wait until any bubbles have settled out.

(7) Ensure that both tubes are fully seated in the recesses(5) in the viewing adapter and that the viewing adapter is fully seated. Insert the standard-color disk(28, fig.1-1) marked 0.0 to 1.0 mg/l, and close the comparator door(4, fig. 2-13).

(8) Hold comparator up to a light source (window, sky, lamp) and look through the two side-by-side openings(9) in the front. Rotate the standard-color disk(7) until the colors seen through the two windows(9) match.

(9) Record the reading seen through the scale window(8) in the front of the comparator.

f. Interpretation of Results: The reading through the scale window corresponds to mg/liter of iron in the sample.

2.6.8.7. Chloride Test. High Range.

a. Purpose of Test: To determine the amount of chloride ion in a water sample.

b. Range: From 1,000 to 20,000 mg/i

c. Equipment Used: Found in *Chloride Test Kit* para 2.6.5, fig. 2-9

Chloride titrant (silver nitrate), (1), fig. 2-9	Test tube, (2), fig. 2-9
Chloride 2 indicator, (3), fig. 2-9	Mixing bottle, (4), fig. 2-9

d. General Techniques Used: Refer to paragraphs cited below as required by procedure.

Planning the Test, para 2.6.1.1	Cleaning Glassware, para 2.6.1.2
Handling and Storing Reagents, para 2.6.1.3	Collecting Water Samples, para 2.6.1.4
Mixing, para 2.6.1.5	Titrating, para 2.6.1.8

e. Test Procedure:

WARNING

CHLORIDE TITRANT (SILVER NITRATE) POISON. Harmful if ingested. Contact may cause severe burns. Do not ingest or allow contact with skin or eyes. In case of contact, immediately flush eyes with water for 15 minutes. Wash skin with soap and plenty of water. In case of ingestion, give large quantities of water or milk. In case of inhalation, remove victim to fresh air. Call medic immediately in all cases.

(1) Condition the dropper for the chloride titrant (silver nitrate)(l, fig. 2-9) by allowing it to soak in the chloride titrant for at least two hours before using it. (Otherwise the drop size may be too small and the resulting answers too large.)

NOTE

If the chloride titrant bottle is full enough to cover the tip of the dropper, and if the bottle has been stored in the upright position, then the tip will have been soaking during storage and this test procedure can be started without waiting.

(2) Collect the water sample by filling the plastic measuring test tube(2) to the brim. Pour the sample into the mixing bottle(4).

WARNING

CHLORIDE 2 INDICATOR POISON. Harmful or fatal if swallowed. May cause eye and respiratory tract irritation. May cause allergic skin reaction. Contains material which can cause cancer. In case of contact, immediately flush eyes with water for 15 minutes. Wash skin with soap and plenty of water. In case of ingestion. DO NOT induce vomiting. Give one or two glasses of water. Never give anything by mouth to an unconscious person. In case of inhalation, remove victim to fresh air. Give artificial respiration if necessary. Call medic in all cases.

WARNING

CHLORIDE 2 INDICATOR

Flammable. Contact with other material may cause fire. In case of fire, use water, carbon dioxide or dry chemical to extinguish.

(3) Open one Chloride 2 indicator powder pillow(3). Add it to the water sample in the mixing bottle(4). Swirl to mix.

(4) Add the chloride titrant(l) drop by drop. Hold dropper vertical. Shake well after each drop. Count the drops until the color of the solution changes to red-brown or orange. If the solution turns yellow and the precipitant that forms is orange, more shaking was needed during the test. Repeat test starting at step (2).

f. Interpretation of Results:

(1) Multiply the number of drops of chloride titrant required times 500 to get the mg/liter of chloride present in the test sample.

(2) Multiply the number of drops of chloride titrant required times 825 to get the mg/liter of sodium chloride present in the test sample.

2.6.8.8. Dissolved Oxygen Test.

a. Purpose of Test: To determine the amount of oxygen gas dissolved in water.

b. Range: 0.2 mg/i to saturation

c. Equipment Used: Found in *Dissolved Oxygen Test Kit*, para 2.6.5, fig. 2-10

Sample bottle, (1), fig. 2-10
Sulfuric acid reagent 1:1, (2), fig. 2-10
Titration flask, 50 ml w/ stopper, (3), fig. 2-10
Sodium thiosulfate, (4), fig. 2-10
Manganese sulfate, (5), fig. 2-10
Mini burette, (6), fig. 2-10
Starch reagent, (7), fig. 2-10
Dropping pipet, 1.0 ml, (8), fig. 2-10
Dropping pipet, 0.5 ml, (9), fig. 2-10
Alkaline potassium iodide, (10), fig. 2-10

d. General Techniques Used: Refer to paragraphs cited below as required by procedure.

Planning the Test, para 2.6.1.1
Cleaning Glassware, para 2.6.1.2
Handling and Storing Reagents, para 2.6.1.3
Collecting Water Samples, para 2.6.1.4
Mixing, para 2.6.1.5
Using Pipets, para 2.6.1.7
Titrating, para 2.6.1.8

e. Test Procedure:

(1) Rinse the sample bottle(l, fig. 2-10) at least 3 times with water from the source to be tested. Cap the bottle(1).

(2) Fill the sample bottle(1) with water to be tested. Do this by completely submerging the bottle(1) below the surface of the water source with the cap still on. Remove the cap underwater. Let the bottle(1) fill. As the bottle(1) is filling squeeze the sides and tap it to ensure no bubbles are trapped. Tightly put the cap back on the bottle(1) while it is still underwater.

(3) Remove the bottle(1) from the water and examine it closely for bubbles. If any are found repeat step (2).

NOTE

Steps (4), (5), and (6) below "fix" the oxygen in the sample so that the test will not be affected by contact with oxygen in the air. Samples collected in the field can be fixed and carried to another location for the remainder of the steps.

WARNING

MANGANESE SULFATE REAGENT

For test purposes only. May be harmful if swallowed. May irritate eyes, skin and mucous membranes on contact. Do not ingest or allow contact with skin or eyes. Avoid breathing vapors. In case of contact, flush eyes with water for at least 15 minutes. Get immediate medical attention. Wash skin with soap and water. In case of ingestion, get immediate medical attention. In case of inhalation, remove victim to fresh air.

(4) Carefully remove the cap from the sample bottle(l) and add 8 drops of manganese sulfate solution(5). Replace the cap on the sample bottle(l). If the manganese supplied in your kit comes with a dropper bottle, drops can be measured directly from the bottle. Otherwise use the 1.0 ml dropping pipet(8) to transfer the drops to the sample bottle(l). Rinse the dropping pipet(8) immediately afterwards.

WARNING

ALKALINE POTASSIUM IODIDE SOLUTION

Corrosive alkali. Harmful if swallowed or inhaled. Burns eyes, skin, nasal and respiratory passages on contact. Vapor irritates eyes and respiratory passages. Do not ingest or allow contact with skin or eyes. Avoid breathing vapors. In case of contact, flush eyes or skin with plenty of water. For eyes, get medical attention. In case of ingestion, DO NOT induce vomiting. Give large amounts of dilute [1: 4] vinegar, lemon, or grapefruit juice. Follow with milk or raw egg whites beaten in water. Call medic immediately. In case of inhalation, remove victim to fresh air.

(5) Carefully remove the cap from the sample bottle(l) and add 8 drops of alkaline potassium iodide solution(10). Replace the cap on the sample bottle(1). If the potassium iodide solution supplied in your kit comes with a dropper bottle, drops can be measured directly from the bottle. Otherwise use the 1.0 ml dropping pipet(8) to transfer the drops to the sample bottle(1). Rinse the dropping pipet(8) immediately afterwards.

(6) Mix by gently turning the sample bottle(l) upside down several times. Allow the precipitate to settle below shoulder of the sample bottle(1).

<u>WARNING</u>

SULFURIC ACID REAGENT

Corrosive acid. May cause permanent damage to eyes, severe bums, and ulcerations on skin. Inhalation may damage respiratory tract. Do not ingest or allow contact with skin or eyes. Avoid breathing vapors. In case of contact, flush eyes or skin with plenty of water. For eyes, call medic. In case of ingestion, DO NOT induce vomiting. Give milk of magnesia and large amounts of water. Follow with milk or raw egg whites beaten in water. Call medic immediately. In case of inhalation, remove victim to fresh air.

(7) Uncap the sample bottle(l). Using the 0.5 ml dropping pipet(9) add 0.5 ml of sulfuric acid(2). Recap the bottle(1) and mix by shaking until the precipitate is completely dissolved. The sample is now "fixed."

(8) Using the sample just treated, fill the 50 ml titration flask(3) to the 50 ml line. Cap the flask(3).

<u>WARNING</u>

THIOSULFATE SODIUM SOLUTION

For test purposes only. May be harmful if swallowed. May irritate eyes, skin and mucous membranes on contact. Do not ingest or allow contact with skin or eyes. Avoid breathing vapors. In case of contact, flush eyes with water for at least 15 minutes. Get immediate medical attention. Wash skin with soap and water. In case of ingestion, get immediate medical attention. In case of inhalation, remove victim to fresh air.

(9) Fill the mini burette(6) with standard sodium thiosulfate solution(4). Follow the steps below.

NOTE

The mini burette consists of a graduated barrel with a tipped plunger that slides freely back and forth inside the barrel. The barrel is marked with 20 numbered major divisions. Each major division is divided into five unnumbered subdivisions. All readings are made where the bottom of the plunger tip intersects the graduated scale.

(a) Remove the cap from the titration reagent sodium thiosulfate solution(4). Insert the open end(3, fig. 2-14) of the mini burette below the liquid. The plunger(l) of the mini burette should be pushed all the way in so the plunger tip(2) is resting on the bottom of the burette barrel(4).

(b) Fill the burette by pulling the plunger(l) up until the plunger tip(2) is lined up with the zero mark on the graduated scale(5). Be sure to keep the tip in the titration solution. Wipe the outside of the mini burette with a tissue before titrating. Recap the bottle of sodium thiosulfate solution(4, fig. 2-10) immediately after filling the burette.

(10) Titrate with standard sodium thiosulfate solution(4) until the brown iodine color has nearly disappeared as follows.

(a) Remove the cap from the titration flask(3).

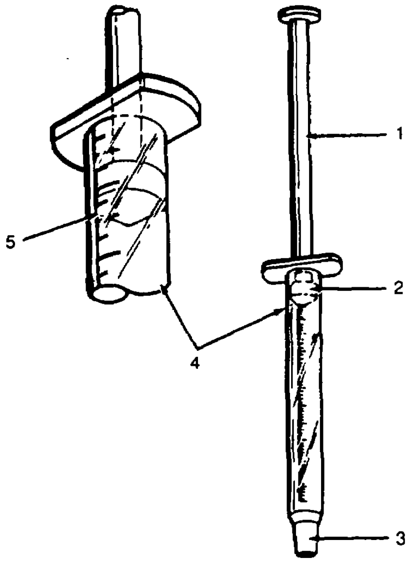


Figure 2-14. Mini Burette.

(b) Hold the titration flask(3) in one hand and the mini burette(6) in the other. Slowly push in the plunger of the mini burette to expel the titration reagent drop by drop. A slight rotating or twisting motion helps the plunger to move smoothly as it is pushed in.

(c) As each drop of reagent falls into the flask(3), swirl the flask(3). Thoroughly mix the solution. Continue adding sodium thiosulfate(4) until the brown iodine color has nearly disappeared. As you near the point at which the color disappears, the solution will clear in the area around the drop and reform as the solution is mixed.

NOTE

If little oxygen was present in the water sample the solution will be only slightly brown, and as little as only one drop of sodium thiosulfate titrant may be required at this step. On the other hand if the oxygen content is high more than one mini burette full of titrant may be required.

NOTE

With experience, drops of different sizes may be expelled from the mini burette depending upon the angle at which it is held. If the mini 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.

WARNING

STARCH REAGENT SOLUTION

For test purposes only. Harmful if swallowed or inhaled. May irritate eyes, skin and mucous membranes on contact. Do not ingest or allow contact with skin or eyes. Avoid breathing vapors. In case of contact, flush eyes with water for at least 15 minutes. Get immediate medical attention. Wash skin with soap and water. In case of ingestion, get immediate medical attention. In case of inhalation, remove victim to fresh air.

(d) Carefully set aside the mini burette(6) filled with sodium thiosulfate. Use the plastic dropping pipet(8) to add 8 drops of starch solution(7). Swirl to mix. The test sample will turn blue.

(e) Using the mini burette(6), continue adding drops of sodium thiosulfate titrant(4) to the test sample in the flask(3). Add the titrant until the blue color just disappears. If no color change is noted by the time the plunger tip(2, fig. 2-14) reaches the 20 mark on the burette, refill the burette(6, fig. 2-10) from the titration reagent(4) bottle. Wipe off the end of burette(3, fig. 2-14), and continue adding titration reagent (4, fig. 2-10) until the color change is observed.

(f) Record the scale reading on the mini burette at the lowest point on the plunger tip(5, fig. 2-14). Record the number of times if any that it was necessary to refill the mini burette.

NOTE

If no additional tests are to be made, discard the titration solution left in the mini burette after the level is recorded. Then thoroughly rinse the mini burette with deionized water before returning it to the kit.

f. Interpretation of Results:

(1) The mini burette has 20 numbered major divisions. Between each there are 5 unnumbered minor divisions. The major divisions correspond to 0.2 mg/l. The minor divisions correspond to 0.04 mg/l.

For example, a reading of 18 major divisions and 2 minor divisions (18.2) would then correspond to:

18 times 0.2 = 3.60 mg/l
2 times 0.04 = 0.08 mg/l
3.68 mg/l of dissolved oxygen in the sample.

NOTE

Sample handling is important for meaningful results. The amount of oxygen dissolved in water changes with depth, temperature, and factors such as sludge, currents, and microbes in the water. Test results can vary depending on how much the test sample was exposed to air, how long it was kept before "fixed" and other factors. It is recommended to take several samples at different depths and locations and perform the test several times for good results.

(2) The amount of oxygen dissolved in water varies considerably with changes in temperature and pressure. Table 2-2 shows, for combinations of temperature and pressure, the amount of oxygen in mg/l present in a pure water sample that is saturated with oxygen. This table can be used as an approximate guide to compare the measured oxygen content to the maximum possible oxygen content for a sample of water at the temperature and pressure of the test sample. Differences between the maximum possible amount in the table and the actual measured amount are due to many factors, such as biological and chemical activity and physical factors such as turbulence.

In using the table you must first determine the pressure for the test sample. If the sample was taken near the surface, the sample pressure is equal to the atmospheric pressure. If it was taken below the surface , the sample pressure is the atmospheric pressure plus the pressure of the water itself. The table lists pressure in terms of inches and millimeters of mercury (Hg). One inch of water exerts a pressure equal to that of 0.074 inches of mercury. Approximate the pressure for a sample taken below the surface as follows. Multiply the sample depth in inches by 0.074. Then add that number to the atmospheric pressure in inches of mercury at the time of measurement to get the sample pressure in inches of mercury.

For instance, if the sample was taken 12 inches below the surface of the water source:

Inches sample was submerged: 12 inches of water Atmospheric pressure at time of measurement: 27.56 in Hg The temperature of the water is 68°F.

then;

Multiply times conversion factor: 12 x 0.074 = 0.888 Pressure of sample = 27.56 + 0.888 = 28.45 inches of Hg (rounded).

and;

from the table the pressure value listed closest to 28.45 is 28.54. For a temperature of 68 °F, the maximum amount of oxygen that can be dissolved in water is about 8.7 mg/l.

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

		Pressure in Millimeters and Inches Hg							
Temp°F	Temp°C	775 mm 30.51 in.	760 mm 29.92 in.	750 mm 29.53 in.	725 mm 28.54 in.	700 mm 27.56 in.	675 mm 26.57 in.	650 mm 25.59 in.	625 mm 24.61 in.
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

2.6.8.9. Zinc Test. High Range.

a. Purpose of Test: To determine the amount of zinc dissolved in water.

b. Range: 2.0 to 20 ppm

c. Equipment Used: Found in Zinc Test Kit, para 2.6.5, fig. 2-11

Zinc comparator, (1), fig. 2-11
Zinc reagent, (2), fig. 2-11
Measuring spoon, 0.05g, (3), fig. 2-11
Measuring spoon, 0.5g, (4), fig. 2-11
Zinc conditioning reagent, (5), fig. 2-11
Two graduated test tubes, (6), fig. 2-11
Dropping pipet, 1.0 ml, (7), fig. 2-11
Deionized water, (8), fig. 2-11

d. General Techniques Used: Refer to paragraphs cited below as required by procedure.

Planning the Test, para 2.6.1.1
Cleaning Glassware, para 2.6.1.2
Handling and Storing Reagents, para 2.6.1.3
Collecting Water Samples, para 2.6.1.4
Mixing, para 2.6.1.5
Using Pipets, para 2.6.1.7
Titrating, para 2.6.1.8

e. Test Procedure:

(1) Make sure both graduated test tubes(6, fig. 2-11) are clean. Rinse both with about an ml of deionized water(8). Use one of the tubes to collect about a half test tube of sample water.

(2) Use the 1 ml dropping pipet(7) to transfer I ml (one dropping pipet full) of the sample water to the empty graduated test tube.

WARNING
ZINC CONDITIONING REAGENT

Irritating to eyes, skin and respiratory tract. For test purposes only. Ingestion can cause nausea, damage mucous membranes, vomiting, pain and circulatory collapse. Do not allow contact with skin or eyes. Do not breathe dust. In case of contact, flush eyes with water for at least 15 minutes. Get immediate medical attention. Wash skin with soap and water. In case of ingestion, get immediate medical attention. In case of inhalation, remove victim to fresh air.

(3) Add one level small spoonful(3)(marked 0.05mg/l) of zinc conditioning reagent(5) to the test tube containing 1 ml of sample water at this point.

(4) Fill the tube that contains 1 ml of sample with deionized water(8) up to the mark etched on the tube.

WARNING
ZINC REAGENT

Irritating to eyes, skin and mucous membranes. Chronic effects: carcinogen. For test purposes only. Do not ingest or allow contact with skin or eyes. Do not breathe dust. In case of contact, flush eyes with water for at least 15 minutes. Get immediate medical attention. Wash skin with soap and water. In case of ingestion, get immediate medical attention. In case of inhalation, remove victim to fresh air.

(5) Use the large measuring spoon(4) (marked 0.5g). Add one level spoonful of zinc reagent(2).

NOTE
Do not shake tube longer than 15 seconds.

(6) Replace the cap on the tube and shake for 15 seconds. Some of the zinc reagent may not dissolve.

(7) Immediately place the test sample in each of the holes in the zinc comparator block(l) and match the color of the solution in the tube with the closest color of the solutions in the test block (zinc ppm comparator).

f. Interpretation of Results:

NOTE

Your comparator is marked in units of parts per million (ppm). The ppm reading is also equal to mg/1.

(1) Find the color, or "shade" that most closely matches that in the tube. The concentration of zinc in parts per million (ppm) is equal to two times the number for the sample in the zinc comparator that most closely matches the color of the test sample. The color intensity may not match perfectly.

(2) If the concentration of zinc in the sample is found to be 8 ppm (mg/l) or less, perform the low-range zinc test in para 2.6.8.10.

2.6.8.10. Zinc Test. Low Range.

a. Purpose of Test: To determine the amount of zinc dissolved in water.

b. Range: 1.0 to 10 ppm

c. Equipment Used: Found in Zinc Test Kit, para 2.6.5, fig. 2-11

Zinc comparator, (1), fig. 2-11
Zinc reagent, (2), fig. 2-11
Measuring spoon, 0.05g, (3), fig. 2-11
Measuring spoon, 0.5g, (4), fig. 2-11
Zinc conditioning reagent, (5), fig. 2-11
Two graduated test tubes, (6), fig. 2-11
Dropping pipet, 1.0 ml, (7), fig. 2-11
Deionized water, (8), fig. 2-11

d. General Techniques Used: Refer to paragraphs cited below as required by procedure.

Planning the Test, para 2.6.1.1
Cleaning Glassware, para 2.6.1.2
Handling and Storing Reagents, para 2.6.1.3
Collecting Water Samples, para 2.6.1.4
Mixing, para 2.6.1.5
Using Pipets, para 2.6.1.7
Titrating, para 2.6.1.8

e. Test Procedure:

(1) Make sure both graduated test tubes(6, fig. 2-11) are clean. Rinse both with about one ml of deionized water(8). Use one of the tubes to collect about a half test tube of sample water.

(2) Use the 1 ml dropping pipet(7) to transfer 2 ml (two dropping pipets full) of the sample water to the empty graduated test tube.

WARNING

ZINC CONDITIONING REAGENT

Irritating to eyes, skin and respiratory tract. For test purposes only. Ingestion can cause nausea, damage mucous membranes, vomiting, pain and circulatory collapse. Do not allow contact with skin or eyes. Do not breathe dust. In case of contact, flush eyes with water for at least 15 minutes. Get immediate medical attention. Wash skin with soap and water. In case of ingestion, get immediate medical attention. In case of inhalation, remove victim to fresh air.

(3) Add one level small spoonful(3) (marked 0.05 mg/l) of zinc conditioning reagent(5) to the test tube containing 2 ml of sample water at this point.

(4) Take the tube with 2 ml of sample. Fill it up to the mark etched on the tube with deionized water(8).

WARNING

ZINC REAGENT

Irritating to eyes, skin and mucous membranes. Chronic effects: carcinogen. For test purposes only. Do not ingest or allow contact with skin or eyes. Do not breathe dust. In case of contact, flush eyes with water for at least 15 minutes. Get immediate medical attention. Wash skin with soap and water. In case of ingestion, get immediate medical attention. In case of inhalation, remove victim to fresh air.

(5) Use the large measuring spoon(4) (marked 0.5g). Add one level spoonful of the zinc reagent(2).

NOTE

Do not shake tube longer than 15 seconds.

(6) Replace the cap on the tube and shake for 15 seconds. Some of the zinc reagent may not dissolve.

(7) Immediately place the test sample in each of the holes in the zinc comparator block(l) and match the color of the solution in the tube with the closest color of the solutions in the test block (zinc ppm comparator).

f. Interpretation of Results:

NOTE

Your comparator is marked in units of parts per million (ppm). The ppm reading is also equal to mg/l.

(1) Find the color, or "shade" that most closely matches that in the tube. The concentration of zinc in parts per million (ppm) is equal to the number for the sample in the zinc comparator that most closely matches the color of the test sample. The color intensity may not match perfectly.

(2) If the color of the test sample most closely matches the 10 ppm color or if it is black or a darker color than found in the comparator, perform the High Range Zinc Test in para 2.6.8.9.

2.6.8.11. Fluoride Test. SPADNS Method.

a. Purpose of Test: To determine the amount of fluorides dissolved in water.

b. Range: O to 2.0 mg/l

c. Equipment Used: Found in Main Carrying Case para 1.8, fig. 1-1

Volumetric Pipet, 5 ml, (4), fig. 1-1
Fluoride solution, SPADNS, (16), fig. 1-1
Pipet filler, (27), fig. 1-1
Fluoride standard solution, (15), fig. 1-1
Spectrophotometer, (20), fig. 1-1
Volumetric flask, 25 ml, (32), fig. 1-1

d. General Techniques Used: Refer to paragraphs cited below as required by procedure.

Planning the Test, para 2.6.1.1
Handling and Storing Reagents, para 2.6.1.3
Mixing, para 2.6.1.5
Spectrophotometer, para 2.6.2.2
Cleaning Glassware, para 2.6.1.2
Collecting Water Samples, para 2.6.1.4
Using Pipets, para 2.6.1.7

e. Test Procedure:

WARNING

High voltage used with Spectrophotometer. Misuse can cause electrical shock and damage equipment. When operating with 115V or 220V power, make sure the power source and equipment are in ground potential. Ensure that the power cable connections are correct for the desired voltage power before connecting the power source.

CAUTION

Accurate volume measurements are very important for this test.

NOTE

The fluoride test is sensitive to interference by small quantities of other chemicals. Glassware must be absolutely clean. If and when repeating a test, the possibility of contamination by other chemicals can be reduced by using the same glassware as first used for the test.

NOTE

Keep the water sample and the fluoride standard solution at the same temperature. At least within one degree. Best results are obtained when both are at 68 °F (20 °C).

(1) Refer to para 2.6.2 for set up and operation of the Spectrophotometer.

(2) Use the 25 ml volumetric flask(32, fig. 1-1) to collect the water sample. Rinse the flask(32) with sample water at least three times. Fill the volumetric flask(32) accurately to the 25 ml mark with a sample of the water to be tested.

NOTE

If water samples are to be collected for later analysis, a clean polyethylene plastic bottle is the best container if available. Rinse the bottle several times with water from the test source before collecting the sample.

(3) Pour the measured 25 ml sample into a clean dry spectrophotometer sample cell (7, fig. 2-5).

WARNING

FLUORIDE STANDARD SOLUTION POISON. Harmful if swallowed. Do not ingest or allow contact with skin or eyes. In case of eye or skin contact, flush with plenty of water. In case of ingestion, give large quantities of water or milk. Call medic immediately.

(4) Shake all the test water out of the 25 ml volumetric flask(32, fig. 1-1). Fill the flask(32) accurately to the 25 ml level with fluoride standard solution(15).

(5) Pour the 25 ml of fluoride standard solution into the other clean and dry spectrophotometer sample cell(7, fig.2-5).

WARNING
SPADNS REAGENT

POISON. Very strong acid. May cause burns. Harmful if swallowed. Do not ingest or allow contact with skin or eyes. In case of contact, immediately flush eyes and skin with water for 15 minutes. Remove contaminated clothing. In case of ingestion, DO NOT induce vomiting. Give one or two glasses of water. Never give anything by mouth to an unconscious person. In case of inhalation, remove victim to fresh air. Give artificial respiration if necessary. Treat for ingestion if symptoms appear. In all cases, call medic immediately.

NOTE
DO NOT wait longer than 3 minutes for color to develop.

(6) Use the 5 ml pipet(4, fig. 1-1) and the piper filler(27) to measure 5 ml of SPADNS reagent(16). Add the solution to the first spectrophotometer sample cell(7, fig. 2-5) containing the test sample. Swirl to mix. Repeat to add 5 ml of SPADNS(16, fig. 1-1) to the second spectrophotometer sample cell. Wait one minute for the color to fully develop.

(7) Insert the "Fluoride (SPADNS Method)" meter scale card(2, fig. 2-5) into spectrophotometer. Place the sample cell containing the fluoride standard solution into the cell holder well(5) in the spectrophotometer.

Adjust the wavelength dial(8) to 580 nm. Turn the LIGHT CONTROL knob(l0) so that the meter scale(14) reads 1.0 mg/l. Remove the sample cell(7) from the spectrophotometer well(5).

(8) Place the sample cell containing the water to be tested into the cell holder well(5) in the spectrophotometer. Record the reading on the meter scale(14).

f. Interpretation of Results:

NOTE
The recorded reading corresponds to the concentration of fluorides in mg/l.

(1) Several other chemicals if present can affect the reading obtained. If desired the value read may be adjusted for the presence of other chemicals if their presence and amounts are known. Table 2-3 shows the errors in reading caused by the presence of several chemicals. For instance if the test sample is known to contain chlorides in a concentration of 7250 mg/l, round the quantity off to the value shown in the table (7000) and read the error of +0.1 mg/l. This means the spectrophotometer reading is +0.1 mg/l of fluoride too high due to the presence of chlorides. Subtract 0.1 from the spectrophotometer reading to compensate for chlorides.

Table 2-3. SPADNS Method Errors Due to Interference

Interference Substance	Concentration	Error
Alkalinity (as $CaCO_3$)	5000 mg/1	-0.1 mg/l F
Aluminum	0.1 mg/1	-0.1 mg/l F
Chloride	7000 mg/1	+0.1 mg/l F
Iron, ferric	10 mg/1	-0.1 mg/l F
Sodium Hexametaphosphate	1.0 mg/1	+0.1 mg/l F
Phosphate, ortho	16 mg/1	+0.1 mg/l F
Sulfate	200 mg/1	+0.1 mg/l F

(2) A simple method of checking for interference by aluminum is to first read the concentration one minute after mixing with the SPADNS reagent. Then wait 15 minutes and read it again. An appreciable increase in the reading indicates the presence of interfering aluminum. If this is the case let the treated sample sit undisturbed for two hours. Then make another reading. This procedure will eliminate the effects of up to 3.0 mg/l of aluminum.

g. Refer to para 2.6.2 for shut down of the Spectrophotometer.

2.6.8.12. Ferrous Iron Test.

a. Purpose of Test: To determine the amount of ferrous iron present in water.
b. Range: 0.0 to 2.0 mg/l
c. Equipment Used: Found in Main Carrying Case, para 1.8, fig. 1-1

Spectrophotometer, (20), fig. 1-1
Ferrous iron reagent, (23), fig. 1-1
Graduated cylinder, (31), fig. 1-1

d. General Techniques Used: Refer to paragraphs cited below as required by procedure.
Planning the Test, para 2.6.1.1
Cleaning Glassware, para 2.6.1.2
Handling and Storing Reagents, para 2.6.1.3
Collecting Water Samples, para 2.6.1.4
Mixing, para 2.6.1.5
Using Graduated Cylinders, para 2.6.1.6
Spectrophotometer, para 2.6.2.2

e. Test Procedure:

WARNING

High voltage used with Spectrophotometer. Misuse can cause electrical shock and damage equipment. When operating with 115V or 220V power, make sure the power source and equipment are in ground potential. Ensure that the power cable connections are correct for the desired voltage power before connecting the power source.

NOTE

Samples should be analyzed as soon as possible after collection to prevent oxidation of ferrous iron to ferric iron.

NOTE

Iron reagent powder pillows are stable up to 48 months depending on storage and handling conditions. A cool, dry atmosphere gives the longest shelf life. The iron reagent powder can be checked by adding the contents of one pillow to about 25 ml of water that contains visible rust. If an orange color does not develop, the reagent has deteriorated and should be replaced.

(1) Refer to para 2.6.2 for set up and operation of the Spectrophotometer.
(2) Fill each of the two spectrophotometer sample cells(7, fig. 2-5) with 25 ml of sample water. Use the graduated cylinder(31, fig. 1-1) to collect and measure the water.

WARNING

FERROUS IRON TEST REAGENT

May be irritating to eyes, skin and respiratory tract. Harmful if swallowed. Do not ingest or allow contact with skin or eyes. Do not breathe dust. In case of contact, immediately flush eyes with water for 15 minutes. Remove contaminated clothing. Wash skin with soap and plenty of water. In case of ingestion, give large quantities of water. In case of inhalation, remove victim to fresh air. Call medic in all cases.

(3) Add one powder pillow of ferrous iron test reagent(23) to one of the sample cells(7, fig. 2-5) containing the water sample. This will be the treated sample. Swirl to mix.

(4) Allow solution to stand for at least 2 minutes but not more than 10 minutes. If iron is present an orange color will develop. Proceed to the next step while waiting.

(5) Place the untreated cell of sample water (blank sample) into the cell holder well(5) in the spectrophotometer. Put the "Iron (FerroVer® Method)" meter scale card(2) into the meter. Use the wavelength dial(8) to adjust the wavelength to 510 nm. Adjust the LIGHT CONTROL knob(l0) until the meter scale(14) reads 0.0 g/ml.

(6) Remove the blank sample from the spectrophotometer. Place the treated sample in the cell holder well(5). Read and record the mg/l of ferrous iron on the meter scale(14).

f. Interpretation of Results:

NOTE

The recorded reading corresponds to the concentration of ferrous iron in the sample in mg/l.

(1) The amount of ferric iron present can be determined as the difference between the amount of ferrous iron determined in this and the results of a total iron test (para 2.6.8.13).

(2) A large excess of iron will inhibit full color development. If the reading is at the high end of the scale, the test should be done again with a diluted sample. Dilute the sample by starting with only 12.5 ml of sample water and adding to it 12.5 ml of deionized water. Then proceed as above. Multiply the spectrophotometer scale reading by two.

g. Refer to para 2.6.2 for shut down of the Spectrophotometer.

2.6.8.13. Total Iron Test.

a. Purpose of Test: To determine the total amount of iron present in water using the (1,1-Phenanthroline Method).

b. Range: 0.0 to 2 mg/l

c. Equipment Used: Found in Main Carrying Case, para 1.8, fig. 1-1
Spectrophotometer, (20), fig. 1-1
Graduated cylinder, (31), fig. 1-1
FerroVer® iron reagent for 25 ml sample, (22), fig. 1-1

d. General Techniques Used: Refer to paragraphs cited below as required by procedure.
Planning the Test, para 2.6.1.1
Handling and Storing Reagents, para 2.6.1.3
Mixing, para 2.6.1.5
Spectrophotometer, para 2.6.2.2
Cleaning Glassware, para 2.6.1.2
Collecting Water Samples, para 2.6.1.4
Using Graduated Cylinders, para 2.6.1.6

e. Test Procedure:

WARNING

High voltage used with Spectrophotometer. Misuse can cause electrical shock and damage equipment. When operating with 115V or 220V power, make sure the power source and equipment are in ground potential. Ensure that the power cable connections are correct for the desired voltage power before connecting the power source.

(1) Refer to para 2.6.2 for set up and operation of the Spectrophotometer.

(2) Fill each of the two spectrophotometer sample cells(7, fig. 2-5) with 25 ml of sample water. Use the graduated cylinder(31, fig. 1-1) to collect and measure the water.

WARNING

IRON REAGENT (FERROVER®)

May cause eye and respiratory tract irritation. May cause allergic respiratory reaction if swallowed or inhaled. Harmful if swallowed. Do not ingest or allow contact with skin or eyes. Do not breathe dust. In case of contact, immediately flush eyes with water for 15 minutes. Remove contaminated clothing. Wash skin with soap and plenty of water. In case of ingestion, DO NOT induce vomiting. Give one or two glasses of water. Never give anything by mouth to an unconscious person. In case of inhalation, remove victim to fresh air. Give artificial respiration if necessary. Call medic in all cases.

(3) Add one FerroVer® iron reagent powder pillow(22) for 25 ml samples to one of the sample cells(7, fig. 2-5) containing the water sample. Swirl to mix.

(4) Allow solution to stand for at least 2 minutes but not more than 10 minutes. If iron is present an orange color will develop. Proceed to the next step while waiting.

(5) Place the untreated cell(7) of sample water (blank sample) in to the cell holder well(5) in the spectrophotometer. Put the "Iron (FerroVer® Method)" meter scale card(2) into the meter. Use the wavelength dial(8) to adjust the wavelength to 510 nm. Adjust the LIGHT CONTROL knob(l0) until the meter scale(14) reads 0 g/ml.

(6) Remove the blank sample(7) from the spectrophotometer. Place the treated sample(7) in the cell holder well(5). Read and record the mg/l of ferrous iron on the meter scale(14).

f. Interpretation of Results:

NOTE

The recorded reading corresponds to the concentration of ferrous iron in the sample in mg/l.

(1) A large excess of iron will inhibit full color development. A diluted sample should be tested if the spectrophotometer meter reading is at the high end of the scale. Repeat the test using a test sample of only 12.5 ml of sample water and adding 12.5 ml of deionized water to make up a total of 25 ml. Multiply the spectrophotometer scale reading by two.

(2) To determine the amount of ferric iron present in a sample, perform the ferrous iron test in paragraph 2.6.8.12 and subtract result from the total iron found by this test.

g. Refer to para 2.6.2 for shut down of the Spectrophotometer.

2.6.8.14. Nitrogen Ammonia Test.

a. Purpose of Test: To determine the total amount of nitrogen present in a water sample in the form of ammonia.

b. Range: 0.0 to 2.0 mg/l

c. Equipment Used: Found in Main Carrying Case, para 1.8, fig. 1-1 and in Zinc Test Kit, para 2.6.5, fig. 2-11

Volumetric pipet, 1.0 ml, (5), fig. 1-1
Nessler reagent, (17), fig. 1-1
Pipet filler, (27), fig. 1-1
Deionized water, (8), fig. 2-11
Rochelle salt solution, (13), fig. 1-1
Spectrophotometer, (20), fig. 1-1
Graduated cylinder, (31), fig. 1-1

d. General Techniques Used: Refer to paragraphs cited below as required by procedure.

Planning the Test, para 2.6.1.1
Handling and Storing Reagents, para 2.6.1.3
Mixing, para 2.6.1.5
Using Pipets, para 2.6.1.7
Cleaning Glassware, para 2.6.1.2
Collecting Water Samples, para 2.6.1.4
Using Graduated Cylinders, para 2.6.1.6
Spectrophotometer, para 2.6.2.2

e. Test Procedure:

WARNING

High voltage used with Spectrophotometer. Misuse can cause electrical shock and damage equipment. When operating with 115V or 220V power, make sure the power source and equipment are in ground potential. Ensure that the power cable connections are correct for the desired voltage power before connecting the power source.

NOTE

For best results, the temperature of the deionized water and the water sample should be 68 ± 2°F (20 ± 1°C). Higher temperatures will cause high readings. Lower temperatures will cause low readings.

(1) Refer to para 2.6.2 for set up and operation of the Spectrophotometer.

(2) Fill one spectrophotometer sample cell(7, fig. 2-5) with 25 ml of sample water. Use the graduated cylinder(3 1, fig. I1-1) to collect and measure the water. This will be the test sample.

(3) Use a clean graduated cylinder(31) to measure 25 ml of deionized water(8, fig. 2-11). Pour into the other spectrophotometer sample cell(7, fig. 2-5). This will be the "blank cell."

WARNING

ROCHELLE SALT SOLUTION

May be harmful if swallowed. May be irritating to skin or eyes. Do not ingest or allow contact with skin or eyes. In case of contact, immediately flush eyes and skin with plenty of water. In case of ingestion, give large quantities of water. Call medic.

(4) If the water being tested has a hardness greater than 100 mg/l, add one drop of Rochelle salt solution(l3, fig. 1-1) to both sample cells(7, fig. 2-5). Otherwise, the hard water will cause an incorrectly high result.

WARNING

NESSLER REAGENT

POISON. Alkali. Contains mercury compounds and sodium hydroxide. Contact may cause burns and irritation. Do not ingest or allow contact with skin or eyes. In case of contact, immediately flush eyes and skin with water for 15 minutes. Remove contaminated clothing. In case of ingestion, DO NOT induce vomiting. Give 1 to 2 glasses of water. Give at least one ounce of vinegar in an equal amount of water. Call medic in all cases.

(5) Use the 1.0 ml pipet(5, fig. 1-1) and the pipet filler(27) to transfer 1.0 ml of Nessler reagent(17) to both sample cells(7, fig. 2-5).

NOTE

If the Nessler reagent becomes dark brown it should be replaced.

NOTE

A precipitate in the bottom of the Nessler reagent bottle is normal. However, carefully extract reagent from the bottle without stirring up any of the solid material at the bottom. If any solid material from the Nessler reagent is used, the results will be erratic.

(6) Wait at least 10 minutes but not more than 25 minutes. A yellow color will develop if ammonia nitrogen is present.

NOTE

Iron and sulfides will interfere by causing a turbidity with the Nessler reagent. Less common interferences such as hydrazine, and several organic compounds may cause turbidity, or a tint of green or other colors in the treated sample. If such interference occurs this test method may not be suitable for the water sample.

(7) Place the sample cell(7) containing the treated deionized water solution into the spectrophotometer cell holder well(5) (as a blank). Put the "Nitrogen Ammonia (Nessler Method)" meter scale card(2) into the meter. Adjust the wavelength dial(8) to 425 nm. Turn the LIGHT CONTROL knob(l0) until the meter scale(14) reads 0 mg/l.

(8) Remove the blank cell (deionized water) and place the treated test sample in the spectrophotometer cell holder(5). Read the results on the meter scale(14).

f. Interpretation of Results:

NOTE

The results indicated by the meter scale are in mg/l of nitrogen.

(1) The concentration of ammonia (NH3) in mg/1 may be computed by multiplying the concentration of nitrogen read from the meter scale by 1.22.

(2) The concentration of ammonium ions (NH4) in mg/l may be computed by multiplying the concentration of nitrogen read from the meter scale by 1.29.

g. Refer to para 2.6.2 for shut down of the Spectrophotometer.

2.6.8.15. Nitrogen as Nitrates Test.

a. Purpose of Test: To determine the amount of nitrogen present in a water sample as nitrates.

b. Range: 0.0 to 30.0 mg/l

c. Equipment Used: Found in Main Carrying Case, para 1.8, fig. 1-1

Spectrophotometer, (20), fig. 1-1
Nitrate (NitraVer® 5) reagent, (24), fig. 1-1
Graduated cylinder, (31), fig. 1-1

d. General Techniques Used: Refer to paragraphs cited below as required by procedure.

Planning the Test, para 2.6.1.1
Handling and Storing Reagents, para 2.6.1.3
Mixing, para 2.6.1.5
Spectrophotometer, para 2.6.2.2
Cleaning Glassware, para 2.6.1.2
Collecting Water Samples, para 2.6.1.4
Using Graduated Cylinders, para 2.6.1.6

e. Test Procedure:

WARNING

High voltage used with Spectrophotometer. Misuse can cause electrical shock and damage equipment. When operating with 115V or 220V power, make sure the power source and equipment are in ground potential. Ensure that the power cable connections are correct for the desired voltage power before connecting the power source.

NOTE

The nitrate reagent is slightly temperature sensitive. For best results, the test should be done with a sample temperature of 68-75°F (20-25 °C).

(1) Refer to para 2.6.2 for setup and operation of the Spectrophotometer.

(2) Fill each of the two spectrophotometer sample cells(7, fig. 2-5) with 25 ml of sample water. Use the graduated cylinder(31, fig. 1-1) to collect and measure the water.

WARNING

NITRATE (NITRAVER® 5) REAGENT

May be irritating to eyes, skin and respiratory tract. Harmful if swallowed. Do not ingest or allow contact with skin or eyes. Do not breathe dust. In case of contact, immediately flush eyes with water for 15 minutes. Remove contaminated clothing. Wash skin with soap and plenty of water. In case of ingestion, give milk or beaten eggs at frequent intervals. Induce vomiting. In case of inhalation, remove victim to fresh air. Call medic in all cases.

(3) To one filled sample cell(7, fig. 2-5), add the contents of one nitrate reagent powder pillow(24, fig. 1-1). This is the treated sample.

NOTE

A deposit of unoxidized metal will remain after the nitrate reagent powder has dissolved. This will not affect test results.

(4) Shake the treated sample vigorously for exactly one minute. An amber color will develop if nitrate nitrogen is present.

(5) Wait at least 5 minutes for full color development in the treated sample. Do not wait more than 15 minutes before completing steps (6) and (7) below.

(6) Place the "Nitrogen, Nitrate (NitraVer® 5 Method)" meter scale card(2, fig. 2-5) into the meter. Adjust the wavelength dial(8) to 500 nm. Place the untreated (blank) sample of water in the Spectrophotometer cell well(5). Adjust the LIGHT CONTROL knob(l0) for a meter scale(14) reading of 0.0 g/ml.

(7) Remove the blank sample from the Spectrophotometer. Place the treated sample into the cell well(5). Read the mg/l of nitrate nitrogen on the meter scale(14). Record results.

f. Interpretation of Results:

NOTE

The meter reading is in mg/l of nitrogen (N) present as nitrates in the sample.

To express results as mg/l of nitrates (NO3), multiply the meter reading by 4.4.

g. Refer to para 2.6.2 for shut down of the Spectrophotometer.

2.6.8.16. pH Wide Range Test.

a. Purpose of Test: To determine the acidity or alkalinity of a water sample expressed as the total pH of the sample.

b. Range: pH 4 to 10

c. Equipment Used: Found in Main Carrying Case, para 1.8, fig. 1-1

Volumetric pipet, 1.0 ml, (5), fig. 1-1
Spectrophotometer, (20), fig. 1-1
Graduated cylinder, (31), fig. 1-1
pH indicator solution, (14), fig. 1-1
Pipet filler, (27), fig. 1-1

d. General Techniques Used: Refer to paragraphs cited below as required by procedure.

Planning the Test, para 2.6.1.1
Handling and Storing Reagents, para 2.6.1.3
Mixing, para 2.6.1.5
Using Pipets, para 2.6.1.7
Cleaning Glassware, para 2.6.1.2
Collecting Water Samples, para 2.6.1.4
Using Graduated Cylinders, para 2.6.1.6
Spectrophotometer, para 2.6.2.2

e. Test Procedure:

WARNING

High voltage used with Spectrophotometer. Misuse can cause electrical shock and damage equipment. When operating with 115V or 220V power, make sure the power source and equipment are in ground potential. Ensure that the power cable connections are correct for the desired voltage power before connecting the power source.

(1) Refer to para 2.6.2 for set up and operation of the Spectrophotometer.

(2) Fill each of the two spectrophotometer sample cells(7, fig. 2-5) with 25 ml of sample water. Use the graduated cylinder(31, fig. 1-1) to collect and measure the water.

(3) Place one cell(7, fig. 2-5) (used as a "blank") in the spectrophotometer cell holder well(5). Insert the "Wide Range pH" meter scale card(2) into the meter. Adjust the wavelength dial(8) to 520 nm. Turn the LIGHT CONTROL knob(l0) until the meter scale(14) needle rests at the far right of its travel arc.

WARNING

WIDE RANGE pH INDICATOR SOLUTION

POISON. Contains methanol. Ingestion causes nausea, intoxication and central nervous system depression and may cause blindness and death. Vapors harmful. Flammable. Do not ingest or allow contact with skin or eyes. Do not breathe vapors. In case of contact, flush skin and eyes with plenty of water. In case of ingestion, induce vomiting by giving salt in warm water. In case of inhalation remove victim from exposure, treat for ingestion if symptoms appear. Call medic in all cases. In case of fire, user smothering foam. Water may be ineffective.

NOTES

The amount of pH indicator added is critical to the accuracy and should be measured as carefully as possible.

The strength of the indicator solution should be checked occasionally in the range normally being tested.

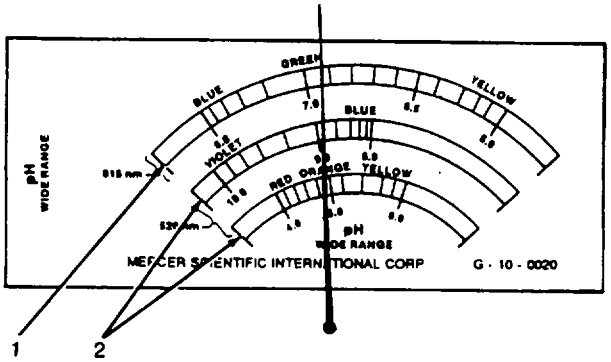
(4) Use the 1.0 ml pipet(5, fig. 1-1) and pipet filler(27) to transfer 1.0 ml of wide range pH indicator solution(14) to only one of sample cells(7, fig. 2-5). Measure carefully. Swirl to mix. This is the test sample.

(5) Note the color of the test sample after the indicator solution has been added.

(6) Remove the blank sample cell from the spectrophotometer. Place the test sample (the one treated with indicator solution) into the spectrophotometer cell holder(5).

(7) Use the two bottom scales(2, fig. 2-15) marked 520 nm. In order for a reading to be valid, two things must both be true. First, the color written on meter card scale where the needle intersects it must match the color of the solution. Second, the needle must intersect the scale between the largest and smallest pH values marked on the scale. If both conditions are true for one of the two bottom scales(2), the pH is the value indicated on that scale. Otherwise, go to the next step.

(8) Remove test sample from spectrophotometer. Then, place the blank cell (containing untreated test sample water) in the spectrophotometer cell holder(5, fig. 2-5). Adjust the wavelength dial(8) to 615 nm. Turn the LIGHT CONTROL knob(l0) until the meter scale(14) needle rests at the far right of its travel arc.



FOR EXAMPLE, WITH ABOVE READING:
IF SOLUTION IS ORANGE, READ BOTTOM SCALE.
IF SOLUTION IS BLUE, READ MIDDLE SCALE,
IF SOLUTION IS GREEN, ADJUST WAVELENGTH
AND READ TOP SCALE.

Figure 2-15. Reading Wide Range pH Meter Scale Card.

(9) Remove the blank sample cell and replace the test-sample cell. Read the pH value from the upper scale(1, fig.2-15) marked 615 nm.

f. Interpretation of Results:

Pure water is neutral and has a pH of 7. Values of pH from 0 to 7 indicate that the water is acidic. The lower the value the more acidic. Values of pH from over 7 to 14 (the maximum) indicate that the water is alkaline.

g. Refer to para 2.6.2 for shut down of the Spectrophotometer.

2.6.8.17. Sulfate Test.

a. Purpose of Test: A turbidimetric method of determining the concentration of sulfates present in water.

b. Range: O to 150 mg/l

c. Equipment Used: Found in Main Carrying Case, para 1.8, fig. 1-1

Spectrophotometer, (20), fig. 1-1	Sulfate (SulfaVer® 4) test reagent, (25), fig. 1-1
Graduated cylinder, (31), fig. 1-1	

d. General Techniques Used: Refer to paragraphs cited below as required by procedure.

Planning the Test, para 2.6.1.1	Cleaning Glassware, para 2.6.1.2
Handling and Storing Reagents, para 2.6.1.3	Collecting Water Samples, para 2.6.1.4
Mixing, para 2.6.1.5	Using Graduated Cylinders, para 2.6.1.6
Spectrophotometer, para 2.6.2.2	

e. Test Procedure:

WARNING

High voltage used with Spectrophotometer. Misuse can cause electrical shock and damage equipment. When operating with 115V or 220V power, make sure the power source and equipment are in ground potential. Ensure that the power cable connections are correct for the desired voltage power before connecting the power source.

NOTE

For best results, water that is highly colored, or is cloudy, or has particles in it should be filtered before the test.

(1) Refer to para 2.6.2 for set up and operation of the Spectrophotometer.

(2) Fill each of the two spectrophotometer sample cells(7, fig. 2-5) with 25 ml of sample water. Use the graduated cylinder(31, fig. 1-1) to collect and measure the water.

WARNING

SULFATE REAGENT (SULFAVER® 4)

May be irritating to eyes, skin and respiratory tract. Harmful if swallowed. Do not ingest or allow contact with skin or eyes. Do not breathe dust. In case of contact, immediately flush eyes with water for 15 minutes. Remove contaminated clothing. Wash skin with soap and plenty of water. In case of ingestion, induce vomiting by sticking finger down throat, then give 1 tablespoon of epsom salt in a glass of water. In case of inhalation, remove victim to fresh air. Call medic in all cases.

(3) Add the contents of one sulfate reagent powder pillow (25) to one sample cell (the test sample). Swirl to mix. The solution will turn white and cloudy if sulfate is present. Allow the sample to stand for at least 5 minutes but not more than 10 minutes.

(4) Place the other untreated sample cell of test water (the blank) into the cell holder well(5, fig. 2-5). Insert the "Sulfate (SulfaVer® 4 Method)" meter scale card(2) into the meter. Adjust the wavelength dial(8) to 450 nm. Turn the LIGHT CONTROL knob(10) until the meter scale(14) reads 0 mg/l.

(5) Remove the blank cell from the spectrophotometer. Place the treated test sample in the cell holder well(5). Read the results from the meter scale(14).

CAUTION

After recording the reading, immediately clean the sample cells with detergent and a brush. A white film will deposit on the inside of the cells which can lead to errors in future tests if this is not done soon after each test.

f. Interpretation of Results:

NOTE

Results as read from the meter scale are in mg/l of sulfate ion (SO4).

If the results are near or at the maximum reading of 150 mg/l, the test should be performed again using a diluted sample. Use the graduated cylinder to measure exactly 12.5 ml of sample water and pour into the test cell. Then add 12.5 ml of deionized water to the same sample cell. Repeat the test using this water sample and multiply readings on the meter scale by 2.

NOTE

The presence of silica in the water sample in excess of 500 mg/l will interfere.

g. Refer to para 2.6.2 for shut down of the Spectrophotometer.

2.6.8.18. Turbidity Test.

a. Purpose of Test: To determine amount of suspended solids in a water sample.

b. Range: 0 to 500 FTU

c. Equipment Used: Found in Main Carrying Case, para 1.8, fig. 1-1

Spectrophotometer, (20), fig. 1-1	Graduated cylinder, (31), fig. 1-1

d. General Techniques Used: Refer to paragraphs cited below as required by procedure.

Planning the Test, para 2.6.1.1	Cleaning Glassware, para 2.6.1.2
Handling and Storing Reagents, para 2.6.1.3	Collecting Water Samples, para 2.6.1.4
Mixing, para 2.6.1.5	Using Graduated Cylinders, para 2.6.1.6
Spectrophotometer, para 2.6.2.2	

e. Test Procedure:

WARNING

High voltage used with Spectrophotometer. Misuse can cause electrical shock and damage equipment. When operating with 115V or 220V power, make sure the power source and equipment are in ground potential. Ensure that the power cable connections are correct for the desired voltage power before connecting the power source.

(1) Refer to para 2.6.2 for setup and operation of the Spectrophotometer.

(2) Fill one of the two spectrophotometer sample cells(7, fig. 2-5) with 25 ml of sample water. Use the graduated cylinder(31, fig. 1-1) to collect and measure the water.

(3) Fill the other sample cell with 25 ml of clear colorless water. Use the graduated cylinder(31) to measure the amount. This will be the test blank. If filters are available, good enough results can usually be obtained by filtering some of the test sample. Then use the filtered water for the blank.

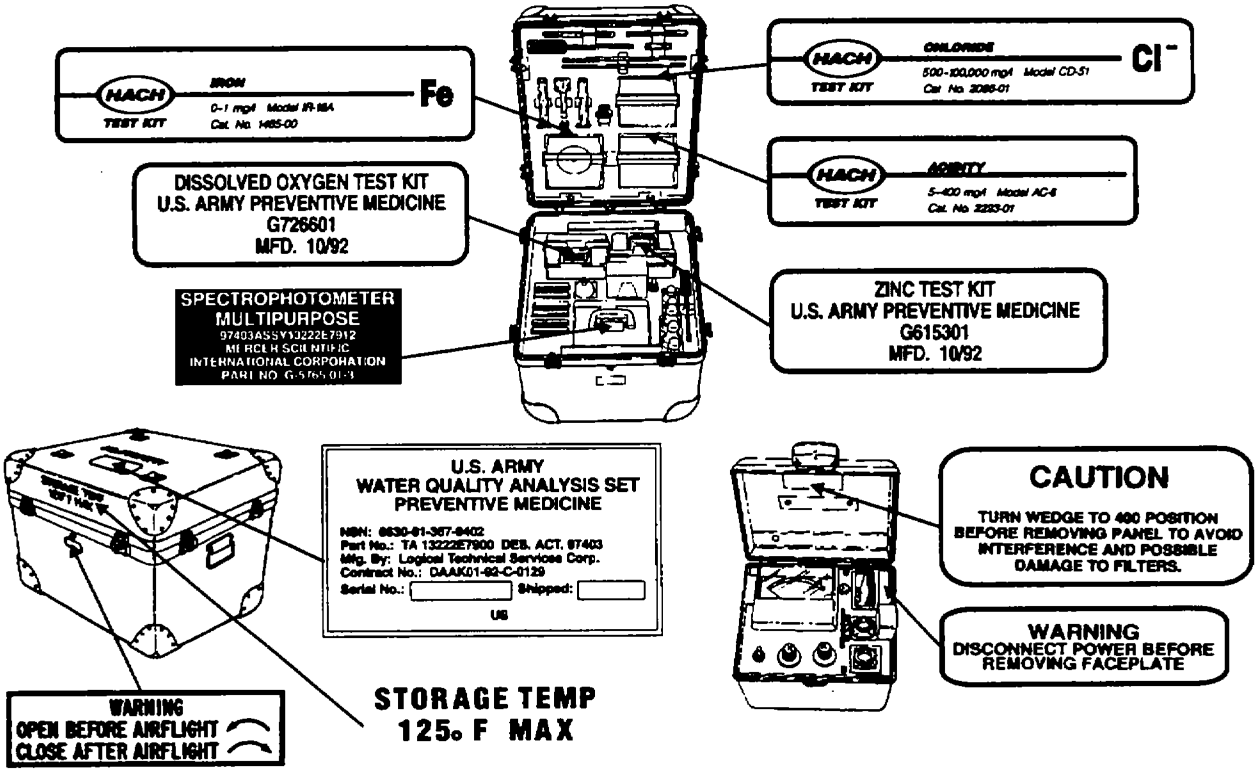
(4) Place the test blank in the spectrophotometer cell holder well(5, fig. 2-5). Put the "Turbidity (Absorptometric Method)" meter scale card(2) into the spectrophotometer. Adjust the wavelength dial(8) to 450 nm. Turn the LIGHT CONTROL knob(0) until the meter scale(I4) reads 0.

(5) Remove the blank. Place test sample in spectrophotometer cell holder(5). Read results from meter scale(14).

f. Interpretation of Results:
In this test turbidity is measured by finding the amount of light that is blocked out by the turbidity (cloudiness) of the sample. Results are given in units called FTU. FTU stands for Formazin Turbidity Units. Formazin is a chemical that causes a milky turbidity when added to water. The meter scale card is marked with FTU units that correspond to specific concentrations of formazin required to get the amount of turbidity present.

g. Refer to para 2.6.2 for shut down of the Spectrophotometer.

2.6.9. Decals and Instruction Plates.



2.6.10. Preparation for Movement.

The WQAS-PM is a portable unit and is designed to be transportable without modification or special packing. Ensure that all components are properly stored in the foam cavities and that the case is securely closed and fastened. If the unit is to be air transported, open the air valve on the main carrying case.

SECTION IV. OPERATIONS UNDER UNUSUAL CONDITIONS

2.7. UNUSUAL ENVIRONMENTIWEATHER.

2.7.1. General. The WQAS-PM is not designed for optimal performance under extreme environmental conditions. The best operating temperature for the system is from 68 to 77°F (20 to 25°C). The further from this range the less accurate results become. Some tests may not work at all under extreme conditions. The WQAS-PM is not recommended for use in subzero temperatures.

2.7.2. Heat: May affect the results of tests done with the WQAS-PM. In hot environments tests should be done in a shaded and well ventilated area. Test results may become less accurate as temperatures rise, but may still serve as valid approximations for many applications. Specific possible effects of higher temperatures include:

a. Possible Effects
  (1) Temperatures above 77°'F (25°'C) may lower accuracy.
  (2) Reactions proceed faster, especially in tests using indicator testing.
  (3) Greater risk of losing oxygen dissolved in water after taking a sample.
  (4) High temperatures may shorten reagent shelf life in proportion to how high and for how long the exposure is.
b. Precautions
  (1) Perform tests in shaded and well ventilated area.
  (2) Perform steps (1) through (6) of dissolved oxygen test (para 2.6.8.8) as quickly as possible.
  (3) Replace reagents more frequently.

2.7.3. Cold: May affect the results of tests and may prevent some tests from working at all if very cold. Specific possible effects of cold include:

a. Possible Effects
  (1) Ice crystals will form at temperatures below 32°F (0°C).
  (2) Reactions will slow down.
  (3) Plastic components will become brittle; may crack.
  (4) Frost may form on Spectrophotometer.
b. Precautions
  (1) Heat water samples so no ice is present.
  (2) Carefully check powder pillows and labware for cracks and damage. Do not use if damaged.
  (3) Try to keep Spectrophotometer sample cells and contents above freezing temperatures.
  (4) WQAS-PM not recommended for use in sub-zero temperatures.

CAUTION

Do not try to heat reagents. May cause splattering or dangerous reactions.

2.7.4. Sea and Salt Spray: May cause contamination or damage to equipment, but will not otherwise interfere with tests if proper precautions are taken. Specific possible effects of sea and salt spray include:

a. Possible Effects
  (1) Contamination of reagents and samples.
  (2) May cause damage to Spectrophotometer.

b. Precautions

  (1) Take extra precaution to shield water samples and reagents from contamination from spray.
  (2) Avoid exposing the spectrophotometer to heavy moisture for extended periods of time.
  (3) Shield Spectrophotometer from salt or sea spray. Wipe surface clean after use with damp cloth. Check for corrosion.

2.7.5. Dust and Sandstorms: May cause contamination or damage to equipment, but will not otherwise interfere with tests if proper precautions are taken. Specific possible effects of dust and sandstorms include:

a. Possible Effects
   (1) Contamination of reagents and samples.
   (2) Dust or sand damage to Spectrophotometer.

b. Precautions

   (1) Take extra precaution to shield water samples and reagents from contamination by dust or sand.
   (2) Shield Spectrophotometer from dust or sand. Wipe surface clean after use with damp cloth.

2.7.6. High Altitude: May affect some tests and reagents. Specific possible effects of high altitude include:

a. Possible Effects

   (1) Affects amount of oxygen dissolved in water.
   (2) Liquid reagents may evaporate more quickly.

b. Precautions

   (1) Perform steps (1) through (6) of dissolved oxygen test (para 2.6.8.8) as quickly as possible.
   (2) Refer to table 2-2 in paragraph 2.6.8.8 for effects of pressure on saturation of oxygen in water.
   (3) Make sure lids to all liquid reagents are kept tightly closed.

2.7.7. High Humidity: Should generally not interfere with tests but may affect Spectrophotometer.

a. Possible Effects

   (1) May accelerate or cause corrosion of Spectrophotometer batteries.
   (2) May cause damage to Spectrophotometer.

b. Precautions

   (1) Check batteries frequently. Clean terminals.
   (2) Avoid exposing the Spectrophotometer to heavy moisture for extended periods of time.

2.8. EMERGENCY PROCEDURES.

In the event of a power outage, the Spectrophotometer may be operated with a battery pack included as standard equipment, located in the bottom of the case (fig. 1-1). See paragraph 2.6.2 for set up and operation of the Spectrophotometer.

2.9. NUCLEAR, BIOLOGICAL, AND CHEMICAL (NBC) DECONTAMINATION PROCEDURES.

NOTE
Detailed decon procedures can be found in FM 3-3, FM 3-4, and FM-3-5.

a. General: The following emergency procedures can be performed until field NBC decon facilities are available.

b. Emergency Procedures: If NBC attack is known or suspected, mask at once and continue mission. If outside, follow decon procedures below to avoid taking contamination into a controlled area. Do not unmask until told to do so.

   (1) Nuclear decontamination: Brush fallout from skin, clothing, and equipment with available brushes, rags, and tree branches. Wash skin and have radiation check made as soon as tactical situation permits.
   (2) Biological decontamination: Remain masked and continue mission until told to unmask.

(3) Chemical detection and decontamination:

WARNING

Do not use decontamination spray on personnel. It could cause personal injury.

(a) Use M8 paper from the M256 Chemical Agent Detector Kit or M9 paper to determine if liquid agent is present on the equipment.

(b) If exposure to liquid agent is known or suspected, clean exposed skin, clothing, personal gear, and equipment, in that order using M258A1 kit. Use the buddy system. Wash exposed skin and thoroughly decontaminate as soon as tactical situation permits.

(c) If the M8 or M9 paper indicate that liquid chemical agent is present on the equipment, use the NBC-MI I decon apparatus for decon of equipment.

c. Contact unit decon team for procedures to decontaminate the WQAS-PM.

CHAPTER 3.
OPERATOR MAINTENANCE INSTRUCTIONS.

This chapter contains Lubrication and troubleshooting procedures that must be accomplished by the operator.

SECTION I. OPERATOR LUBRICATION

Lubrication not required.

SECTION II. OPERATOR TROUBLESHOOTING

3.1. OPERATOR TROUBLESHOOTING.

Operator troubleshooting and maintenance for the WQAS-PM equipment is limited to checking the power-setup for the Spectrophotometer (paragraph 2.6.2.3) and to those actions required in the PMCS (table 2-1). Apart from equipment failures and errors in technique, many problems you might encounter when analyzing water samples using the WQAS will be related to the chemistry involved. An example is interference by other chemicals in the sample. A detailed discussion of the chemistry and alternative methods are beyond the scope of this manual and the capabilities of the WQAS-PM. Unresolved problems should be referred to your supervisor.

The Malfunction Symptom Index below lists common symptoms that might be corrected by operator maintenance. Table 3-1 is a troubleshooting logic tree which can be used to isolate faults for replacement or for referral to unit maintenance.

MALFUNCTION SYMPTOM INDEX

MALFUNCTION	TROUBLESHOOTING PROCEDURE (TABLE 3-1)
CHEMICAL REAGENTS	
Analysis results much high or lower than expected or are erratic	Procedure 3-1
Reactions do not occur as described in test procedures	Procedure 3-2
SPECTROPHOTOMETER	
Spectrophotometer test results too high, low, or not consistent	Procedure 3-3
Spectrophotometer not operative under ac power	Procedure 3-4
Spectrophotometer not operative under dc power	Procedure 3-5

It is not feasible to list all the possible individual malfunctions that might occur with the WQAS-PM. If in doubt consult your supervisor.

Table 3-1. Operator Troubleshooting.

PROCEDURE 3-1. Analysis Results Much Higher or Lower Than Expected Or Are Erratic.

Visually Inspect Equipment Used in Analysis. Refer to Table 2-1. Replace Damaged Items and Expired Reagents.

Clean Glassware. Refer to Para 2.6.1.2.

Repeat Test Three Times.

Results of Re-tests Are Consistent and As Expected. Record Test Results.	Results of Re-tests Not Consistent or Not As Expected. Refer to Para 2.6.1.9 For Possible Sources of Error. If Errors Not Explained, Consult Supervisor.

PROCEDURE 3-2. Reactions Do Not Occur As Described In Test Procedures.

Visually Inspect Equipment Used in Analysis. Refer to Table 2-1. Replace Damaged Items and Expired Reagents.

Clean Glassware. Refer to Para 2.6.1.2.

Repeat Test Three Times.

Results of Re-tests Are Consistent and As Expected. Record Test Results.	Results of Re-tests Not Consistent or Not As Expected. Refer to Para 2.6.1.9 For Possible Sources of Error. If Errors Not Explained, Consult Supervisor.

PROCEDURE 3-3. Spectrophotometer Tests Too High, Too Low, or Not Consistent.

Visually Inspect Spectrophotometer and Sample Cells for Cleanliness.

Test Sample Cells To Ensure They Match. Follow Para 3.2.

Cells Do Not Match. Replace Both Cells.	Cells Match, But Analysis Results Still Not Satisfactory. Refer Instrument To Unit Maintenance. Consult Supervisor.

Table 3-1. Operator Troubleshooting - Continued.

WARNING

Electrical shock may occur if spectrophotometer front panel is opened while connected to AC power. Always unplug power cord from both unit and external power source before removing front panel. If shock occurs, see medic.

PROCEDURE 3-4. Spectrophotometer Not Operative Under Ac Power.

Set Up for Ac Operation. Refer to para 2.6.2.3.a. Carefully Check All Connections.

To Check Power, Hold Power Switch in ZERO CHECK Position and Turn ZERO ADJUST Knob.

Meter Needle Does Not Move.	Meter Needle Moves.
Refer Instrument to Unit Maintenance. Consult Supervisor.	Perform Test as Described in Applicable Paragraph.

PROCEDURE 3-5. Spectrophotometer Not Operative Under Dc Power.

Set Up for Dc Operation. Refer to para 2.6.2.3.b. Carefully Check All Connections.

To Check Power, Hold Power Switch in ZERO CHECK Position and Turn ZERO ADJUST Knob.

Meter Needle Does Not Move.	Meter Needle Moves.
Remove Front Panel. Remove Batteries. Replace with New Batteries. Refer to para 2.6.2.3.b.	Perform Test as Described in Applicable Paragraph.

Reassemble Unit.

To Check Power, Hold Power Switch in ZERO CHECK Position and Turn ZERO ADJUST Knob.

Meter Needle Does Not Move.	Meter Needle Moves.
Refer Instrument to Unit Maintenance. Consult Supervisor.	Perform Test as Described in Applicable Paragraph.

SECTION III. OPERATOR MAINTENANCE PROCEDURES

3.2. TEST FOR SAMPLE CELL MATCH.

This task covers: Inspection/Testing

INITIAL SETUP

Materials/Parts
Spectrophotometer, G5765-01-3
Cell, Sample G-10-0029, 2 each, See Appendix C

Inspection/Test:

WARNING

High voltage used with Spectrophotometer. Misuse can cause electrical shock and damage equipment. When operating with 115V or 220V power, make sure the power source and equipment are in ground potential. Ensure that the power cable connections are correct for the desired voltage power before connecting the power source.

(1) Make sure sample cells(7, fig. 2-5) are clean and dry.
(2) Set up and operate the Spectrophotometer (para 2.6.2).
(3) Push the on/off toggle switch(12) to ON and allow unit to warm up for 2 minutes.
(4) Place the % Transmittance Absorbance meter scale card(2) into the meter(fig 2-6). Adjust the wavelength dial(8, fig. 2-5) to 510 nm.
(5) Hold the on/off toggle switch(12) in the ZERO CHECK position and turn the ZERO ADJUST knob(l 1) until the meter scale(14) reads 0% transmittance.
(6) Place one sample cell in the sample cell well(5), and adjust the LIGHT CONTROL knob(l0) until the meter scale(14) reads 95% transmittance. Rotate the sample cell 180 degrees, and read the transmittance value on the meter scale(14). Record the result.
(7) Place the second sample cell in the sample cell well(5) and record the transmittance value on the meter scale(14). Rotate the cell 180 degrees and record the result.
(8) If any one of the three meter readings recorded taken in step (6) and (7) above are either below the lower limit of 94% transmittance or above the upper limit of 96% transmittance, repeat the test. If a second test confirms that readings are outside the limits, replace both cells.
(9) Refer to para 2.6.2 for shut down of the Spectrophotometer.

CHAPTER 4.
UNIT MAINTENANCE INSTRUCTIONS.

SECTION I. UNIT LUBRICATION

Lubrication not required.

SECTION II. UNIT TROUBLESHOOTING

4.1. GENERAL.

All unit troubleshooting and maintenance should be proceeded by maintenance and troubleshooting in accordance with operator maintenance (Chapter 3) and the PMCS in Table 2-1. If problems are not fixed by operator maintenance procedures, then unit maintenance actions should be performed as described in this chapter and by authorized persons. The only component of the WQAS-PM requiring maintenance support at the unit level is the Spectrophotometer. Troubleshooting described here is intended to help isolate the cause of malfunctions of the Spectrophotometer to one of the replaceable assemblies. Replaceable assemblies for the Spectrophotometer are as listed below.

UNIT MAINTENANCE
SUMMARY OF SPECTROPHOTOMETER REPLACEMENT/REPAIR ACTIONS

ASSEMBLY	ACTION TYPE	PART NUMBER
Lamp Assembly	Replaceable	G-10-0031
Fuse	Replaceable	MIL-F-15160
Photocell Assembly	Replaceable	MSI- 1108-1

If a fault cannot be isolated to one of the replaceable assemblies, the entire Spectrophotometer should be replaced.

SPECTROPHOTOMETER UNIT MALFUNCTION SYMPTOM INDEX

MALFUNCTION	TROUBLESHOOTING PROCEDURE (TABLE 4-1)
Spectrophotometer not operative under dc power	Procedure 4-2
FUSE	
Spectrophotometer not operative under ac power (ZERO ADJUST control does not work)	Procedure 4-1
LAMP ASSEMBLY	
Power on (ZERO ADJUST) works, but LIGHT ADJUST control does not work	Procedure 4-3
Spectrophotometer suspected to give results that are too high, too low, or erratic	Procedure 4-4
PHOTOCELL ASSEMBLY	
Power on (ZERO ADJUST) works, but LIGHT ADJUST control does not work	Procedure 4-3
Spectrophotometer suspected to give results that are too high, too low, or erratic	Procedure 4-4

Table 4-1. Unit Troubleshooting

WARNING

Electrical shock may occur if spectrophotometer front panel is opened while connected to ac power. Always unplug power cord from both unit and external power source before removing front panel. If shock occurs, see medic.

PROCEDURE 4-1. Spectrophotometer Not Operative Under Ac Power (ZERO ADJUST Control Does Not Work).

Set Up and Check Ac Power Operation. Use Table 3-1, Procedure 3-4.

Ac Power Operating OK.

Ac Power Not Operating.
Check/Replace Fuse. Use Para. 4.2.

Spectrophotometer Working.

Spectrophotometer Not Working.

Spectrophotometer Requires Replacement For Use With Ac Power.

PROCEDURE 4-2. Spectrophotometer Not Operative Under Dc Power.

Set Up and Check Dc Power Operation. Use Table 3-1, Procedure 3-5. Replace Batteries if Necessary.

Dc Power Operating OK.

Dc Power Not Operating.

Spectrophotometer Requires Replacement For Use With Dc Power

Table 4-1. Unit Troubleshooting - Continued.

PROCEDURE 4-3. Power On (ZERO ADJUST) Works But LIGHT ADJUST Does Not Work.

Inspect Lamp By Holding a Piece of Paper in the Sample Well. If Lamp Is Working, Light Image Will Be Visible On Paper.

Light Image Visible.

Check Photocell. Use Procedure in Para 4.4.

Photocell Working.

Replace Spectrophotometer.

Photocell Not Working.

Replace Photocell.
Use Procedure in Para 4.4.

Spectrophotometer Working.

Spectrophotometer Not Working.

Replace Spectrophotometer.

Light Image Not Visible.

Replace Lamp Assembly. Use Procedure in Para 4.3.

Spectrophotometer Working.

,

Spectrophotometer Not Working.

Replace Spectrophotometer.

PROCEDURE 4-4. Spectrophotometer Suspected to Give Results That Are Too High, Too Low, or Erratic.

Check Photocell. Use Procedure in Para 4.4.

Photocell Not Working.

Replace Photocell.
Use Procedure in Para 4.4.

Photocell Working.

Check Lamp. Use Procedure 4-3 Above.

Lamp Working.

If Both Lamp And Photocell are Working Correctly, Replace Spectrophotometer.

Lamp Not Working.

Replace Lamp Assembly.
Use Procedure in Para 4.3.

Spectrophotometer Working.

Spectrophotometer Not Working.

If Both Photocell and Lamp Assembly Have been Replaced, Replace Spectrophotometer.

SECTION III. UNIT MAINTENANCE PROCEDURES

4.2. FUSE REPLACEMENT.

This task covers: a. Removal/Replacement. b. Testing

INITIAL SETUP

Materials/Parts
Fuse, PN MIL-F-15160, See Appendix C
Tools
Tool Kit, General Mechanics, Automotive, See Appendix B

Equipment Condition
Unit disconnected and front panel removed (para 2.6.2.3).

a. Removal/replacement.

WARNING

High voltage used with Spectrophotometer. Misuse can cause electrical shock and damage equipment. When operating with 115V or 220V power, make sure the power source and equipment are in ground potential. Ensure that the power cable connections are correct for the desired voltage power before connecting the power source.

NOTE

A spare fuse is kept in the bottom of the Spectrophotometer case.

(1) Remove the fuse(2, fig. 4-1) found at upper right corner of the power supply board(l) and replace.

(2) Ensure that the unit is properly connected for ac operation. See paragraph 2.6.2.3 a.

b. Testing.

(1) Ensure that the unit is properly connected for ac operation. See paragraph 2.6.2.3 a.

(2) Zero the Spectrophotometer (para 2.6.2.6). If the unit does not work after replacing the fuse, replace the unit.

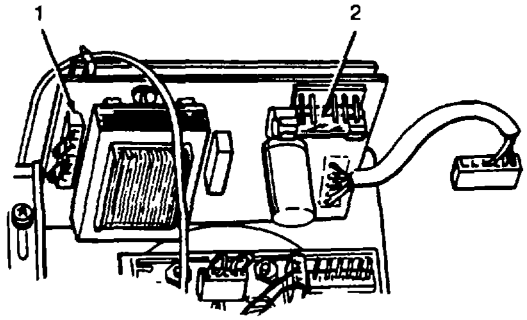


Figure 4-1. Fuse Replacement.

4.3. LAMP REPLACEMENT.

This task covers: a. Removal b. Replacement c. Alignment

INITIAL SETUP

Materials/Parts
Lamp Assembly, PN G-10-0031, See Appendix C
Tools
Tool Kit, General Mechanics, Automotive, See Appendix B

Equipment Condition
Unit disconnected and front panel removed (para 2.6.2.3).

a. Removal.

WARNING

High voltage used with Spectrophotometer. Misuse can cause electrical shock and damage equipment. When operating with 115V or 220V power, make sure the power source and equipment are in ground potential. Ensure that the power cable connections are correct for the desired voltage power before connecting the power source.

(1) Disconnect the lamp cable(4, fig. 4-2) from the amplifier board(3) at connection BC4(2).
(2) Loosen the bulb setscrew(l) in the lamp holder(6) and extract the lamp(5).

b. Replacement.

CAUTION

Do not over tighten the bulb set screws. Bulb damage could result.

NOTE

Replacement lamp assembly is located in bottom of Spectrophotometer case.

(1) Install the replacement lamp assembly into the lamp holder(6). The lamp(5) must be aligned with the lamp filament positioned vertically. It must be placed as far into lamp holder(5) as possible.
(2) Attach lamp cable to amplifier board at BC4(2).
(3) Replace front panel and ensure that the unit is properly connected. See para 2.6.2.3.a. for ac operation; see para 2.6.2.3.b. for dc operation.

c. Alignment.

(1) Check bulb alignment by placing a piece of paper in the sample cell well(5, fig. 2-5) on the right hand wall. Turn the on/off toggle switch(12) to ON. Adjust the wavelength dial(8) to 550 nm to bring the bulb filament image into focus on the paper. If the image is dim, turn LIGHT CONTROL knob(l0) to intensify light. Proper alignment gives an image of an oval completely enclosing a vertical filament image(7, fig. 4-2).
(2) If alignment is required, remove front panel (see para 2.6.2.3).
(3) Adjust the filament image by loosening the set screw(l) and rotating the lamp holder(6).
(4) Replace front panel and ensure that the unit is properly connected. See para 2.6.2.3.a. for ac operation; see para 2.6.2.3.b. for dc operation.
(5) Repeat steps (1) thru (4) above if further adjustment is required.

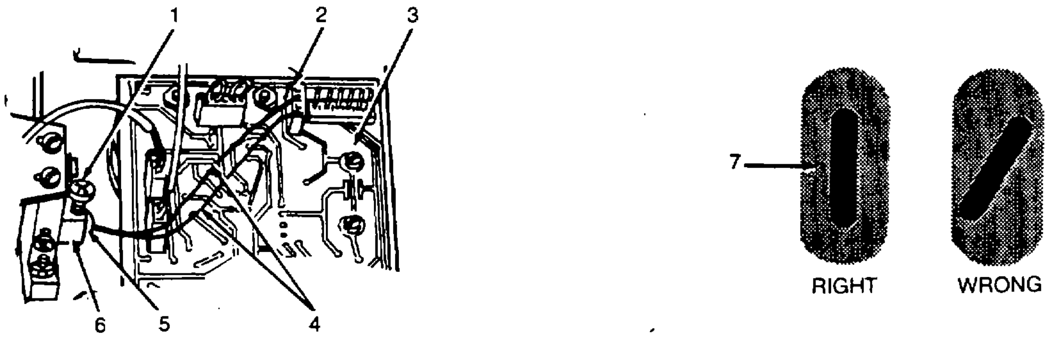


Figure 4-2. Adjusting Lamp.

4.4. PHOTOCELL REPLACEMENT.

This task covers:	a. Test	b. Replacement

INITIAL SETUP

Materials/Parts
Photocell Assembly, PN MSI- 1108-1, See Appendix C
Tools
Tool Kit, General Mechanics, Automotive, See Appendix B
Multimeter, 0-5000 Volt, See Appendix B

a. Test

WARNING

High voltage used with Spectrophotometer. Misuse can cause electrical shock and damage equipment. When operating with 115V or 220V power, make sure the power source and equipment are in ground potential. Ensure that the power cable connections are correct for the desired voltage power before connecting the power source.

(1) Ensure that the unit is properly connected for dc operation. See paragraph 2.6.2.3 b.

(2) Check operation by testing the ZERO ADJUST knob(11, fig. 2-5) with on/off toggle switch(l2) at ZERO CHECK (para 2.6.2.6).

(3) Loosen the two thumbscrews(9) on the front panel. Turn the unit on its left side, and gently pull the panel away from the case (see para 2.6.2.3).

NOTE

Before removal, note position of wires and plug on photocell cable.

(4) Disconnect the photocell assembly cable(3, fig. 4-3) from the amplifier board at BC2(2). Set multimeter to 50 microampere range. Connect the positive lead to the photocell cable(3) shield (black wire). Connect negative lead to the center conductor (white wire).

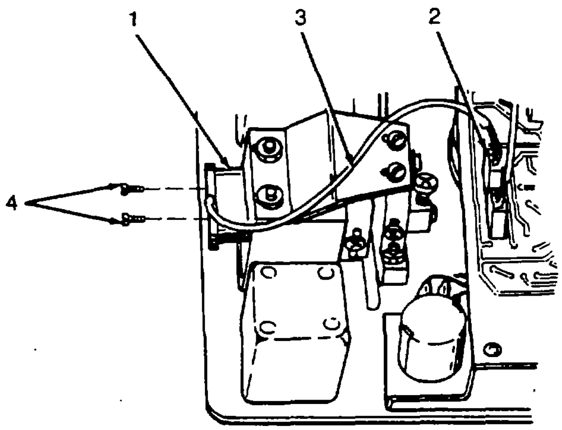


Figure 4-3. Photocell Replacement.

(5) Set the Spectrophotometer wavelength dial(8, fig. 2-5) to 700 nm. Turn the on/off toggle switch(12) to ON. Rotate the LIGHT CONTROL knob(l0) fully clockwise. The multimeter should indicate a reading greater than 5 microamperes.

CAUTION

Be sure that photocell cable wires and plug are in correct position or damage may occur to the Spectrophotometer.

(6) If ok, reconnect photocell cable to the amplifier board at BC2(2, fig. 4-3). Replace front panel and ensure that the unit is properly connected. See para 2.6.2.3.a. for ac operation; see para 2.6.2.3.b. for dc operation. If not ok, replace the photocell as described below.

b. Replacement

(1) Make sure all power is disconnected.

NOTE

Before removal, note position of wires and plug on photocell cable.

(2) Disconnect the photocell cable(3, fig. 4-3) from the amplifier circuit board at BC2(2).
(3) Remove the two screws(4) holding the photocell(l) in place. Remove photocell and cable assembly. Cable(3), photocell(l), and plug(2) are replaced as a single assembly.
(4) Install replacement photocell assembly and secure in place with two screws(4).

CAUTION

Be sure that photocell cable wires and plug are in correct position or damage may occur to the Spectrophotometer.

(5) Connect photocell cable(3) to amplifier circuit board at BC2(2).
(6) Replace front panel and ensure that the unit is properly connected. See para 2.6.2.3.a. for ac operation; see para 2.6.2.3.b. for dc operation.

CHAPTER 5
DIRECT SUPPORT MAINTENANCE INSTRUCTIONS.

There is no direct support maintenance for the WQAS-PM.

APPENDIX A.
REFERENCES

SCOPE

This appendix lists all forms, field manuals, and technical manuals referenced in this manual.

A.1. FORMS AND RECORDS.

Army Logistics Readiness and Sustainability	AR 700-138
Recommended Changes to Publications	DA Form 2028
Recommended Changes to Equipment Technical Manuals	DA Form 2028-2
Equipment Inspection and Maintenance Worksheet	DA Form 2404
The Army Maintenance Management System (TAMMS)	DA Pam 738-750
Functional Users Manual for the Army Maintenance Management System-Aviation (TAMMS-A)	DA Pam 738-751
Product Quality Deficiency Report	SF 368

A.2. FIELD MANUALS.

Chemical and Biological Contamination Avoidance	FM 3-3
NBC Protection	FM 3-4
NBC Decontamination	FM 3-5
First Aid for Soldiers	FM 21-11

A.3. TECHNICAL MANUALS.

Administrative Storage of Equipment	TM 740-90-1
Procedures for Destruction of Equipment to Prevent Enemy Use	TM 750-244-3

APPENDIX B.
MAINTENANCE ALLOCATION CHART
SECTION I. INTRODUCTION

B.1. THE ARMY MAINTENANCE SYSTEM MAC.

a. This introduction (Section I) provides a general explanation of all maintenance and repair functions authorized at various maintenance levels under the standard Army Maintenance System concept.

b. The Maintenance Allocation Chart (MAC) in Section II designates overall authority and responsibility for the performance of maintenance functions on the Water Quality Analysis Set-Preventive Medicine, NSN 6630-01-367-9402. The application of the maintenance functions to the end item or component will be consistent with the capacities and capabilities of the designated maintenance levels, which are shown in the MAC in column (4) as:
  - **Unit** includes two subcolumns, C (operator/crew) and O (unit) maintenance.
  - **Direct Support** includes an F subcolumn.
  - **General Support** includes an H subcolumn.
  - **Depot** includes a D subcolumn.

c. Section III lists the tools and test equipment (both special tools and common tool sets) required for each maintenance function as referenced from Section II.

d. Section IV contains supplemental instructions and explanatory notes for a particular maintenance function.

B.2. MAINTENANCE FUNCTIONS.

Maintenance functions are limited and defined as follows:

a. **Inspect**. To determine the serviceability of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination (e.g. by sight, sound or feel).

b. **Test**. To verify serviceability by measuring the mechanical, pneumatic, hydraulic, or electrical characteristics of an item and comparing those characteristics with prescribed standards.

c. **Service**. Operations required periodically to keep an item in proper operating condition; e.g. to clean (includes decontamination, when required), to preserve, to drain, to paint, or to replenish fuel, lubricants, chemical fluids, or gases.

d. **Adjust**. To maintain or regulate, within prescribed limits by bringing into proper position or by setting the operation characteristics to specified parameters.

e. **Align**. To adjust specified variable elements of an item to bring about optimum or desired performance.

f. **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.

g. **Remove/Install**. To remove and install the same item when required to perform service or other maintenance functions. Install may be the act of emplacing, seating, or fixing into position a spare, repair part or module (component or assembly) in a manner to allow the proper functioning of an equipment or system.

h. **Replace**. To remove an unserviceable item and install a serviceable counterpart in its place. "Replace" is authorized by the MAC and assigned maintenance level is shown as the third position code of the SMR code.

i. **Repair**. The application of maintenance services including fault location/troubleshooting, removal, installation and disassembly, assembly procedures and maintenance actions to identify troubles and restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part subassembly, module (component or assembly), end item or system.

j. **Overhaul**. That maintenance effort (service/action) prescribed to restore an item to a completely serviceable/operational condition as required by maintenance standards in appropriate technical publications (i.e. DMWR). Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like new condition.

k. **Rebuild**. Consists of those services/actions necessary for the restoration of unserviceable equipment to a like new condition in accordance with original manufacturing standards. Rebuild is the highest degree of material maintenance supplied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (e.g., hours/miles) considered in classifying Army equipment/components.

B.3. EXPLANATION OF COLUMNS IN THE MAC, SECTION II.

a. **Column 1, Group Number**. Column 1 lists functional group code numbers, the purpose of which is to identify maintenance significant components, assemblies, subassemblies, and modules with the next higher assembly.

b. **Column 2, Component/Assembly**. Column 2 contains the item names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. **Column 3, Maintenance Function**. Column 3 lists the function to be performed on the item listed in Column 2. (For detailed explanation of these functions see paragraph B.2.)

d. **Column 4, Maintenance Level**. Column 4 specifies each level of maintenance authorized to perform each function listed in Column 3, by indicating work time required (expressed as Man hours in whole hours or decimals) in the appropriate subcolumn. This work time figure represents the active time required to perform that 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 are shown for each level. 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 operating conditions. This time includes preparation time (including any necessary disassembly/assembly time), trouble shooting/fault location time, and quality assurance time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the maintenance allocation chart. The symbol designations for the various maintenance levels are as follows:
    - C.......... Operator or crew maintenance
    - O .... Unit maintenance
    - F.......... Direct support maintenance
    - L .... Specialized Repair Activity (SRA)
    - H.......... General support maintenance
    - D.......... Depot maintenance

e. **Column 5, Tools and Test Equipment Reference Code**. Column 5 specifies, by code, those common tool sets (not individual tools), common TMDE, and special tools, special TMDE, and special support equipment required to perform the designated function. Codes are keyed to tools and test equipment in Section III.

f. **Column 6, Remarks**. When applicable, this column contains a letter code, in alphabetical order, which is keyed to the remarks contained in Section IV.

B.4. EXPLANATION OF COLUMNS IN TOOL AND TEST EQUIPMENT REQUIREMENTS, SECTION III.

a. **Column 1, Reference Code**. The tool and test equipment reference code correlates with a code used in the MAC, Section II, Column 5.

b. **Column 2, Maintenance Level**. The lowest level of maintenance authorized to use the tool or test equipment.

c. **Column 3, Nomenclature**. Name or Identification of the tool or test equipment.

d. **Column 4, National Stock Number**. The National Stock Number of the tool or test equipment.

e. **Column 5, Tool Number**. The manufacturer's part number, model number, or type number.

B.5. EXPLANATION OF COLUMNS IN REMARKS, SECTION IV.

a. **Column 1, Remarks Code**. The code recorded in column 6, Section II.

b. **Column 2, Remarks**. This column lists information pertinent to the maintenance function being performed as indicated in the MAC, Section II.

SECTION II. MAINTENANCE ALLOCATION CHART FOR WQAS-PM

(1) GROUP NUMBER	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL C	O	F	H	D	(5) TOOLS AND EQUIPMENT	(6) REMARKS
00	Water Quality Analysis Set Preventive Medicine								
01	Case, Transit and Storage	Inspect Replace	0.10 0.25						
02	Test Kit, Acidity	Inspect Replace	0.10 0.10						
03	Test Kit, Ferric Iron	Inspect Replace	0.10 0.10						
04	Test Kit, Chloride, High Range	Inspect Replace	0.10 0.10						
05	Test Kit, Dissolved Oxygen	Inspect Replace	0.10 0.10						
06	Test Kit, Zinc	Inspect Replace	0.10 0.10						
07	Spectrophotometer	Inspect	0.20						
		Test	0.10						
		Repair		1.00				1, 2	
		Replace	0.10						
		Adjust	0.50						
08	Chemicals and Supplies	Inspect Replace	0.10 0.10						

SECTION III. TOOLS AND TEST EQUIPMENT FOR WQAS-PM

Tool or Test Equipment Ref Code	Maintenance Level	Nomenclature	National Stock Number	Tool Number
1	O	Tool Kit, General Mechanics, Automotive	5180-00-177-7033	SC5150-90-CL-N26
2	O	Multimeter	6625-00-999-6282	AN/URM 105C

SECTION IV. NO REMARKS FOR WQAS-PM

APPENDIX C

UNIT AND DIRECT SUPPORT MAINTENANCE REPAIR PARTS AND SPECIAL TOOLS LIST

Section I. INTRODUCTION

C.1. SCOPE.

This RPSTL lists and authorizes spares and repair parts, special tools, special test, measurement, and diagnostic equipment (TMDE), and other special support equipment required for performance of Unit and Direct Support maintenance of the Water Quality Analysis Set, Preventive Medicine. It authorizes the requisitioning, issue, and disposition of spares, repair parts and special tools as indicated by the source, maintenance and recoverability (SMR) codes.

C.2. GENERAL.

This repair parts and special tools list is divided into the following sections:

a. Section II. Repair Parts List. A list of spares and repair parts authorized by this RPSTL for use in Be performance of maintenance. This list also includes parts which must be removed for replacement of the authorized parts. Parts lists are composed of functional groups in ascending alphanumeric sequence, with the parts in each group listed in ascending figure and item number sequence. Bulk materials are listed by item name in FIG. BULK at the end of this section. Repair parts kits are listed separately in their own functional group within section II. Repair parts for reparable special tools are also listed in section II. Items listed are shown on the associated illustration.

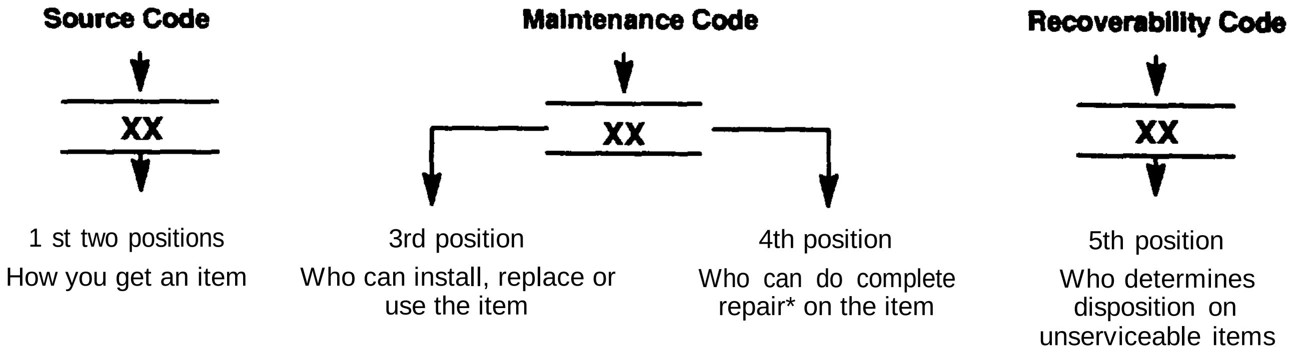
b. Section Ill. Special Tools List. A list of special tools, special TMDE, and special support equipment authorized by this RPSTL (as indicated by Basis of Issue (BOl) information in DESCRIPTION AND USABLE ON CODE column).

c. Section IV. Cross-Reference Indexes. There are two cross-reference indexes in this RPSTL: The National Stock Number Index and the Part Number Index. The National Stock Number Index refers you to the figure and item number. The Part Number Index refers you to the figure and item number.

C.3. EXPLANATION OF COLUMNS (SECTIONS II AND III).

a. ITEM NO. (Column (1)). Indicates the number used to identify items called out on the illustration.

b. SMR Code (Column (2)). The source, maintenance, and recoverability (SMR) code contains supply/requisitioning information, maintenance level authorization criteria, and disposition instruction, as shown in the following breakout:



*Complete Repair: Maintenance, capacity, capability, and authority to perform all corrective maintenance tasks of the “Repair” function in a use/user environment in order to restore serviceability to a failed item.

(1). Source Code. The source code tells you how to get an item needed for maintenance, repair, or overhaul of an end item/equipment. Explanations of source codes follows:

Source Code		Explanation
PA		Stock items; use the applicable NSN to requisition/request items with these source codes. They are authorized to the level indicated by the code entered in the 3rd position of the SMR code. **NOTE: Items coded PC are subject to deterioration.
PB		
PC**		
PD		
PE		
PF		
PG		
KD		Items with these codes are not to be requested/requisitioned individually. They are part of a kid which is authorized to the maintenance level indicated in the 3rd position of the SMR code. The complete kit must be requisitioned and applied.
KF		
KB		
MO	(Made at Unit/AVUM Level)	kerns with these codes are not to be requisitioned/requested individually. They must be made from bulk material which is identified by the part number in the DESCRIPTION and USABLE ON CODE (UOC) column and listed in the Bulk Material group of the repair parts list of the RPSTL. If the item is authorized to you by the 3rd position code of the SMR code, but the source code indicates it is made at a higher level, order the item from the higher level of maintenance.
MF	(Made at DS/AVIM Level)	
MH	(Made at GS Level)	
ML	(Made at Specialized Repair Activity (SRA))	
MD	(Made at Depot)	
AO	(Assembled by Unit/AVUM Level)	Items with these codes are not to be requested/requisitioned individually. The parts that make up the assembled item must be requisitioned or fabricated and assembled at the level of maintenance indicated by the source code. If the 3rd position code of the SMR code authorizes you to replace the item, but the source code indicates the item is assembled at a higher level, order the item from the higher level of maintenance.
AF	(Assembled by DS/AVIM Level)	
AH	(Assembled by GS Category)	
AL	(Assembled by SRA)	
AD	(Assembled by Depot)	

XA - Do not requisition an “XA”-coded item. Order its next higher assembly. (Refer to the NOTE below.)

XB - If an ‘XB” item is not available from salvage, order it using the CAGEC and part number given.

XC - Installation drawing, diagrams, instruction sheet, field service drawing; identified manufacturer’s part number

XD - Item is not stocked. Order an ‘XD”-coded item through normal supply channels using the CAGEC and part number given, if no NSN is available.

NOTE

Cannibalization or controlled exchange, when authorized, may be used as a source of supply for items with the above source codes, except for those source coded “XA” or those aircraft support items restricted by requirements of AR 750-1.

(2). Maintenance Codes. Maintenance you the level(s) of maintenance authorized to use and repair support items. The maintenance codes are entered in the third and fourth positions of the SMR code as follows:

(a) The maintenance code entered in the third position tells you the lowest maintenance level authorized to remove, replace, and use the item. The maintenance code entered in the third position will indicate authorization to the following levels of maintenance.

Maintenance Code	**Application/Explanation**
C	- Crew or operator maintenance done within Unit/AVUM maintenance.
O	- Unit level/AVUM maintenance can remove, replace, and use the item.
F	- Direct Suppot/AVIM maintenance can remove, replace, and use the item.
H	- General Support maintenance can remove, replace, and use the item.
L	- Specialized Repair Activity can remove, replace, and use the item.
D	- Depot can remove, replace, and use the item.

(b) The maintenance code entered in the fourth position tells you whether or not the item is to be repaired and identifies the lowest maintenance level with the capability to do complete repair (i.e., perform all authorized repair functions.)

NOTE

Some limited repair may be done on the item at a lower level of maintenance, if authorized by the Maintenance Allocation Chart and SMR code.

Maintenance Code	**Application/Explanation**
O	- Unit/AVUM is the lowest level that can do complete repair of the item.
F	- Direct Support/AVIM is the lowest level that can do complete repair of the item.
H	- General Support is the lowest level that can do complete repair of the item.
L	- Specialized Repair Activity is the lowest level that can do complete repair of the item.
D	- Depot is the lowest level that can do complete repair of the item.
Z	- Nonreparable. No repair is authorized.
B	- No repair is authorized. No parts or special tools are authorized for the maintenance of “B” coded item. However, the item may be reconditioned by adjusting, lubricating, etc., at the user level.

(3). Recoverability Code. Recoverability codes are assigned to items to indicate the disposition action on unserviceable items. The recoverability code is shown in the fifth position of the SMR Code as follows:

Recovembility Code	**Application/Explanation**
Z	- Nonreparable item. When unserviceable, condemn and dispose of the item at the level of maintenance shown in 3d position of SMR Code.
O	- Reparable item. When not economically reparable, condemn and dispose of the item at Unit or AVUM level.
F	- Reparable item. When uneconomically reparable, condemn and dispose of the item at the Direct Support or AVIM level.

Recoverability Code		Application/Explanation
H	-	Reparable item. When uneconomically reparable, condemn and dispose of the item at the General Support level.
D	-	Reparable item. When beyond lower level repair capability, return to depot. Condemnation and disposal of item not authorized below depot level.
L	-	Reparable item. Condemnation and disposal not authorized below Specialized Repair Activity (SRA).
A	-	Item requires special handling or condemnation procedures because of specific reasons (e.g., precious metal content, high dollar value, critical material, or hazardous material). Refer to appropriate manuals/directives for specific instructions.

c. NSN (Column (3)). The national stock number for the item is listed in this column

d. CAGEC (Column(4)). Commercial and Government Entity Code (CAGEC) is 5-digit numeric code which is used to identify the manufacturer, distributor, or Government agency/activiy that supplies the item.

e. PART NUMBER (Column (5)). Indicates the primary number used by the manufacturer (individual, company, firm, corporation, or Government activity), 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.

NOTE

When you use an NSN to requisition an item, the item you receive may have a different part number from the number listed.

f. DESCRIPTION ON CODE (UOC) (Column (6). This column includes the following information:

(1). The Federal item name and, when required, a minimum description to identify the item.

(2). Part numbers of bulk materials are referenced in this column in the line entry to be manufactured/fabricated.

(3). The statement "END OF FIGURE" appears just below the last item description in Column (6) for a given figure in both Section II and Section III.

(4). The Usable On Code, when applicable. (See paragraph C.5, Special Information.)

g. QTY (Column (7)). The QTY (quantity per figure) column indicates the quantity of the item used in the breakout shown on the illustration/figure, which is prepared for a functional group, subfunctional group, or an assembly. A "V" appearing in this column instead of a quantity indicates that the quantity is variable and may vary from application to application.

C.4. EXPLANATION OF INDEX FORMAT AND COLUMNS (SECTION IV).

a. NATIONAL STOCK NUMBER (NSN) INDFX.

(1). STOCK NUMBER Column. This column lists the NSN in national item identification number (NIIN) sequence. The NIIN consists of the last nine digits of the NSN, e.g.

NSN
5305-01-574-1467
NIIN

When using this column to locate an item, ignore the first four digits of the NSN. Use the complete NSN (13 digits) when requisitioning items by stock number.

(2). FIG. Column. This column lists the number of the figure where the item is identified/located. The figures are in numerical order in Section II and Section III.

(3). ITEM Column The item number identifies the item associated with the figure listed in the adjacent FIG. column. This item is also identified by the NSN listed on the same line.

b. PART NUMBER INDEX. Part numbers in this index are listed by part number in ascending alphanumeric sequence (i e., vertical arrangement of letters and number combination which places the first letter or digit of each group in order A through Z, followed by the numbers 0 through 9, and each following letter or digit in like order).

(1). CAGEC Column. The Commercial and Government Entity Code (CAGEC) is a 5-digit code used to identify the manufacturer, distributor, or Government agency/activity that supplies the item.

(2). PART NUMBER Column. Indicates the part number assigned to the item.

(3). STOCK NUMBER. This column lists the NSN for the associated part number and manufacturer identified in the PART NUMBER and CAGEC columns to the left.

(4). FIG. Column This column lists the number of the figure where the item is identified/located in Section II or Section Ill.

(5). ITEM Column. The item number is that number assigned to the item as it appears in the figure referenced in the adjacent figure number column.

C.5. SPECIAL INFORMATION.

a. USABLE ON CODE. The usable on code appears in the lower left comer of the Description Column heading. Usable on codes are shown as " UOC: ...." in the Description Column (justified left) on the last line of the applicable item description/nomenclature. Uncoded items are applicable to all models. Identification of the usable on codes used in the RPSTL are:

Code	Used On
FGF	Model 1901-1

b. FABRICATION INSTRUCTIONS. Bulk materials required to manufacture items are listed in the Bulk Material Functional Group of this RPSTL. Part numbers for bulk materials are also referenced in the Description Column of the line entry for the item to be manufactured/fabricated.

c. INDEX NUMBERS. Items which have the word BULK in the figure column will have an index number shown the item number column. This index number is a cross-reference between the National Stock Number/Part Number Index and the bulk material list in Section II.

C.6. HOW TO LOCATE REPAIR PARTS.

a. When NATIONAL STOCK Part Numbers are NOT Known.

(1). First. Using the table of contents, determine the assembly or subassembly group to which the item belongs. This is necessary since figures are prepared for assembly groups and subassembly groups, and listings are divided into the same groups.

(2). Second. Find the figure covering the functional group or the subfunctional group to which the item belongs.

(3). Third. Identify the item on the figure and note the figure and item number,

(4). Fourth in the repair parts list for the figure and item numbers. The NSNs and part numbers are on the same line as the associated item numbers.

b. When National Stock Numbers Part Number is Known.

(1). First. Using the of National Stock Number and Part Number Indexes find the pertinent National Stock Number or Part Number. The NSN index is in National Item identification Number (NIIN) sequence (see paragraph 4.a.). The part numbers in the Part Number index are listed in ascending alphanumeric sequence (see paragraph 4.b.). Both indexes cross-reference you to the illustration/figure and item number of the item you are looking for. Note the figure and item number next to the NSN/part number.

(2). Seconod. Turn to the figure and item number, verify that the item is the one you are looking for, then locate the item number in the repair parts list for the figure.

C.7. ABBRBVIATIONS.

Abreviations	Explanation
BOI	Basis Of Issue
CAGEC	Commercial And Government Entity Code
MAC	Maintenance Allocation Chart
NIIN	National Item Identification Number (Consists of the last 9 digits of the NSN.)
NSN	National Stock Number
RPSTL	Repair Parts and Special Tools List
SMF	Source, Maintenance and Recoverability
TMDE	Test, Measurement and Diagnostic Equipment
UOC	Usable On Code
WQAS-PM	Water Quality Analysis Set - Preventive Medicine

SECTION II. REPAIR PARTS LIST

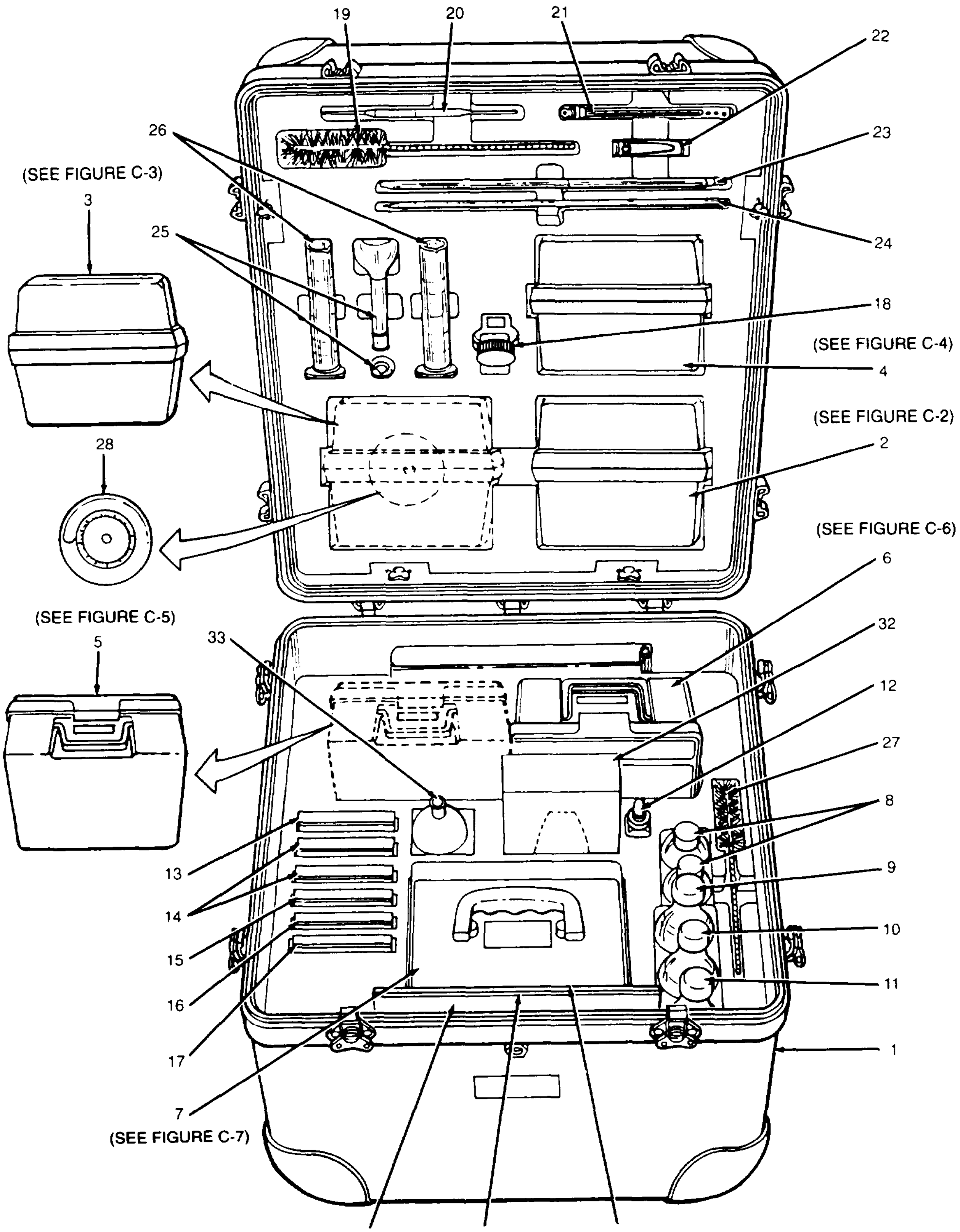


Figure C-1. Water Quality Analysis Set Preventive Medicine.

SECTION II

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 01 CASE, TRANSIT AND STORAGE	
					FIG. 1 TRANSIT CASE	
1	XBOZZ		4U289	19005-1	CASE, TRANSIT AND ST	1
2	PBOZZ	6630010265600	91224	2223-01	TEST KIT, ACIDITY (SEE FIGURE 2 FOR BREAKDOWN)	1
3	PBOZZ	6630010351159	97403	13222E7696	TEST KIT, IRON DETER (SEE FIGURE 3 FOR BREAKDOWN)	1
4	PBOZZ	6630010601844	91224	2086-01	TEST KIT, CHLORIDE HIGH RANGE (SEE FIGURE 4 FOR BREAKDOWN)	1
5	PBOZZ	6630010351160	53390	G7266-01-9	TEST KIT,OXYGEN DIS (SEE FIGURE 5 FOR BREAKDOWN)	1
6	PBOZZ	6630010264529	53390	6153-01-9	TEST KIT, ZINC DETER (SEE FIGURE 6 FOR BREAKDOWN)	1
7	PBOZZ	6650010123290	91224	2504-00	SPECTROPHOTOMETER (SEE FIGURE 7 FOR BREAKDOWN)	1
8	PCOZZ	6810011101492	91224	23293-42	INDICATOR SOLUTION, WIDE RANGE	2
9	PCOZZ	6810010120899	91224	291-31	FLORIDE STANDARDS	1
10	PCOZZ	6810011051428	91224	444-49	FLORIDE REAGENT SO SPADNS	1
11	PCOZA		91224	151-3	MECURIC POTASSIUM NESSLERS REAGENT	1
12	PCOZZ	6810010117191	91224	1725-33	SALT SOLUTION ROCHELLE	1
13	PCOZZ	6810010132685	91224	21065-56	SULFATE TEST REAGEN POWDER PILLOWS	1
14	PCOZZ	6810010117.193	91224	14034-56	NITRATE TEST REAGEN POWDER PILLOW	1
15	PCOZZ	6810010126447	91224	1037-59	POWDER PILLOWS, FERR IRON REAGENT	1
16	PCOZZ	6810010083015	91224	854-66	PHENANTHROLINE, REAG	1
17	PCOZZ	6810010701783	91224	927-59	PHENANTHROLINE IRON REAGENT, POWDER PILLOWS, FOR 5 ML SAMPLE	1
18	PAOZZ		4U289	19006-1	DETERGENT, GENERAL P	1
19	XDOZZ		81348	H-B-1051 ,SZ 3/4, TY 1 ST A, CL 2	BRUSH, TEST TUBE	1
20	PAOZZ	6640000240039	22527	21-157V	PIPET, VOLUMETRIC MICRO	1
21	PAOZZ		64467	5101	THERMOMETER, ARMORED -30 TO +120 DEGREES	1
22	PAOZZ	6630001274765	91224	968-00	CLIPPERS	1
23	PAOZZ	6640010131865	05178	3602-0005	PIPET, VOLUMETRIC 5.0 ML	1
24	PAOZZ	6640011853179	05178	3602-0001	PIPET, MEASURING 1.0 ML	1
25	PAOZZ	6640011200204	97403	13222E7902	FLASK, VOLUMETRIC 25 ML WITH STOPPER.	1
26	PAOZZ	6640003390315	97403	13222E7781	CYLINDER, GRADUATED 25 ML	2
27	XDOZZ		81348	H-B-1051, SZ 1 1/2, TY 1 ST A, CL 1	BRUSH, SAMPLE CELL	1
28	PAOZZ	6630010733021	91224	1756-00	DISK, COLOR STANDARD O TO 1.0 MG/L	1
29	XDOZZ	6630011197523	97403	13222E7917	LOADING DIAGRAM, WAT	1
30	XDOZZ	9905011197478	97403	13222E7916	PLATE, INSTRUCTION MULTIPURPOSE TEST	1
31	XDOZZ		97403	13222E7918	CARD INSTRUCTIONS TEST KITS	1
32	PAOZZ	8540007935425	97403	13222E7798	TISSUE, FACIAL	1
33	PAOZZ	6640009762446	22527	13-681-50	FILLER, PIPET	1

END OF FIGURE

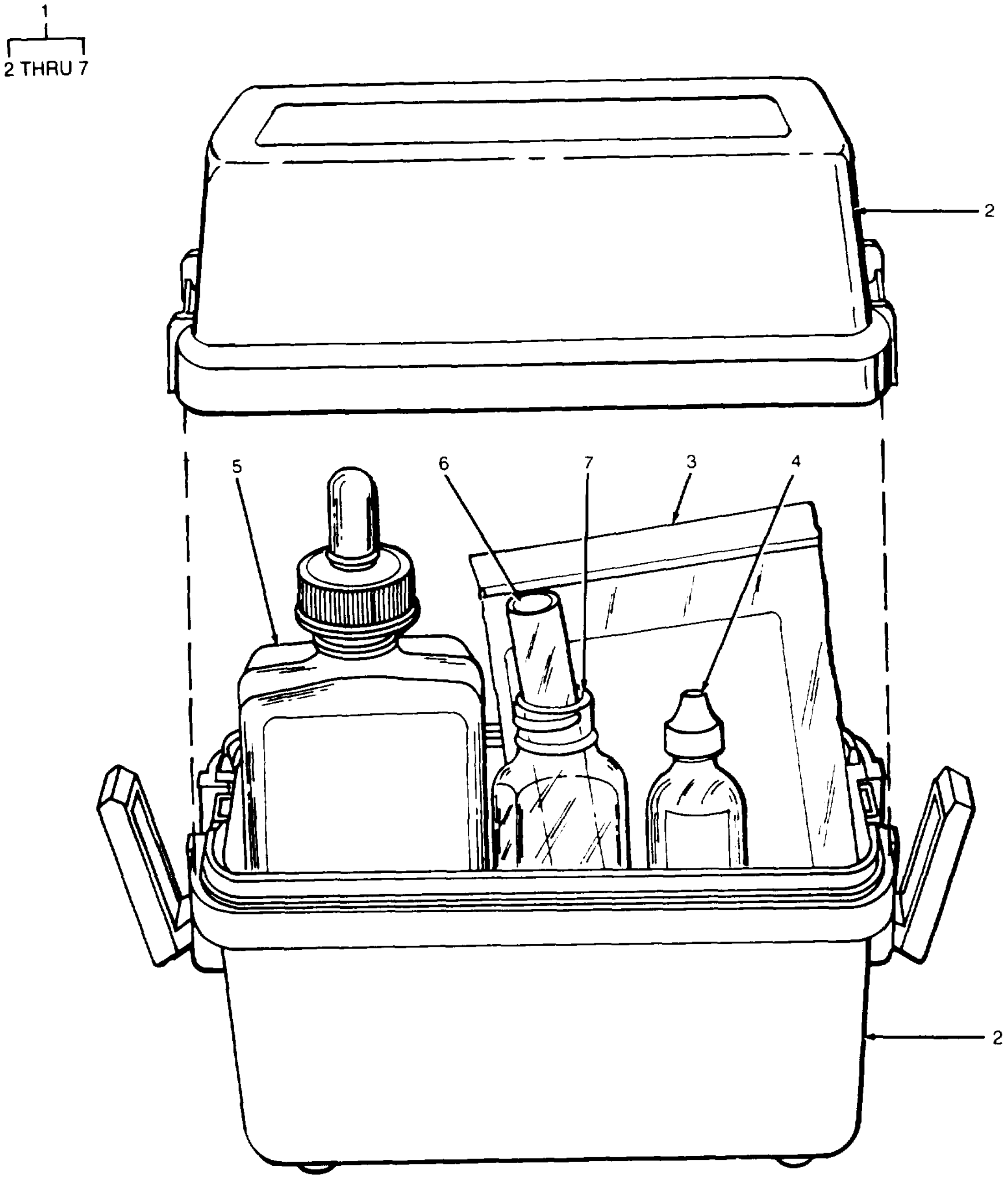


Figure C-2. Test Kit, Acidity.

SECTION II

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) PTY
					GROUP 02 TEST KIT, ACIDITY	
					FIG. 2 TEST KIT, ACIDITY	
1	PBOZZ	6630010265600	91224	2223-01	TEST KIT, ACIDITY RANGE 5-500 MG/L	1
2	XDOZZ		91224	46601-00	.CASE	1
3	PCOZZ	6810007989844	91224	943-99	.BROM CRESOL GREEN-M METHYL RED POWDER PILLOW	1
4	PCOZZ	6810007989643	91224	1897-36	.PHENOLPHTHALEIN SOL	1
5	PCOZZ		91224	23493-32	.SODIUM HYDROXIDE, SO	1
6	PAOZZ	6640001274779	91224	438-00	.TEST TUBE 5.83 ML	1
7	PAOZZ	6640010689153	91224	2327-06	. BOTTLE, SCREW CAP MARKED 10, 15, 20, AND 23 ML	1

END OF FIGURE

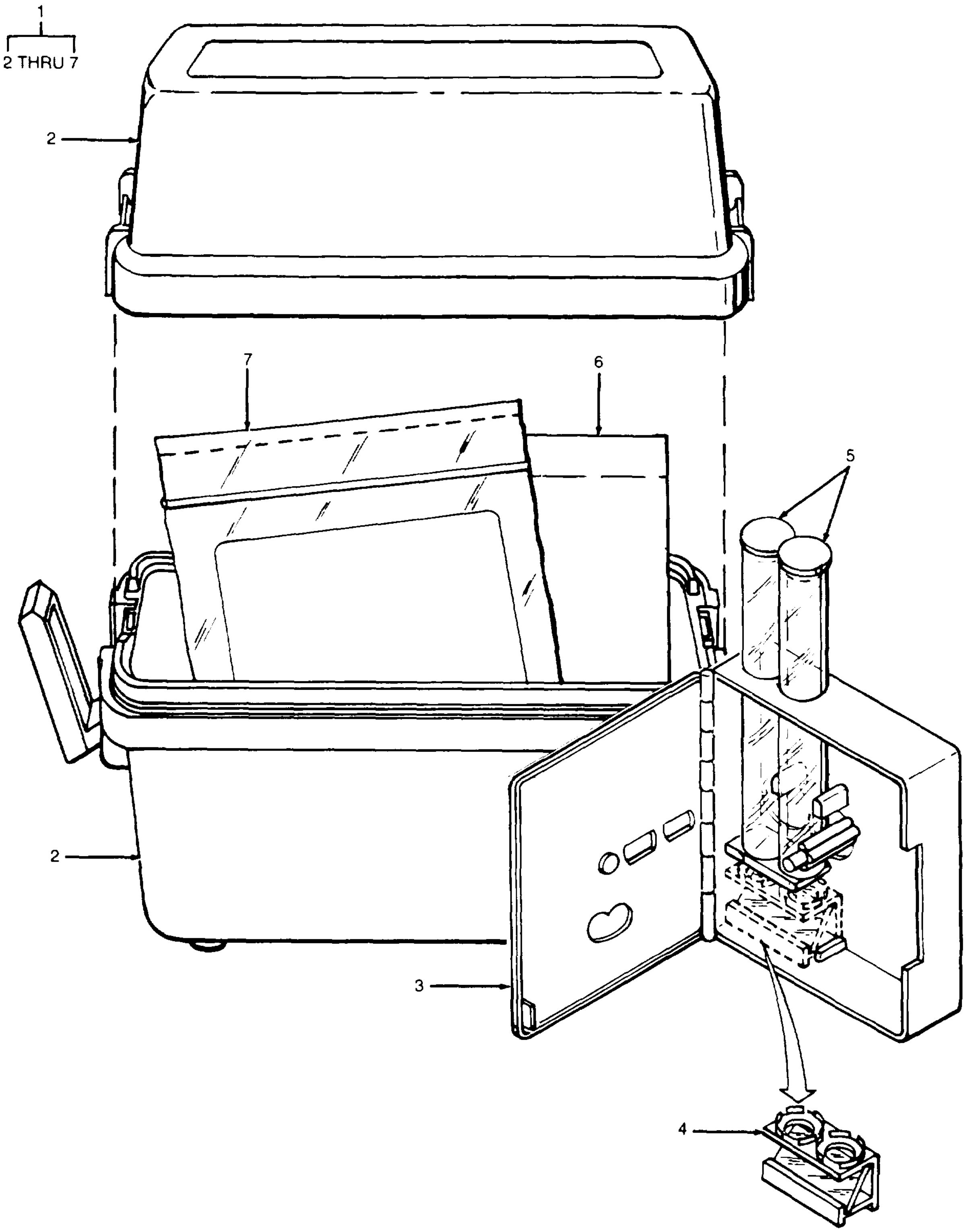


Figure C-3. Test Kit, Ferric Iron.

SECTION II

GROUP 03 TEST KIT, FERRIC IRON

FIG. 3 TEST KIT, FERRIC IRON

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
1	PBOZZ	6630010351159	97403	13222E7896	TEST KIT, IRON DETER RANGE 0-10 MG/L	1
2	XDOZZ		91224	46601-00	.CASE	1
3	XDOZZ		91224	1732-00	.COLOR COMPARATOR	1
4	XDOZZ		91224	24122-00	.ADAPTER, VIEWING	1
5	XDOZZ		91224	46600	. TUBE, VIEWING, COLOR W/STOPPERS	2
6	PAOZZ	6630009261288	79172	U-9450	DISK, COLOR STANDARD 0 TO 10 MG/L	1
7	PCOZZ	6810010083015	91224	854-66	:PHENANTHROLINE, REAG 25 ML SAMPLE	1

END OF FIGURE

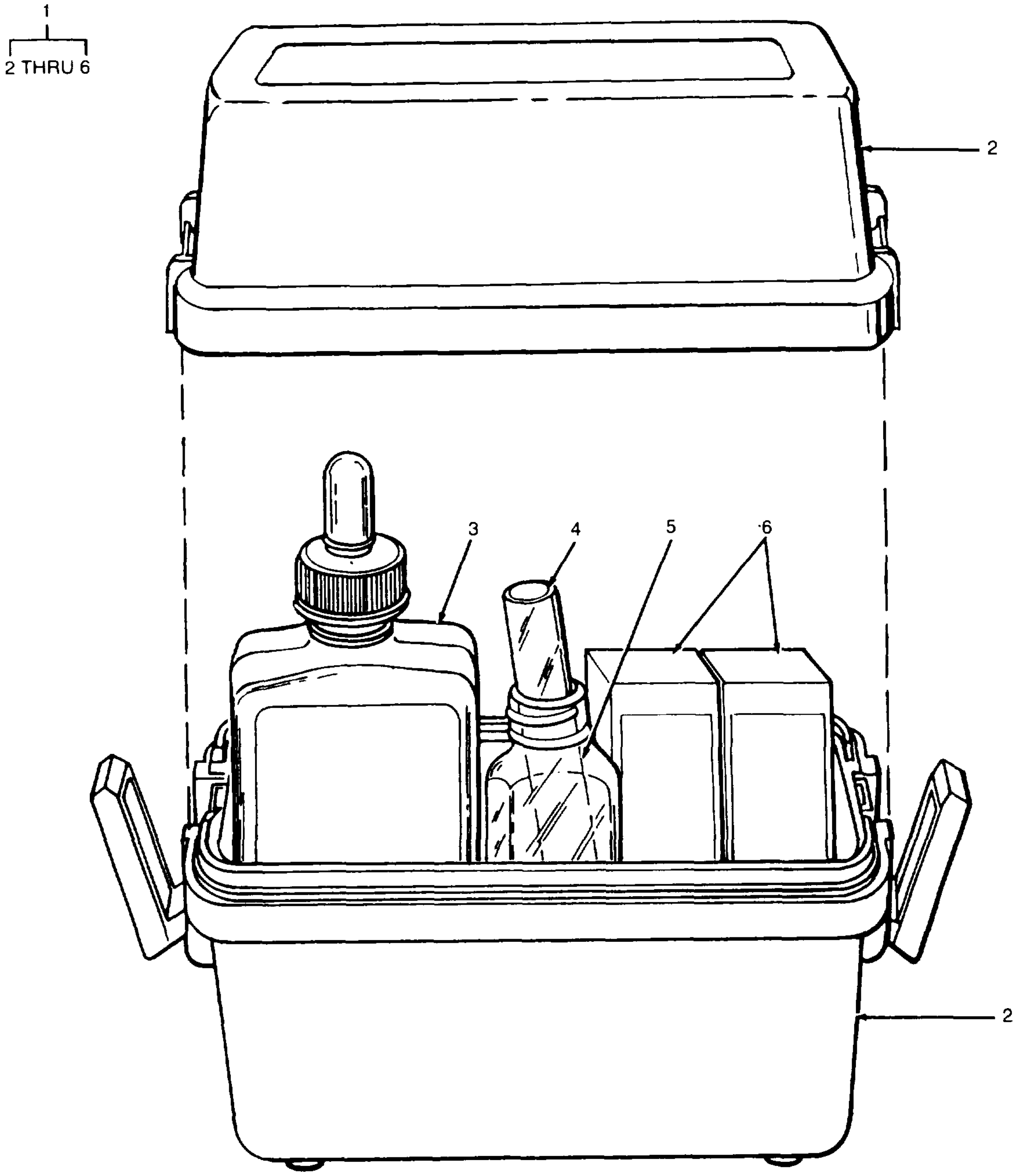


Figure C-4. Test Kit, Chloride, High Range.

SECTION II

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 04 TEST KIT, CHLORIDE, HIGH RANGE	
					FIG. 4 TEST KIT, CHLORIDE, HIGH RANGE	
1	PBOZZ	6630010601844	91224	2086-01	TEST KITtCHLORIDE HIGH RANGE	1
2	XDOZZ		91224	46601-00	.CASE	1
3	PCOZA		91224	23494-32	SILVER NITRATE SOLU HIGH RANGE	1
4	PAOZZ	6640001274779	91224	438-00	.TEST TUBE 5.83 ML	1
5	PAOZZ	8125013661609	91224	439-06	.BOTTLE,SCREW CAP UNMARKED	1
6	PCOZZ	6810007989790	91224	1043-59	. CHLORIDE TEST POWDE PILLOW	1

END OF FIGURE

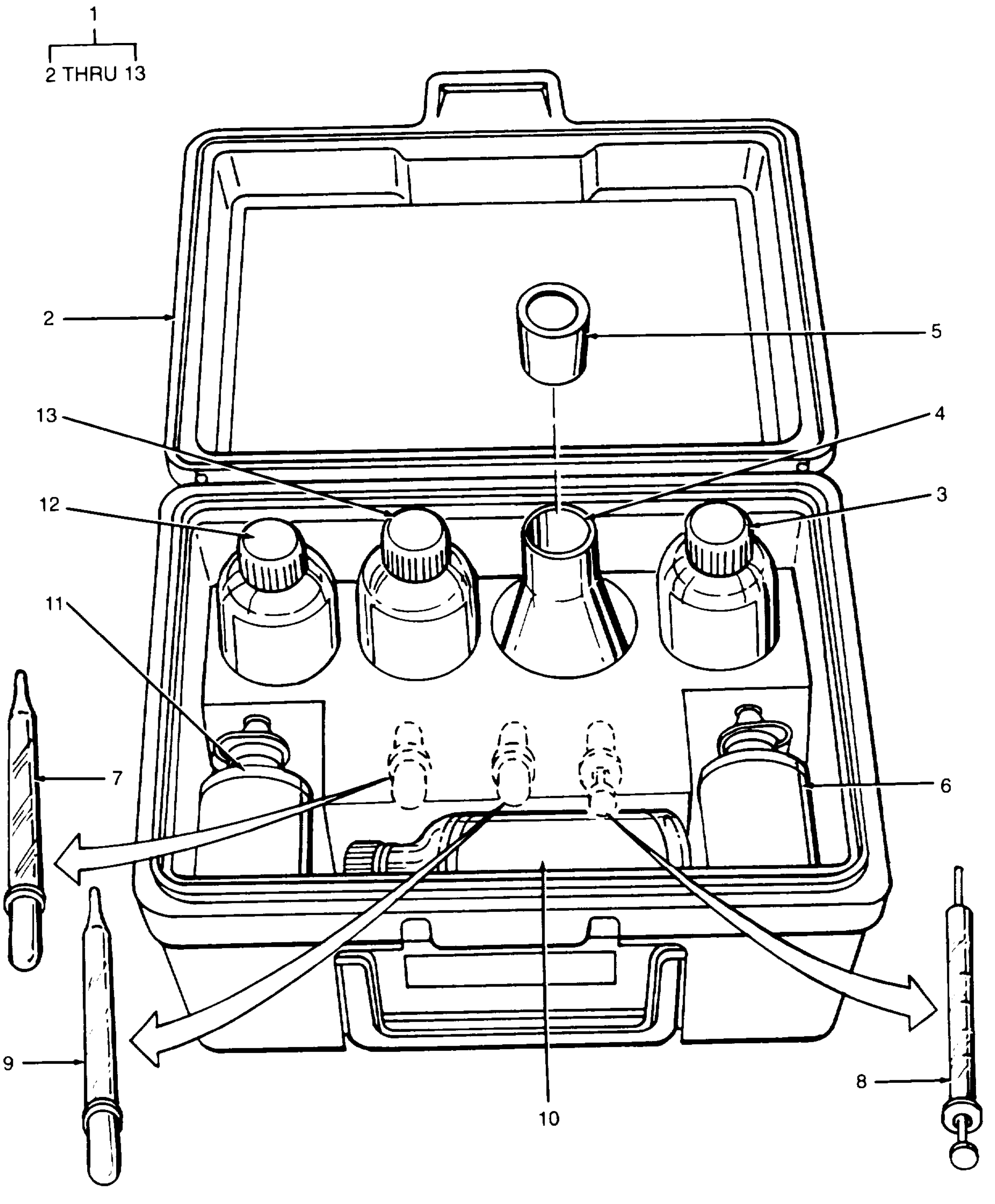


Figure C-5. Test Kit, Dissolved Oxygen.

SECTION II

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES(UOC)	(7) PTY
					GROUP 05 TEST KIT, DISSOLVED OXYGEN	
					FIG. 5 TEST KIT, DISSOLVED OXYGEN	
1	PBOZZ	6630010351160	53390	G7266-01-9	TEST KIT, OXYGEN DIS RANGE 0.5-15 MG/L	1
2	XDOZZ	6630010703067	53390	G309-01-9	.CASE, CARRYING, WATER	1
3	PCOZZ	6810011411460	53390	G 6208-18	.SULFURIC ACID, REAGE	1
4	PAOZZ	6640011200201	53390	5894-01-0	.FLASK, ERLENMEYER 50 ML	1
5	PAOZZ	6640010443774	53390	7000-01-1	STOPPER, BOTTLE	1
6	PCOZZ	6810010700714	53390	6209-18-4	.MANGANESE SULFATE R 1	1
7	PAOZZ	6640011072118	53390	F7707-01	.PIPET, DROPPING 0.5 ML GRADUATION MARK	1
8	PAOZZ	6640011015644	53390	6306-01-4	.BURET, LABORATORY	1
9	PAOZZ	6640010948349	53390	7460-01-7	.PIPET, DROPPING 1.0 ML GRADUATION MARK	1
10	PCOZZ	6810010701819	53390	6212-18-7	.STARCH INDICATOR RE	1
11	PCOZZ	6810011319688	53390	6210-18-1	.POTASSIUM IODIDE SO	1
12	PAOZZ	6630010933244	53390	5012-01-8	.BOTTLE, SAMPLE	1
13	PCOZZ	6810010700715	53390	G 6211-18	.THIOSULFATE STANDAR	1

END OF FIGURE

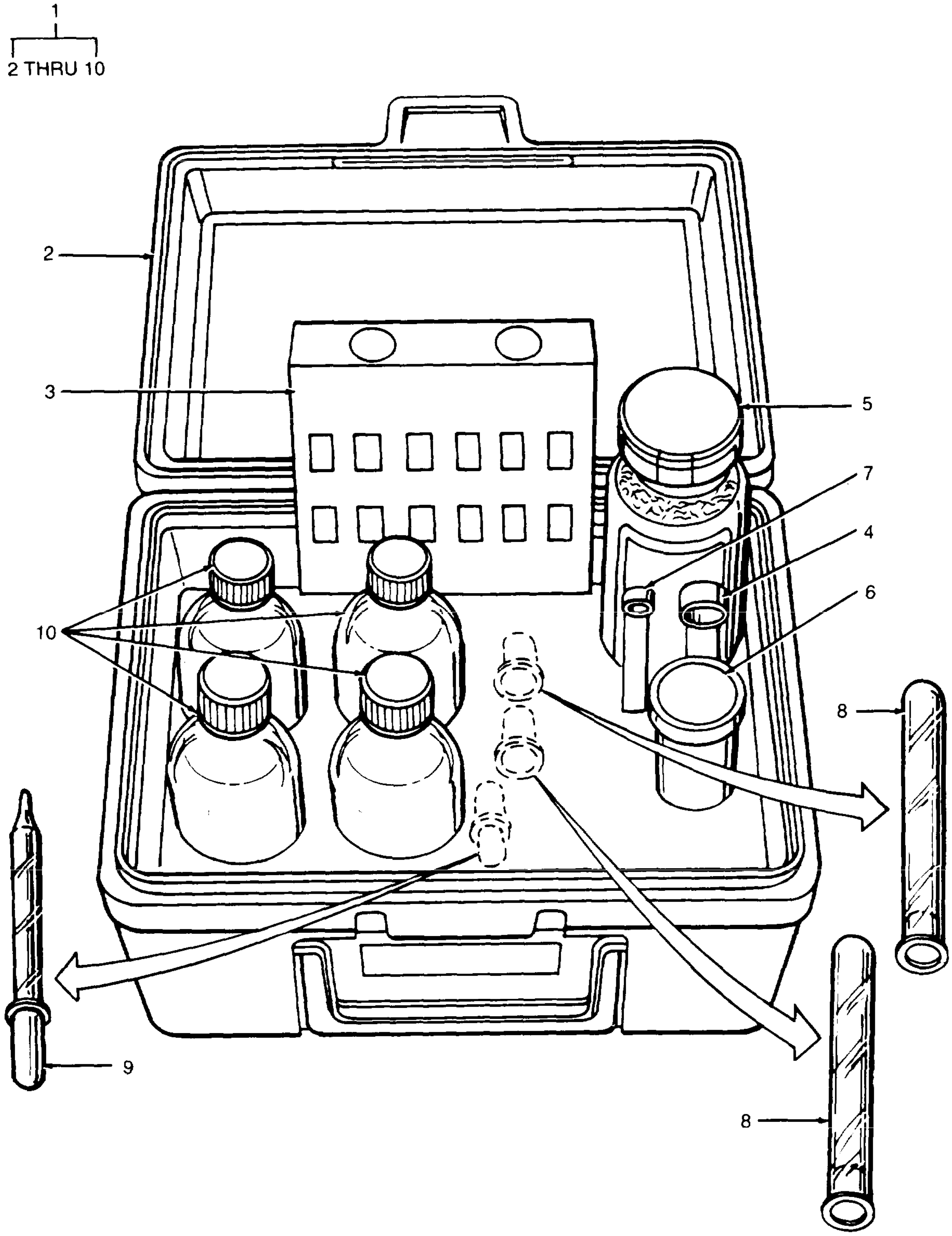


Figure C-6. Test Kit, Zinc.

SECTION II

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) QTY
					GROUP 06 TEST KIT, ZINC	
					FIG. 6 TEST KIT, ZINC	
1	PBOZZ	6630010264529	53390	6153-01-9	TEST KIT, ZINC DETER RANGE 1-20 MG/L	1
2	XDOZZ	6630010703067	53390	6309-01-8	.CASE, CARRYING, WATER	1
3	XDOZZ		53390	6272-01-7	.COLOR COMPARATOR 0-10 MG/L	1
4	PAOZZ	6640010707877	53390	6361-01-8	.SPOON, MEASURING 0.5 GM	1
5	PCOZZ	6810010706403	53390	6627318	.ZINC, REAGENT	1
6	PCOZZ	6810010769571	53390	6274-08-8	.ZINC, CONDITIONING R	1
7	PADZZ	6640011255386	53390	6358-01-5	.SPOON, MEASURING, PLA 0.05 GM	1
8	PAOZZ	6640010933289	53390	6977-01-3	.TES UBE ,COMPARISO 5 M	2
9	PAOZZ	6640010948349	53390	7460-01-7	.PIPE DROPPING 1.0 ML GRADUATION MARK	1
10	PCOZZ	6810010701784	53390	6170-18-7	.DISTILLED WATER, TEC	4

END OF FIGURE

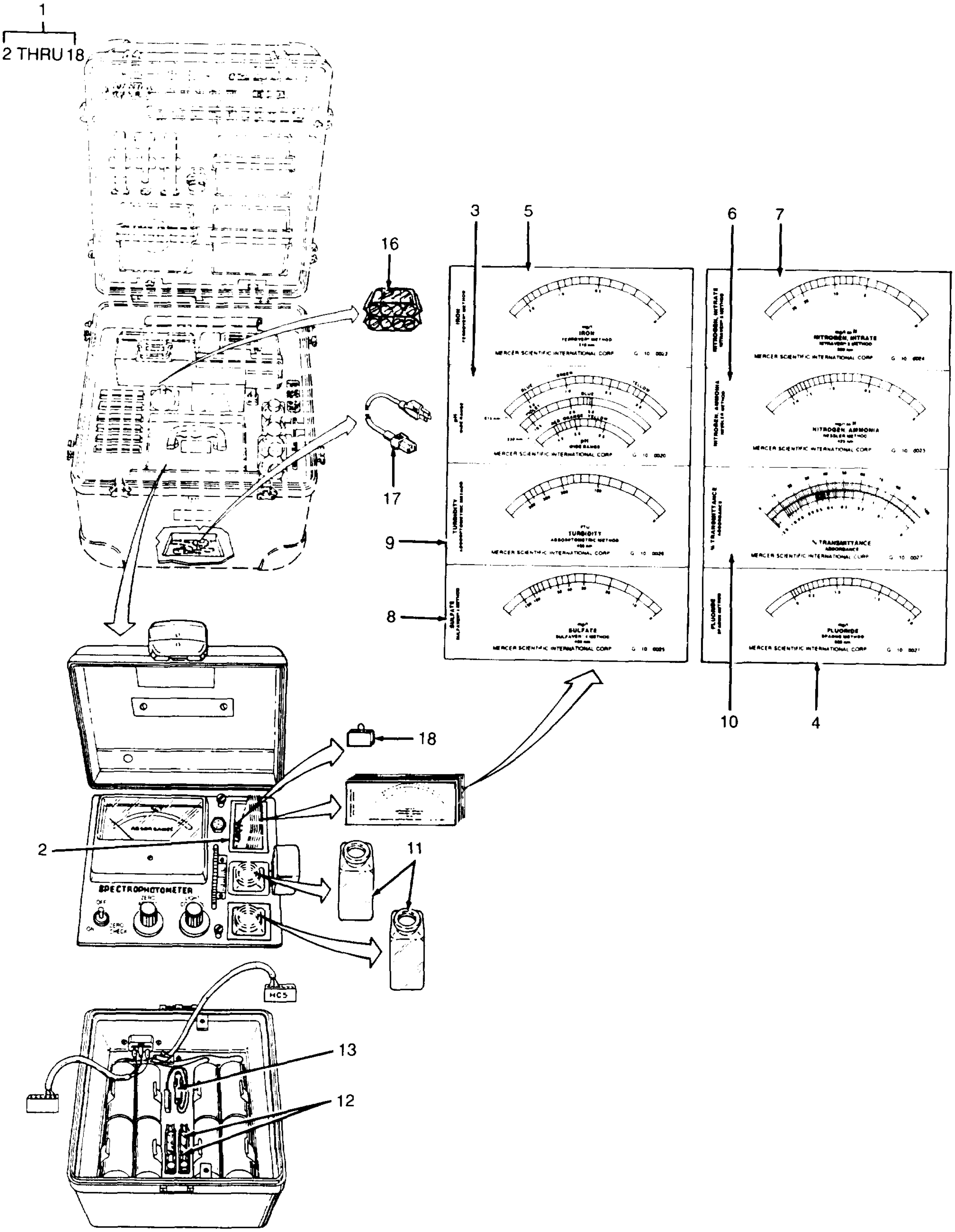


Figure C-7. Spectrophotometer. (Sheet 1 of 2)

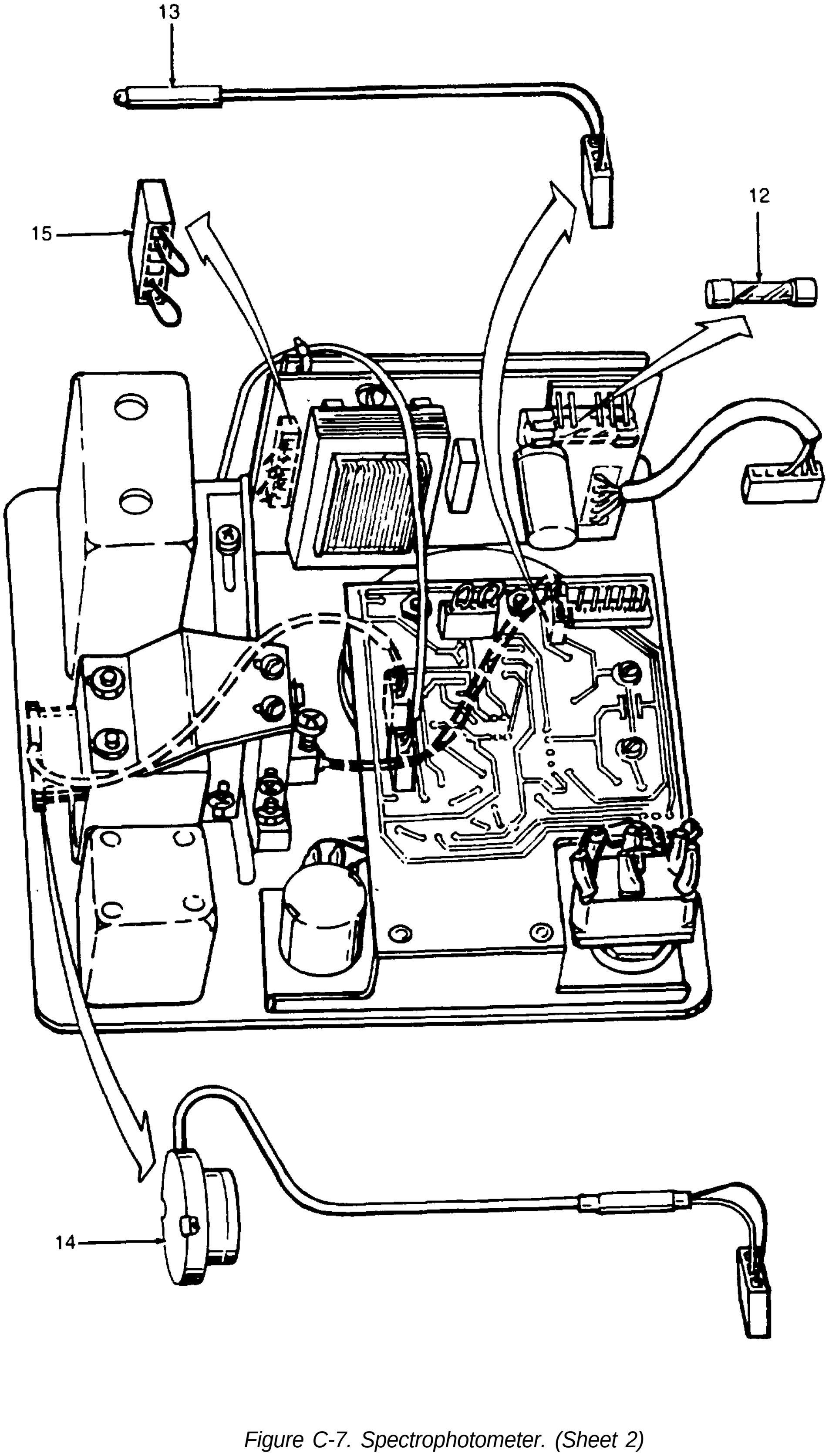


Figure C-7. Spectrophotometer. (Sheet 2)

SECTION II

(1) ITEM NO	(2) SMR CODE	(3) NSN	(4) CAGEC	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODES (UOC)	(7) PTY
					GROUP 07 SPECTRDPHOTOMETER	
					FIG. 7 SPECTROPHOTOMETER	
1	PBOZZ	6650010123290	91224	2504-00	SPECTROPHOTOMETER MULTIPURPOSE	1
2	XDOZZ		OCMH6	G-10-0017	.HOLDER, CARD	1
3	KFOZZ		OCMH6	G-10-0020	.METER CARD, PH WIDE RANGE PART OF KIT P/N MSI-1136-1	2
4	KFOZZ		OCMH6	G-10-0021	.METER CARD, FLUORIDE PART OF KIT P/N MSI-1136-1	2
5	KFOZZ		OCMH6	G-10-0022	.METER CARD, IRON PART OF KIT P/N MSI-1136-1	2
6	KFOZZ		OCHH6	G-10-0023	METER CARD, NITROGEN AMMONIA PART OF KIT P/N HSI-1136-1	2
7	KFOZZ		OCMH6	G-10-0024	.METER CARD, NITROGEN NITRATE PART OF KIT P/N MSI-1136-1	2
8	KFOZZ		OCMH6	G-10-0025	.METER CARD, SULFATE PART OF KIT P/N MSI-1136-1	2
9	KFOZZ		OCMH6	G-10-0026	.METER CARD, TURBIDIT PART OF KIT P/N MSI-1136-1	2
10	KFOZZ		OCMH6	G-10-0027	.METER CARD, PER CENT TRANSMITTANCE ABSORBANCE PART OF KIT P/N MSI-1136-1	2
11	PAOZZ		OCMH6	G-10-0029	.CUVETTE, SPECTROPHOT	2
12	PADZA	5920002810205	81349	F02B250V1/8AS	.FUSE, CARTRIDGE	3
13	PAOZZ		OCMHL	G-10-0031	.LIGHT, INSTRUMENT	2
14	PAOZZ		OCMH6	MSI-1108-1	.SEMICONDUCTOR DEVIC	1
15	PADZZ		OCMH6	G-10-0028	.DUMMY CONNECTOR, PLU	1
16	PAOZZ	6135008357210	81349	BA-3030/U	BATTERY, NONRECHARG LK, BA-3030/U	8
17	PAOZZ		OCMH6	G-10-0018	.CABLE ASSEMBLY, SPEC	1
18	PAOZZ		OCHH6	G-10-0030	.DUMMY CONNECTOR, PLU	1
	PBOZZ		OCMH6	MSI-1136-1	.SCALEPLATE, ELECTRIC SPECTROPHOTOMETER	1
					METER CARD, PH (2) 7-3	
					METER CARD, FLUORIDE (2) 7-4	
					METER CARD, IRON (2) 7-5	
					METER CARD, NITROGEN (2) 7-6	
					METER CARD, NITROGEN (2) 7-7	
					METER CARD, SULFATE (2) 7-8	
					METER CARD, TURBIDIT (2) 7-9	
					METER CARD, PER CENT (2) 7-10	

END OF FIGURE

SECTION III

SPECIAL TOOLS LIST

NOT APPLICABLE

SECTION IV

CROSS-REFERENCE INDEXES

NATIONAL STOCK NUMBER INDEX

STOCK NUMBER	FIG.	ITEM	STOCK NUMBER	FIG.	ITEM
6640-00-024-0039	1	20			
6630-00-127-4765	1	22			
5920-00-281-0205	7	12			
6640-00-339-0315	1	26			
8540-00-793-5425	1	32			
6135-00-835-7210	7	16			
6640-00-976-2446	1	33			
6810-01-008-3015	1	16			
6810-01-011-7191	1	12			
6810-01-011-7193	1	14			
6810-01-012-0899	1	9			
6650-01-012-3290	1	7			
	7	1			
6810-01-012-6447	1	15			
6640-01-013-1865	1	23			
6810-01-013-2685	1	13			
6630-01-026-4529	1	6			
	6	1			
6630-01-026-5600	1	2			
	2	1			
6630-01-035-1160	1	5			
	5	1			
6630-01-060-1844	1	4			
	4	1			
6640-01-068-9153	2	7			
6610-01-070-1783	1	17			
6810-01-070-1819	5	10			
6630-01-073-3021	1	29			
6810-01-105-1428	1	10			
6810-01-110-1492	1	8			
6640-01-120-0204	1	25			
6640-01-185-3179	1	24			
8125-01-366-1609	4	5			

SECTION IV

CROSS-REFERENCE INDEXES

PART NUMBER INDEX

CAGEC	PART NUMBER	STOCK NUMBER	FIG.	ITEM
81349	BA-3030/U	6135-00-835-7210	7	16
81349	F02B250V1/8AS	5920-00-281-0205	7	12
OCMH6	G-10-0018		7	17
OCMH6	G-10-0028		7	15
OCMH6	G-10-0029		7	11
OCMHC	G-10-0030		7	18
OCMH6	G-10-0031		7	13
53390	67266-01-9	6630-01-035-1160	1	5
			5	1
81348	H-B-1051,SZ 1 1/2,TY 1,ST A,CL 1		1	27
81348	H-B-1051,SZ 3/4,TY 1,ST A,CL 2		1	19
OCMH6	MS1-1108-1		7	14
OCMH6	MS1-1136-1		7	
91224	1037-59	6810-01-012-6447	1	15
91224	12065-56	6810-01-013-2685	1	13
22527	13-681-50	6640-00-976-2446	1	33
97403	13222E7781	664Q-00-339-0315	1	26
97403	13222E7798	8540-00-793-5425	1	32
97403	13222E7902	6640-01-120-0204	1	25
97403	13222E7916		1	30
97403	13222E7917		1	29
97403	13222E7918		1	31
91224	14034-56	6810-01-011-7193	1	14
91224	151-3		1	11
91224	1725-33	6810-01-011-7191	1	12
91224	1756-00	6630-01-073-3021	1	29
4U289	19006-1		1	18
91224	2086-01	6630-01-060-1844	1	4
			4	1
22527	21-157V	6640-00-024-0039	1	20
91224	2223-01	6630-01-026-5600	1	2
			2	1
91224	2327-06	6640-01-068-9153	2	7
91224	23293-42	6810-01-110-1492	1	8
91224	23493-32		2	5
91224	23494-32		4	3
91224	2504-00	6650-01-012-3290	1	7
			7	1
91224	291-31	6810-01-012-0899	1	9
05178	3602-0001	6640-01-185-3179	1	24
05178	3602-0005	6640-01-013-1865	1	23
91224	439-06	8125-01-366-1609	4	5
91224	444-49	6810-01-105-1428	1	10
64467	5101		1	21
53390	6153-01-9	6630-01-026-4529	1	6
			6	1
53390	6212-18-7	6810-01-070-1819	5	10
91224	854-66	6810-01-008-3015	1	16
91224	927-59	6810-01-070-1783	1	17

SECTION IV

CROSS-REFERENCE INDEXES

PART NUMBER INDEX

CAGEC	PART NUMBER	STOCK NUMBER	FIG.	ITEM
91224	968-00	6630-00-127-4765	1	22

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GLOSSARY

SECTION I. ABBREVIATIONS

CPC	Corrosion Prevention and Control
°C	Degree(s) Centigrade (Celsius)
°F	Degree(s) Fahrenheit
EIR	Equipment Improvement Recommendation
FTU	Formazin Turbidity Units. Turbidity units of measure based on a Formazin stock suspension.
g	grams
Hz	Hertz
kg	Kilogram
1	Liter
lb	Pound
mg/l	Milligrams per liter
ml	Milliliter-approximately the same as a cubic centimeter
nm	Nanometer
NBC	Nuclear, Biological, and Chemical
oz	Ounce
ppm	Parts per million, used interchangeably with milligrams per liter (mg/l)
PMCS	Preventive Maintenance Checks and Services
T	Transmittance
TAMMS	The Army Maintenance Management System
Vac	Volts alternating current
Vdc	Volts direct current
WQAS	Water Quality Analysis Set
WQAS-PM	Water Quality Analysis Set-Preventive Medicine

SECTION II. DEFINITION OF UNUSUAL TERMS

Acid-Having a pH of less than 7.

Adjust-To maintain or regulate, within prescribed limits by bringing into proper position, or setting the operation characteristics to specified parameters.

Align-To adjust specified variable elements of an item so as to bring about optimum or desired performance.

Alkaline-Having a pH of more than 7.

Ammonia Nitrogen-A product of the microbiological decay of plant and animal protein.

Buffer (reagent) solutions-Buffer solutions are equilibrium systems containing substances which, within limits, neutralize added acids or bases.

Burette (Buret) - A graduated tube for measuring liquid volumes or granular substances.

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.

Colorimetric Test-A test used to measure the concentration of a constituent of a sample by comparing the color of the sample against the colors of known standard solutions.

Comparator-A device used to compare the color of a sample against a standard during colorimetric testing..

Dropping Pipet-Eyedropper-like pipet with a measurement mark used to measure and transfer liquids.

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.

Fix-To treat a chemical solution so that its concentration does not change.

Graduated Cylinder-Chemical apparatus with measurement markings used to accurately measure liquids.

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.

Interferences-When testing for a particular element, another element or compound present in the sample will cause an error in the result.

Meniscus-A curvature in a liquid top level in a measuring tube caused by an affinity to the tube material by the liquid.

Nanometer-10^{-9} meters.

Oxidation-The combination of a substance with oxygen.

Photocell-Device that converts light intensity to an electrical signal.

Pipet-Laboratory apparatus with which fluids are measured or transferred.

Pipet-Filler Rubber bulb used to safely fill pipets by suction.

pH-the logarithm of the reciprocal of the hydrogen ion activity expressed in moles per liter.

Powder Pillows-Chemicals in dry powder form, usually pre-measured and packaged individually for one test.

Precipitate-A solid which forms when a substance held in solution passes out of solution into a solid form.

Shelf Life-The expected duration of time, under specified conditions, in which a chemical substance will react with a predetermined result.

SPADNS Reagent-A reagent used with the spectrophotometer test for fluorides.

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.

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 signaled by observation of a end point.

Titrimetric-Test A test using the process of titration to determine the concentration of a substance in solution.

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 Sample-A measured amount of raw water which is to be analyzed.

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By Order of the Secretary of the Army:

DENNIS J. REIMER
General, United State Army
Chief of Staff

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01759

DISTRIBUTION:
To be distributed in accordance with DA Form 12-25-E, block no. 6335, requirements for TM 10-6630-245-13&P.

These are the instructions for sending an electronic 2028

The following format must be used if submitting an electronic 2028. The subject line must be exactly the same and all fields must be included; however only the following fields are mandatory: 1, 3, 4, 5, 6, 7, 8, 9,10,13,15,16,17, and 27.

From: "Whomever" <whomever@avma27.army.mil>
To: mpmt%avma28@st-louis-emh7.army.mil

Subject:: DA Form 2028
1. **From**: Joe Smith
2. Unit: home
3. **Address**:4300 Park
4. **City**: Hometown
5. **St:** :MO
6. **Zip**: 77777
7. **Date Sent**: 19-OCT-93
8. **Pub no**: 55-2840-229-23
9. **Pub Title**: TM
10. **Publication Date**: 04-JUL-85
11. Change Number: 7
12. Submitter Rank: MSG
13. **Submitter FName**: Joe
14. Submitter MName: T
15. **Submitter LName**: Smith
16. **Submitter Phone**: 123-123-1234
17. **Problem**: 1
18. Page: 2
19. Paragraph: 3
20. Line: 4
21. NSN: 5
22. Reference: 6
23. Figure: 7
24. Table: 8
25. Item: 9
26. Total: 123
27. **Text**:

This is the text for the problem below line 27.

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS

SOMETHING WRONG WITH PUBLICATION

THEN...JOT DOWN THE DOPE ABOUT IT ON THIS FORM. CAREFULLY TEAR IT OUT, FOLD IT AND DROP IT IN THE MAIL.

FROM: (PRINT YOUR UNIT'S COMPLETE ADDRESS)

DATE SENT

PUBLICATION NUMBER	PUBLICATION DATE	PUBLICATION TITLE

BE EXACT PIN-POINT WHERE IT IS

PAGE NO.	PARA-GRAPH	FIGURE NO.	TABLE NO.	IN THIS SPACE, TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT.

PRINTED NAME, GRADE OR TITLE AND TELEPHONE NUMBER	SIGN HERE

DA FORM 1 JUL 79 2028-2

PREVIOUS EDITIONS ARE OBSOLETE.

P.S.--IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR RECOMMENDATION MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS.

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 decigram = .035 ounce
1 decagram = 10 grams = .35 ounce
1 hectogram = 10 decagrams = 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 milliters = .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	1.356	metric tons	short tons	1.102
pound-inches	Newton-meters	.11296			

Temperature (Exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C