DEPARTMENT OF THE ARMY TECHNICAL MANUAL

OPERATOR'S ORGANIZATIONAL, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL

PETROLEUM BASE LABORATORY ASSEMBLY
NSN 6640-00-303-4940

HEADQUARTERS, DEPARTMENT OF THE ARMY

21 DECEMBER 1981

CHANGE No. 1

**HEADQUARTERS
DEPARTMENT OF THE ARMY,
WASHINGTON, D.C., 30 June 1986**

**Operator, Organizational, Direct, Support
And General Support Maintenance Manual
Petroleum Base
Laboratory Assembly
NSN 6640-00-303-4940**

TM 5-6640-214-14, 21 December 1981, is changed as follows:

1. Remove and insert pages as indicated below:

	REMOVE PAGES	INSERT PAGES
Warning Pages	a thru d	a thru d
Table of Contents	i thru iii/(iv blank)	i thru iii/(iv blank)
Chapter 1	1-1 thru 1-4	1-1 through 1-4
	1-9thru 1-12	1-9 thru 1-12
Chapter 2	2-1 thru 2-6	2-1 thru 2-6
	2-13 and 2-14	2-13 and 2-14
	2-25 and 2-26	2-25 and 2-26
	2-31 thru 2-34	2-31 thru 2-34
		2-34.1 and 2-34.2
	2-35 thru 2-50	2-35 thru 2-50
Chapter 3	3-11 and 3-12	3-11 and 3-12
Appendix B	B-5 and B-6	B-5 and B-6
Appendix C	C-3 thru C-30	C-3 thru C-22
Appendix D		D-1 and D-2

2. New or changed text material is indicated by a vertical bar in the margin. An illustration change is indicated by a miniature pointing hand.

3. Retain this sheet in the front of manual for reference purposes.

By Order of the Secretary of the Army:

JOHN A. WICKHAM, JR.
General, United States Army
Chief of Staff

Official:

R. L. DILWORTH
Brigadier General, United States Army
The Adjutant General

DISTRIBUTION:
To be distributed in accordance with DA Form 12-25A, Operator, Organizational, Direct Support and General Support Maintenance requirements for Laboratory, Petroleum, Base Assembly.

WARNING

- **When the electrical power for the laboratory is to be supplied by a generator, the MAIN POWER CIRCUIT BREAKER must be in the UN position prior to starting the generator. The main power breaker SHOULD NOT BE SHUT OFF MANUALLY EXCEPT IN THE CASE OF AN EMERGENCY. Turning the circuit breaker to the ON position when the power is already applied can result in sparking which can ignite any combustible vapors which may be present in the laboratory.**

- **Mercury is a poisonous material which may enter the body by ingestion, inhalation, or skin absorption. Mercury has such density, high surface tension, and low viscosity that pouring without splashing and spilling is almost impossible. When mercury is poured, always use a funnel and make the transfer over spill trays.**

- **If a mercury spill occurs, do not vacuum or sweep the area. This will disperse mercury throughout the laboratory. Spills may be cleaned up by using a glass tube of about 6mm diameter drawn out to an opening of about 1 mm and connected by rubber tubing to a filter flask connected with a vacuum pump or aspirator, the flask acting as a trap. Control of mercury vapor should not be attempted with Flowers Of Sulfur as this is not effective. Spills must be reported to the Environmental Science Officer providing services to the unit. Ventilation must be adequate throughout the laboratory. Exhaust hoods and fans must be installed and operated to prevent exposure of personnel to hazardous vapors, fumes, or mists.**

- **Benzene (C_6H_6) is a highly toxic chemical: a recognized carcinogen. A substitute chemical should be used wherever possible, but if benzene must be used, it must be contained within a laboratory hood or other well ventilated enclosure. Benzene has been deleted from the integral components of the end item list (COEIL).**

- **Acute poisoning by carbon tetrachloride can result in death. Its use should be prevented, if possible. The Threshold Limit Value (TLV) established by the Occupational Safety and Health Act of 1970 standards (29CFH1910-1000) is 10 ppm, a level which can not be detected by odor. If used it must be contained within a laboratory hood.**

- **Aniline ($C_6H_5NH_2$) is an extremely toxic chemical. A single glove or part of a shoe saturated with aniline may cause severe poisoning. Poisoning can occur from inhalation, ingestion, or skin absorption. If aniline must be used, wear protective clothing and assure adequate ventilation by using a laboratory hood. In case of accident: remove clothing and flush body with water for 15 minutes. Get medical help. Aniline is hypergolic (self-igniting) with fuming nitric acid.**

WARNING

- **Do not allow the consumption of food or beverages in the laboratory or storage rooms.**
- **No smoking in the laboratory or associated areas where chemicals are handled or stored.**
- **Bromine is an extremely strong irritant to the eyes and upper respiratory tract. Use eye and skin protective equipment and a laboratory exhaust hood. Bromine may ignite combustible material upon contact.**
- **When iodine is heated, it produces vapors which are an extremely strong irritant to the eyes and upper respiratory tract. Contact with these vapors must be avoided.**
- **Vapors from hydrochloric acid are a strong irritant to the eyes and respiratory tract. Concentrations of 1000 ppm or more in air are dangerous to life, even for brief exposures. It should be used only under an exhaust hood.**
- **Hydrofluoric acid is extremely irritating and corrosive to the skin and mucous membranes. Concentrations at 50 to 250 ppm are dangerous to life, even for brief exposures. It produces severe skin burns. Gangrene of the affected areas may follow. It must be handled under an exhaust hood and personal protective clothing worn: face shield, gloves, etc. Hydrofluoric acid is corrosive to glass.**
- **Nitric acid vapor is highly irritating to the eyes and respiratory tract and to the skin. It is corrosive to the teeth. Nitric acid should be handled with protective clothing and under an exhaust hood.**
- **In the oxidation of organic materials, nitric acid produces oxides of nitrogen (red/brown cloud). Since nitrogen oxides are only slightly irritating to the upper respiratory tract, it is possible to inhale a dangerous concentration without much discomfort. Inhalation of nitrogen oxide must be avoided. Anyone known to have inhaled nitrogen oxide fumes should be placed under medical care whether or not he shows symptoms.**
- **Nitric acid reacts explosively with metallic powders, carbides, hydrogen sulfide and turpentine. It should be isolated from contact with reducing materials or organic substances: it may cause explosion or combustion on contact.**

WARNING

- **Sulfuric acid contact with the body results in rapid destruction of tissue, causing severe burns. Personnel should wear protective clothing. In all cases of contact in any form, start first aid at once! Immediately flush area with running water. Remove clothing and continue to flush with plenty of water. Then application of mild alkaline solutions may be in order. Do not apply oils or ointments without instructions from a physician. If eyes are involved, they should be immediately irrigated with copious quantities of warm water for at least 15 minutes. If the acid is taken internally, do not attempt to induce vomiting. Do not give anything by mouth to an unconscious patient. If he is conscious, encourage him to wash out his mouth with large amounts of water; then have him drink milk mixed with whites of eggs. If this is not available, have him drink as much water as possible. All persons injured should be referred to a physician.**

- **Oxalates (sodium, ammonium, etc.) are corrosive and produce local irritation. Avoid skin contact.**

- **Many of the chemicals listed in the COEIL (Appendix C) have exposure TLV's established by the Occupational Safety and Health Act of 1970 standards (29CFR1910-1000). These chemicals are identified with a double asterisk (* *) in the Item No. column in the COEIL. Proper procedures must be established to prevent overexposure to these substances.**

- **Many of the chemicals in the laboratory are dangerous. They may be toxic, corrosive, explosive, flammable, irritant, carcinogenic, etc. Broken or damaged containers must be handled with caution to prevent exposure of personnel to the hazards that may be involved with a particular chemical.**

- **Adequate ventilation must be available to the supply room where chemicals are stored as well as the laboratory. Also, ensure that the fume hoods are properly installed, vented to the outside of the building, and have connecting ducts that are airtight.**

- **Do not direct compressed air against the skin. Do not use compressed air for cleaning except where reduced to less than 30 psi (2.11 ky/cmr) and then only with chip guarding and eye protection. The air compressors should be located to prevent the intake of combustible/.explosive vapors.**

- **Acetic acid is particularly dangerous in contact with chromic acid, sodium peroxide, and nitric acid. Store separate from oxidizing and combustible materials.**

WARNING

- **Ammonium nitrate explodes more readily if contaminated. It must be kept cool and unconfined. Store in well ventilated area. Separate from all organic materials or other contaminating substances.**

- **Bromine may ignite a combustible material upon contact: a very powerful oxidizer. Store in cool, dry area, out of direct sunlight. Separate from combustible, organic, or other readily oxidizable materials.**

- **Cobalt chloride in contact with acids or acid fumes will result in highly toxic chloride fumes.**

- **Store hydrochloric acid in a cool well-ventilated place, separated from all oxidizing materials.**

- **Hydrofluoric acid is corrosive to all common metals and glass. Store in a suitable container.**

- **Hydrogen peroxide is a dangerous fire and explosion hazard. Store in cool, ventilated, noncombustible area in vented containers, remote from combustible, organic, readily oxidizable materials and catalytic metals.**

- **Tetraethyl lead is a powerful poison. It can enter the body by inhalation or absorption through the skin. Tetraethyl lead exposed to Sunlight or allowed to evaporate forms triethyl lead, which is also poisonous. Any open receptacle, container, clothing, or other object in contact with these materials must be kept clean, or personnel may be subject to serious lead poisoning.**

- **When filling the Reid Vapor Pressure (RVP) bomb bath, exercise extreme caution in adding the required ten (10) parts per million (PPM) of copper sulfate. Do not exceed this proportion as twelve (12) ppm of copper sulfate is poisonous,**

- **Several of the chemicals listed in the integral components of the end item list (COEIL) are EXPLOSIVE and should be handled with extreme care. These chemicals are flagged with an asterisk (*) in the Item, No. column in the COEIL.**

TECHNICAL MANUAL
No. 5-6640-214-14

HEADQUARTERS
DEPARTMENT UF THE ARMY
WASHINGTON, DC, 21 December 1981

OPERATOR, ORGANIZATIONAL, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL PETROLEUM BASE LABORATORY ASSEMBLY NSN 6640-00-303-4940

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 the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in the back of this manual direct to: Commander, U.S. Army Troop Support Command, ATTN: AMSTR-MCTS, 4300 Goodfellow Blvd., St. Louis, MO 63120-1798. A reply will be furnished directly to you.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS (Continued)

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1-1. SCOPE.

This manual is for your use in operating and maintaining Petroleum Base Laboratory Assembly, NSN 6640-00-303-4940. It provides instructions for laying out, assembling, operating, and maintaining the base laboratory and major components and for performing required tests and analysis of petroleum products. Information contained must be supplemented by reference to related publications (Appendix A) that describe authorized testing procedures.

1-2. MAINTENANCE FORMS AND RECORDS.

a. Equipment maintenance forms and procedures are contained in TM38-750, The Army Maintenance Management System (TAMMS).

b. Blank forms to be used in the preparation of records, reports and requisitions pertaining to the Base Laboratory are as follows:

(1) DA Form 285 (Accident Report).

(2) DA Form 285-1 (Accident Report-Continuation Sheet).

(3) DA Form 285-2 (Accident Report-Coding and Key Punch Sheet).

(4) DA Form 1051 (Record of Injury).

(5) DA Form 1804 (Petroleum Sample Tag).

(6) DA Form 2077 (Petroleum Products Laboratory Analysis Report).

(7) DA Form 2407 (Maintenance Request).

(8) DA Form 2407-1 (Maintenance Request-Continuation Sheet).

(9) DD Form 6 (Report of Packaging and Handling Deficiencies).

(10) DD Form 200 (Report of Survey).

(11) DD Form 250 (Material Inspection and Receiving Report).

(12) DD Form 250c (Material Inspection and Receiving Report-Continuation Sheet).

(13) DD Form 250-1 (Tanker/Barge Material Inspection and Receiving Report).

(14) DD Form 1425 (Specifications and Standards Requisition).

(15) SF 361 (Discrepancy in Shipment Report).

(16) SF 368 (Quality Deficiency Report).

1-3. HAND RECEIPT.

Hand receipts for Components of End Item (COEI), Basic Issue Items (BII), and Additional Authorization List (AAL) items are published in a Hand Receipt manual, TM5-6640-214-14-HR. This manual is published to aid in property accountability and is available through:

Commander
U.S. Army Adjutant General Publication Center
ATTN: ADGL-OD
2800 Eastern Blvd.
Baltimore, Md. 21220

1-4. ADMINISTRATIVE STORAGE.

a. Preparing for Limited Storage.

(1) Disconnect service lines from gas, compressed air, electric, and drain lines, and disconnect all lines between cabinets.

(2) Place terminal junctions and covers in proper cabinets.

(3) Remove panel boxes and other controls, and replace in proper cabinets or units.

(4) Disassemble all apparatus that is not permanently mounted on elevating platforms or within cabinets.

(5) Store in drawers or compartments all equipment and apparatus that requires storing; fasten firmly.

(6) Place flexible metal tubing in place on rear of pipe racks. Load pipe racks to storage or shipping position, and lock racks in place.

(7) Drain all oil from equipment such as vacuum pumps, air compressors, etc.

(8) Draw leveling devices up from floor by means of their leveling bolts.

(9) Lower the elevating platforms of the cabinets, and lock in the lowered position; place the elevating platform covers in place and fasten.

(10) Place the cabinets on their wooden shipping platforms (figs. 2-1 and 2-2) and fasten in place. Place upper sections of shipping containers (figs. 2-1 and 2-2) in position on shipping platforms and lock in position by means of the fastening devices.

(11) Place all other items, large containers of chemicals, etc., on shipping platforms or within crates, and fasten in position; place covers, upper sections, etc., on the containers and fasten securely.

b. Preparing for Extended Storage. To ensure safe transit and to protect equipment against weather, follow the principles and instructions described in TM 38-250. Cabinet units packed in their specially constructed armor ply shipping containers need no further packing. Cabinets and containers are so constructed that no damage will result from shipping or storage. To assure that the shipping containers are relatively water and vapor tight, apply a strap of water resistant tape over the joints of the shipping cases and the supporting platforms prior to storage or shipment. For further information , refer to TM 740-90-1 (Administrative Storage).

1-5. DESTRUCTION OF ARMY MATERIEL TO PREVENT ENEMY USE.

a. General. Demolition should be carried out only upon orders of the commanding officer. Destruction should be as complete as available time, equipment, and personnel allow. If thorough demolition of all parts cannot be accomplished, destroy the most important parts. Because of the flammable and explosive nature of many of the chemicals, equipment, and samples contained in the base laboratory, adequate safety precautions must be taken to protect personnel involved in demolition.

b. Detailed Procedures.

(1) Smash all apparatus, equipment, glassware, and controls. Make certain precision instruments are demolished.

(2) Break and/or bend all copper tubing and smash valves.

(3) Cut all wiring, conduits, and service lines.

(4) Remove chemicals from drawers and cabinets; pour out chemicals and smash containers.

(5) Demolish drawers, cabinets, fume hood, vacuum pumps, air compressor, and refrigeration units, using heavy object.

(6) Demolish shipping containers and crates.

(7) Remove fire extinguishers and discharge contents outside of laboratory building.

(8) Immediately before leaving laboratory building, open gas valves on all gas cylinders.

(9) If available, pour gasoline, oil, or other flammable liquid over units of the laboratory, and ignite by incendiary grenades, rockets, gunfire, or other available means.

CAUTION

Do not use matches to ignite laboratory if gas cylinders were opened prior to leaving the building; escaping gases may make the building highly explosive. Keep all personnel at a safe distance when laboratory building is being demolished by fire and/or gunfire, because of explosive nature of many of the items within the building.

b. Additional Information. Additional information on procedures for destruction of equipment to prevent enemy use, refer to TM 750-244-3.

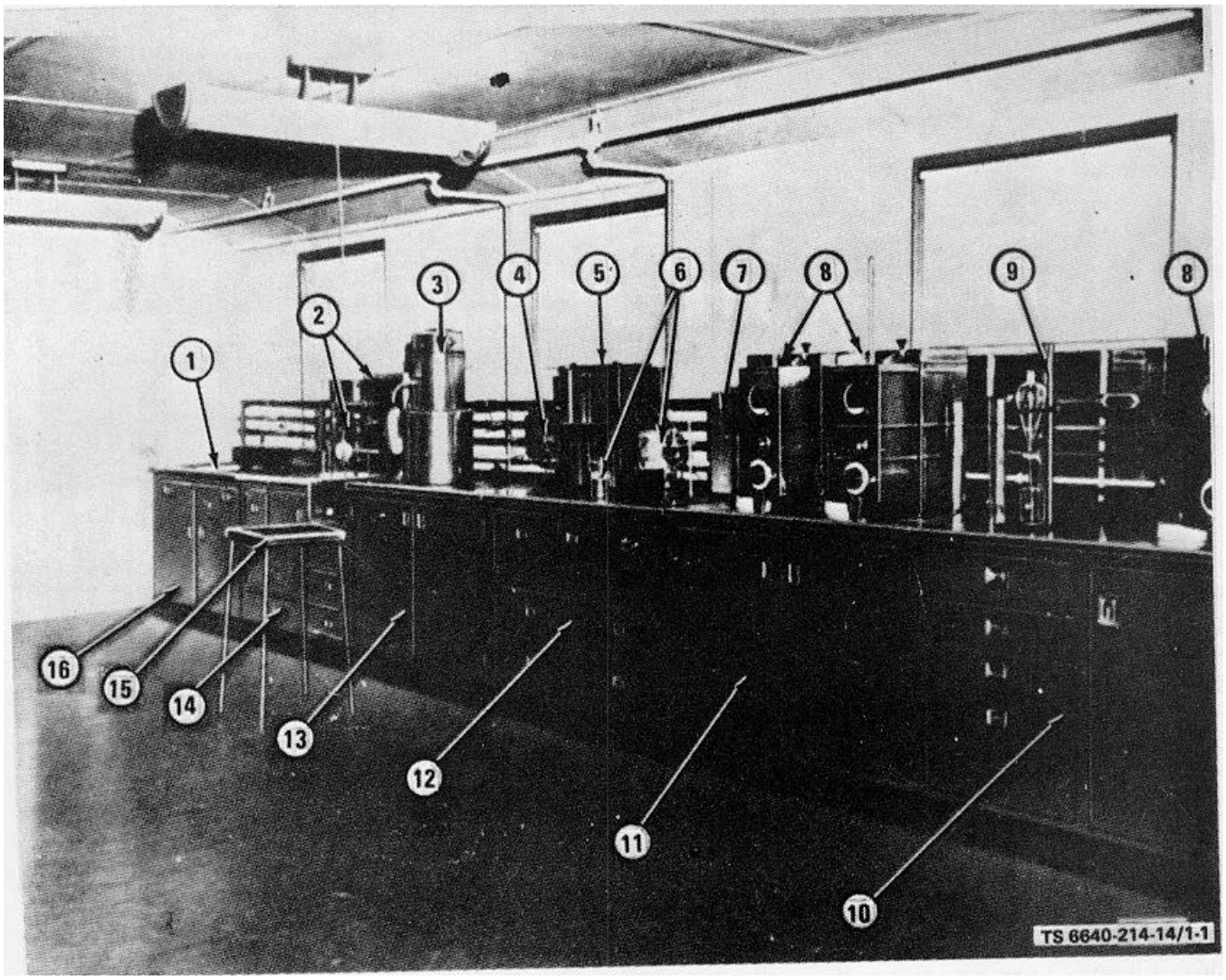
1-6. REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIR).

EIR's will be prepared on DA Form SF 368, Quality Deficiency Report. Instructions for preparing EIR's are provided in DA Pam 738-750, The Army Maintenance Management System (TAMMS). EIR's should be mailed directly to Commander, Headquarters, U.S. Army Troop Support Command, ATTN: AMSTR-QX, 4300 Goodfellow Blvd., St. Louis, MO. 63120-1798. A reply will be furnished directly to you.

Section II. DESCRIPTION AND DATA

1-7. GENERAL.

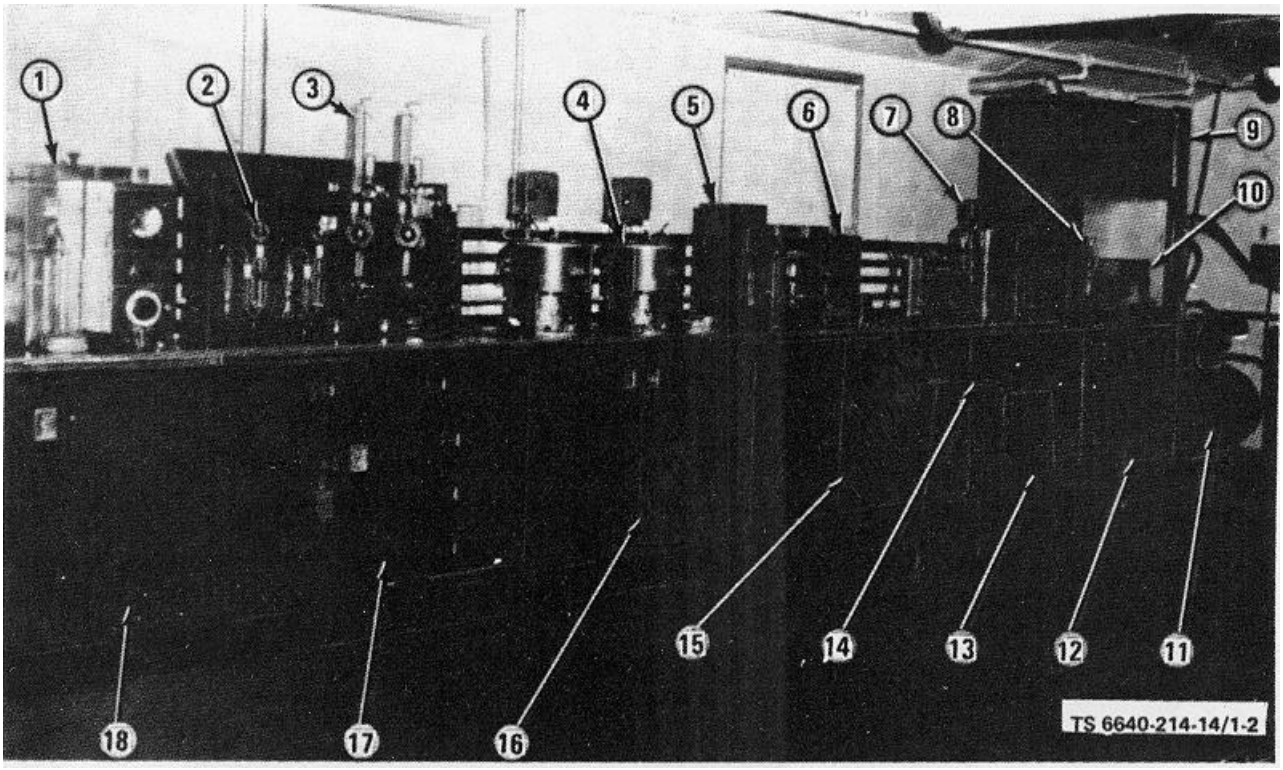
The petroleum base laboratory assembly (figs. 1-1 thru 1-5) is used at fixed installations to perform certain designated tests on petroleum products, such as gasoline, diesel fuel, kerosene, lubricating oil and grease. The laboratory assembly includes 26 cabinets and all of the laboratory apparatus and materials required to perform its assigned function. At the rear of the cabinets, integral service lines for electricity, water, propane gas, compressed air, and drainage are mounted. The working space necessary for conducting the required laboratory tests is provided by the tops of the cabinet units. The units may be combined in various arrangements to fully utilize available floor space and to permit a compact and efficient work area. After a suitable laboratory layout is selected, the cabinets are joined by coupling the service lines. Laboratory apparatus and materials are listed in Appendix C.



Legend for figure 1-1:

1. Sink
2. Oxidation stability apparatus
3. Water still
4. Automatic control for water still
5. Bookcase
6. Sulfur determination apparatus, bomb method
7. Surface type panel board
8. Distillation apparatus
9. Separatory funnel and beaker with support stand
10. Single distillation apparatus cabinet
11. Double distillation apparatus cabinet
12. Storage cabinet
13. Water still cabinet
14. Oxidation stability cabinet
15. Collapsible laboratory stool
16. Sink cabinet

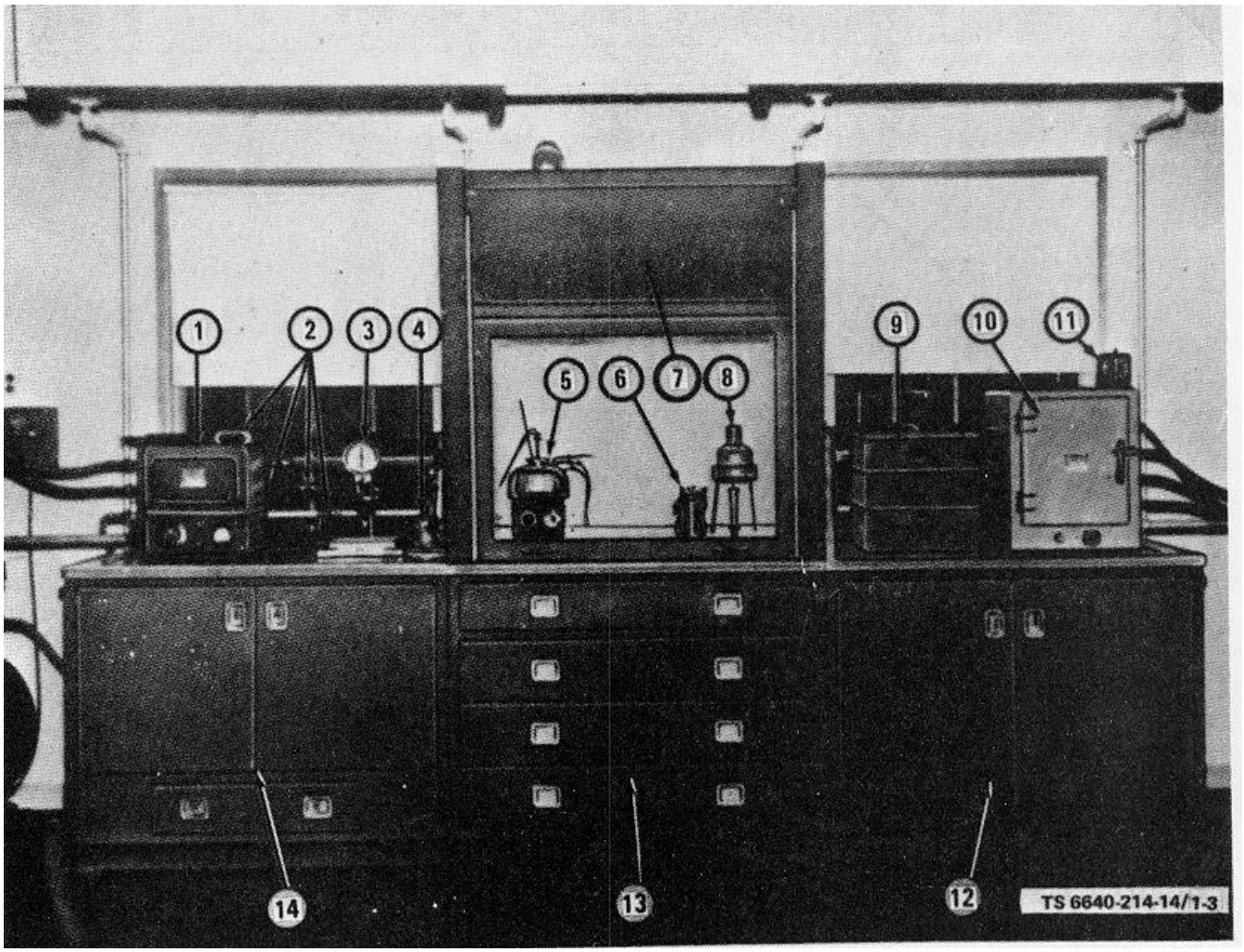
Figure 1-1. Unit of Cabinets Assembled Along Left Wall, Forward Portion.



Legend for figure 1-2:

1. Distillation apparatus
2. Sulfur determination apparatus, wick lamp method
3. Tetraethyl lead apparatus
4. High temperature kinematic viscosimeter apparatus
5. Low temperature kinematic viscosimeter apparatus
6. Surface type panel board
7. Foam test apparatus
8. Burning test lamp
9. Fume hood
10. Gum determination apparatus, copper dish method
11. Air Compressor
12. Gum apparatus ca6binet with fume hood mounted on top
13. Storage cabinet
14. Collapsible laboratory stoolp
15. Low temperature kinematic viscosemeter cabinet
16. High temperature kinematic viscosemeter cabinet
17. Storage cabinet with vacuum pump installed in left side
18. Single distillation apparatus

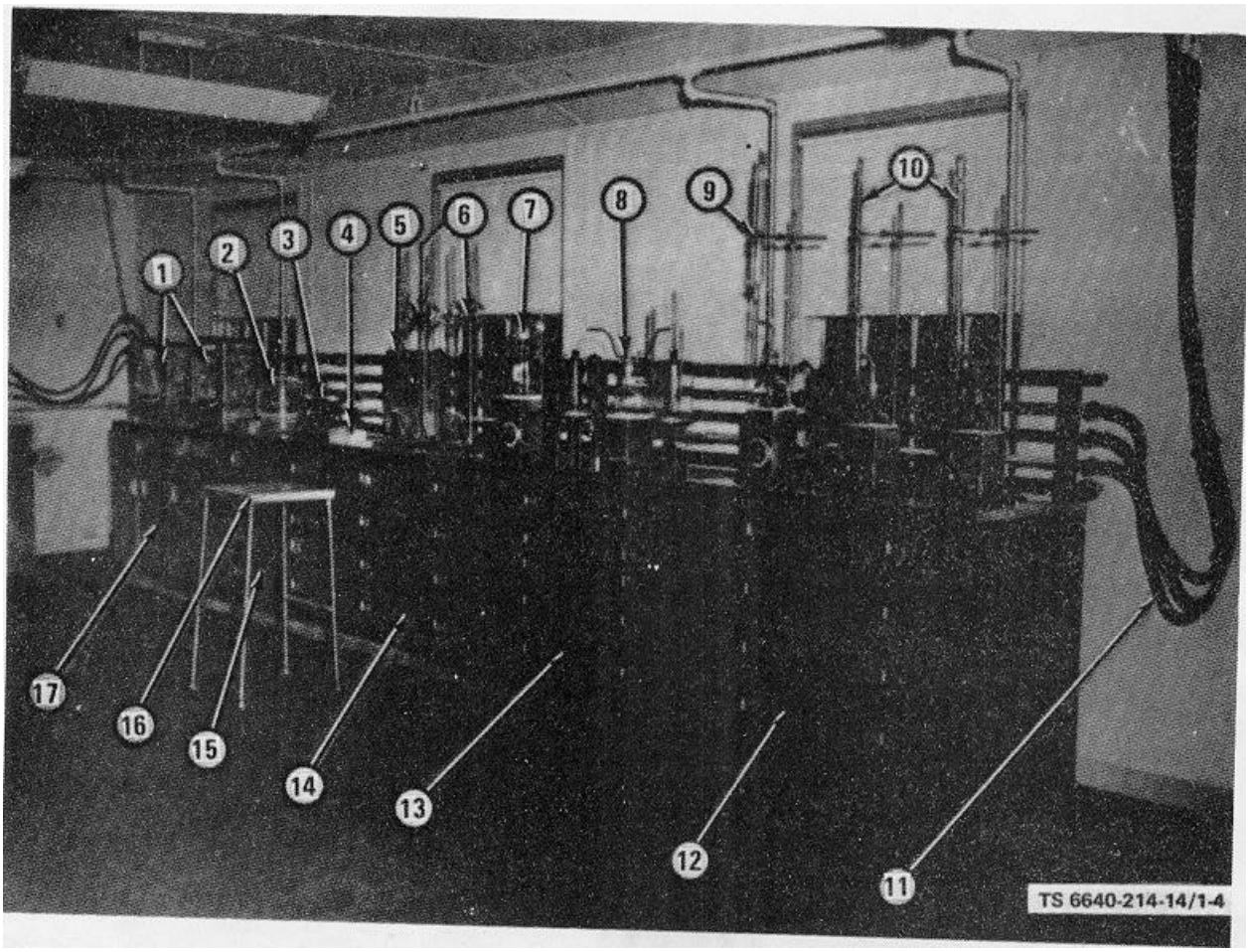
Figure 1-2. Unit of Cabinets Assembled Along Left Wall, Rear Portion.



Legend for figure 1-3:

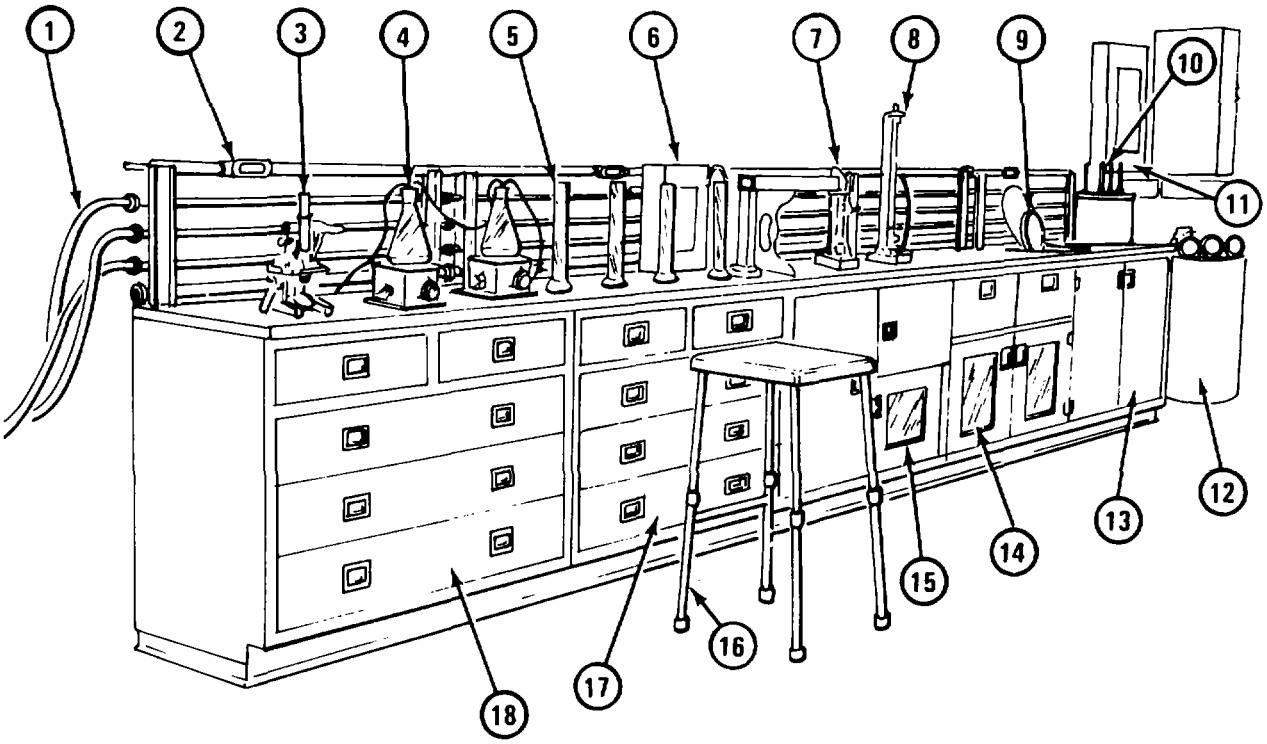
1. Muffle furnace
2. Outlets for service lines
3. Penetrometer
4. Grease working machine
5. Pensky-Martens closed cup flash point tester
6. Tag closed cup flash point tester
7. Fume hood
8. Conradson carbon residue apparatus
9. Constant temperature water bath
10. Electric oven
11. Timer
12. Water bath and electric oven cabinet
13. Storage cabinet with fume hood mounted on top
14. Muffle furnace and penetrometer cabinet

Figure 1-3. Unit of Cabinets Assembled Along End Wall.



1. Analytical balances
2. Desiccator
3. Torsion balance
4. Balance weights
5. Surface type panel board
6. Titration apparatus
7. Aniline point apparatus
8. Steam emulsion apparatus
9. Crankcase dilution apparatus
10. Water determination apparatus
11. Flexible metal braided hose
12. Storage cabinet
13. Storage cabinet
14. Storage cabinet
15. Storage cabinet
16. Collapsible laboratory stool
17. Balance cabinet

Figure 1-4. Unit of Cabinets Assembled Along Right Wall, Rear Portion.



TS 6640-214-14/1-5

1. Flexible metal braided hose
2. Electric outlet
3. Microscope
4. Sediment apparatus, extraction method
5. Thermohydrometer and glass cylinder
6. Surface type panel-board
7. Comparative - colorimeter
8. Saybolt chromometer
9. Channel point apparatus
10. Centrifuge
11. Main control panels, electric
12. Vapor pressure apparatus
13. Centrifuge and channel point apparatus cabinet
14. Cloud- and pour-point cabinet
15. Refrigerator cabinet
16. Collapsible laboratory stool
17. Storage cabinet
18. Storage cabinet

Figure 1-5. Unit of Cabinets Assembled Along Right Wall, Forward Portion.

1-8. CABINET UNITS.

Cabinet units differ in appearance according to the components they are designed to accommodate (paras 2-9 thru 2-27), although essential construction characteristics are similar. The units are constructed of cold rolled steel sheets, and the tops are fabricated of stainless steel. Leveling bolts are provided at each of the four interior corners. Cabinets housing mounted equipment are provided with elevating-platform mechanisms for raising and lowering laboratory apparatus into position. The platforms are lowered only when the cabinets are stored or shipped. A stainless steel cover, normally stored in the cabinet base, is placed over the opening in the top of the cabinet when laboratory apparatus is in lowered position. The rear of each cabinet is equipped with a pipe rack 'to which are clamped the service lines and a flexible metal braided hose. The rack is raised when cabinets are placed in operating position, and lowered only when cabinets are stored or shipped. Cabinet drawers designed for storing glassware and delicate instruments are lined with die-cut rubberized horsehair or similar resilient and shock-absorbing material for nesting the items. The drawers are provided with fastening devices to prevent breakage or displacement. Cabinet units identified below correspond to Quartermaster Corps drawing numbers as listed:

a. Water bath and electric oven cabinet (Unit No. 1, Drawing No. 5-14-322).

b. High temperature kinematic viscosimeter cabinet (Unit No. 2, Drawing No. 5-14-323).

c. Distillation apparatus cabinets (Double) (Unit No. 3, Drawing No. 5-14-324); Distillation apparatus (Single) (Unit No. 4, Drawing No. 5-14-325).

d. Muffle furnace and penetrometer cabinet (Unit No. 5, Drawing No. 5-14-326).

e. ASTM Gum apparatus cabinet (Unit No. 6, Drawing No. 5-14-327).

f. Water still cabinet (Unit No. 7, Drawing No. 5-14-328).

g. Tetraethyl lead and sulfur determination apparatus cabinet (Unit No. 8, Drawing No. 5-14-329).

h. Glassware storage cabinets (Units No. 19-14, 24 and 26, Drawing No. 5-14-330).

i. Chemical storage cabinet (Unit No. 15, Drawing No. 5-14-331).

j. Balance table cabinet (Unit No. 16, Drawing No. 5-14-332).

k. Sink cabinet (Unit No. 17, Drawing No. 5-14-333).

l. Oxidation stability cabinet (Unit No. 18, Drawing No. 5-14-334).

m. Fume hoods (Unit No. 19, Drawing No. 5-14-335). Unit consists of two fume hoods, one of which is to be mounted on the cabinet housing the gum apparatus (Unit No. 6), and the second to be mounted on one of the storage cabinets.

n. Low temperature kinematic viscosimeter cabinet (Unit No. 20, Drawing No. 5-14-336).

o. Refrigerator cabinet (Unit No. 21, Drawing No. 5-14-337).

p. Cloud- and pour-point apparatus cabinet (Unit No. 22, Drawing No. 5-14-337).

q. Air compressor Base (Unit No. 23, Drawing No. 5-14-339).

r. Centrifuge and channel point apparatus cabinet (Unit No. 25, Drawing No. 5-14-340).

1-9. TABULATED DATA

a. Cabinet Units.

(1) Cabinet Dimensions. Height 35 3/4 inches (0.91 m)
Length 47 inches (1.19 m)
Width 22 inches (0.56 m).

(2) Shipping Container Dimensions.
Height 43 inches (1.09 m) (approximately)
Length 51 3/4 inches (1.31 m)
Width 31 1/4 inches (0.794 m).

b. Air Compressor.

(1) Receiver (mounted) Dimensions.
Height 40 inches (1.02 m) (approximately)
Length 49 inches (1.24 m)
Width 22 inches (0.56 m).

(2) Shipping Container Dimensions.
Height 45 1/2 inches (1.16 m) (approximately)
Length 51 7/8 inches (1.32 m).

c. Fume Hoods.

(1) Fume Hood Dimensions. Height 47 inches (1.19 m)
Length 47 inches (1.19 m),
Width 23 inches (0.58 m).

(2) Shipping Container Dimensions.
Height 52 5/8 inches (1.34 m) (approximately)
Length 52 1/4 inches (1.33 m)
Width 28 1/4 inches (0.72 m).

d. Vapor-Pressure Apparatus (Bath Unit).

(1) Bath Dimensions.

Height (Without motor stirrer) 32 inches (0.81 m),
Diameter 17 inches (0.43 m).

(2) Shipping Container.

Height 43 1/4 inches (1.10 m) (approximately)
Length 25 7/8 inches (0.657 m),
Width 25 7/8 inches (0.657 m).

e. Base Laboratory Unit Total. Total weight 23,181 pounds (10,515 kilograms). Total cubic feet 1,181 .42 cubic feet (33,46 cubic meters).

CHAPTER 2

OPERATING INSTRUCTIONS

Section I. SERVICE UPON RECEIPT

2-1. UNCRATING.

Items must be uncrated carefully to prevent damage to either the container or the contents. The 26 cabinet units are packed in fabricated cases of 1/2-inch plywood, bonded to 24-gage galvanized steel. The plywood is fastened around an inner frame of spruce wood with the steel side of the plywood facing the container interior (figs. 2-1 and 2-2). All edges are covered with 18-gage angles. Each case is provided with 6 recessed handles bolted to the armorply casing, and with 6 recessed locking fasteners that secure the casing to the case platform. The platform is constructed of 2-inch (50.8 mm) tongue and grooved spruce fastened to three 2- by 4-inch (50.8 mm by 101.60 mm) skids.

The case for the vapor pressure apparatus is similar to the case for the cabinet units, except that it is provided with 4 recessed handles and 4 locking fasteners. Equipment not contained in the cabinet units or armorply cases is packed in wooden crates of varying sizes. All containers should be retained for future use in storing or shipping laboratory equipment.

WARNING

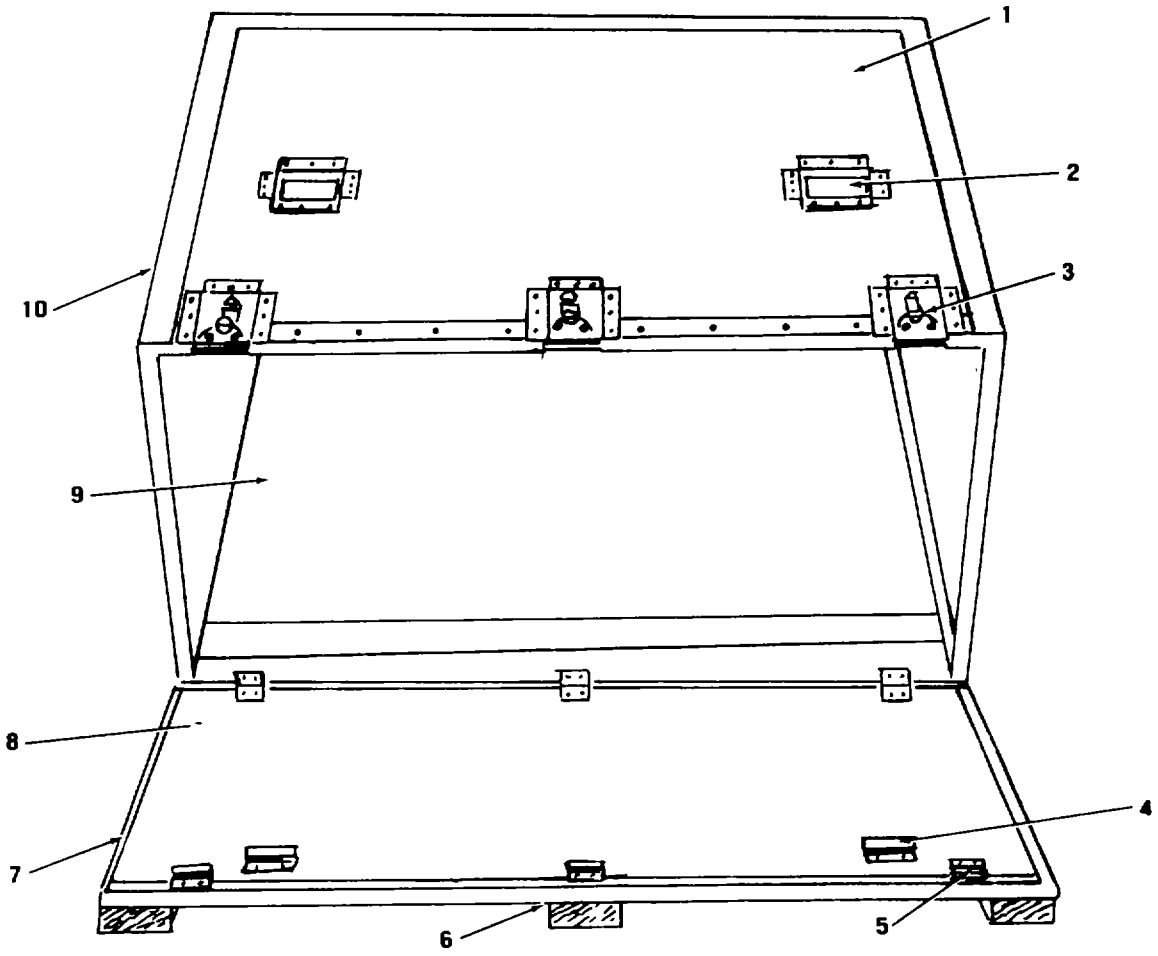
Before proceeding, always keep in mind the WARNINGS listed in the front of this manual.

2-2. INSPECTING.

Upon receipt of the laboratory assembly, all containers must be checked by operating personnel to make certain that every item is present and in condition for operation. Cabinet units should be checked to see that they are free of dents, that doors and drawers are aligned and operable and that elevating platforms travel freely, lock in position as required, and are free of excessive end or side play. Equipment mounted within the cabinets should be checked to see that it is secure and that all fastening devices are present and snug. All other items of equipment, including glassware and chemicals, should be inspected for breakage, cleanliness, and general serviceability.

2-3. CORRECTING DEFICIENCIES.

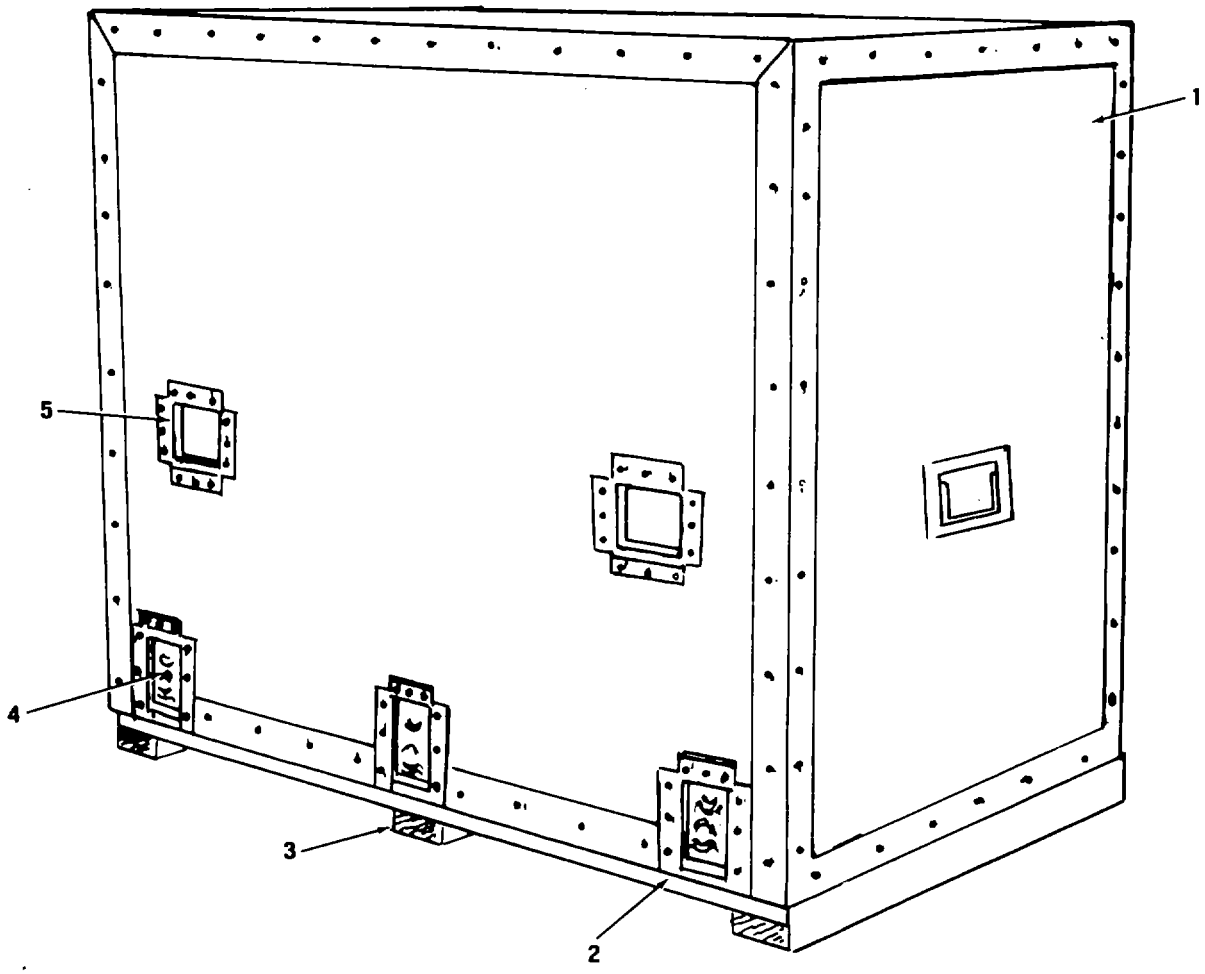
Correct deficiencies disclosed by initial inspection in one of the following ways:



1. Upper section of shipping container
2. Carrying handle
3. Locking device
4. Equipment fastening device
5. Locking
6. Skid
7. Rubber gasket
8. Shipping platform
9. Steel side of plywood
10. Angle iron device

Figure 2-1. Shipping Container and Platform (81337) 5-14-341

a. New Equipment. Common deficiencies in any component part of the Petroleum Base Laboratory Assembly will be listed on Standard Form SF 368 (Quality Deficiency Report) as described by AR 702-7, and forwarded to the US Army Troop Support and Aviation Materiel Readiness Command, ATTN: AMSTR-Q, 4300 Goodfellow Blvd, St. Louis, MO 63120-1798. Deficiencies in new equipment are the responsibility of the manufacturer and are not to be corrected at the expense of the using organization.



1. Upper section of shipping container
2. Shipping platform
3. Skid
4. Locking device
5. Carrying handle

Figure 2-2. Shipping Container, Closed and Locked (81337) 5-14-341

b. Used Equipment. Treat deficiencies noted in used or reactivated equipment in one of the following ways:

(1) Correct deficiencies within the scope of organizational maintenance.

(2) Refer deficiencies beyond the scope of organizational maintenance to maintenance level specified in maintenance allocation chart.

(3) Refer deficiencies of a serious nature to maintenance level specified in the maintenance allocation chart.

Section II. SETTING-UP PROCEDURES

2-4. ARRANGING UNITS.

When an acceptable layout for the base petroleum laboratory has been decided upon, the equipment is placed in position. Before cabinets are positioned, the pipe rack of each cabinet is raised and locked. After cabinets are placed in position, they are leveled by means of the four leveling bolts. The units must fit tightly against one another and their tops must be flush. Proposed layouts for the base laboratory are described below.

a. Quonset Hut Layout. The proposed layout for the petroleum base laboratory within a Quonset hut (fig. 2-3) provides for the laboratory proper, a supply room, a washroom and an octane room. In figure 2-3, item numbers 1 through 26 are identical with unit numbers 1 through 26 in paragraph 1-8. The cabinets, with their allied testing equipment, are assembled along both side walls, the inside end wall, and along the center of the laboratory proper.

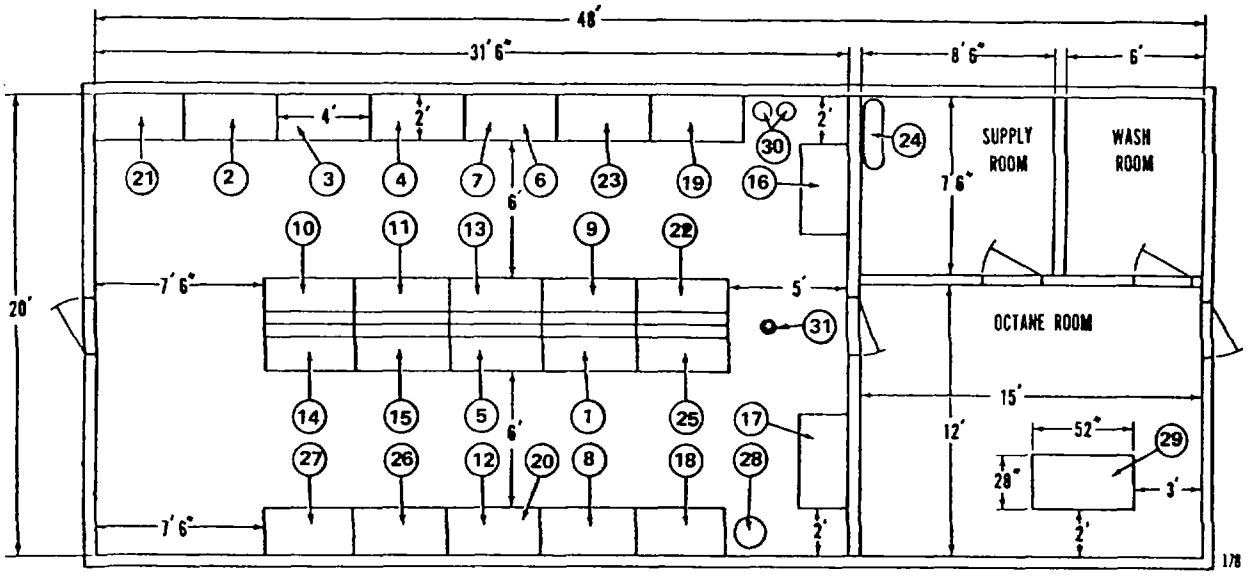


Figure 2-3. Proposed Layout for Petroleum Base Laboratory in Quonset Hut.

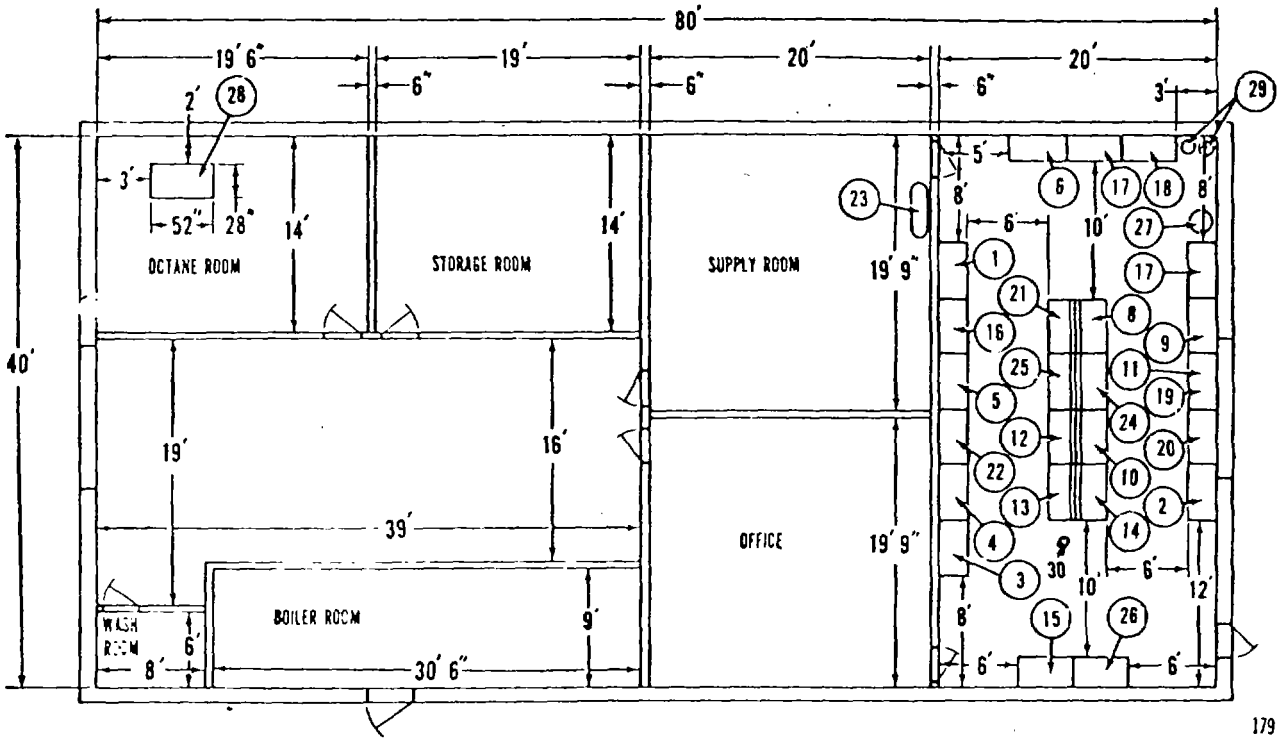
Legend for figure 2-3:

1. Constant temperature water bath and electric oven cabinet
2. Saybolt viscosimeter cabinet
3. Double distillation apparatus cabinet
4. Single distillation apparatus cabinet
5. Muffle furnace and penetrometer cabinet
6. Gum stability apparatus cabinet; base for fume hood (19)
7. Water still cabinet
8. Tetraethyl lead apparatus and sulfur determination (lamp) apparatus cabinet
9. Glass storage cabinet
10. Glass storage cabinet
11. Glass storage cabinet; base for fume hood (19)
12. Glass storage cabinet
13. Glass storage cabinet
14. Glass storage cabinet
15. Chemical storage cabinet
16. Balance cabinet or table
17. Sink cabinet
18. Oxidation stability apparatus cabinet
19. Fume hoods
20. Kinematic viscosimeter cabinet
21. Refrigerator cabinet
22. Cloud- and pour- point apparatus cabinet
23. Air compressor
24. Glass storage cabinet
25. Centrifuge cabinet
26. Glass storage cabinet
27. Vapor pressure bath
28. Fuel test engine
29. Oxygen cylinders
30. Shower head

b. Baker-Building Layout. The proposed layout for the petroleum base laboratory within a Baker building (fig. 2-4) provides for the laboratory proper, an office, a supply room, a storage room, and an octane room, plus a washroom for laboratory personnel and a boiler room for the heating equipment. In figure 2-4, item numbers 1 through 26 are identical with unit numbers 1 through 26 in paragraph 1-7. The cabinets and allied equipment are assembled along the four walls and in the center of the laboratory proper.

2-5. CONNECTING SERVICE LINES.

The pipe rack at the rear of each cabinet is equipped with five service lines: an electric conduit, a gas pipe, a compressed air pipe, a water pipe, and a drainpipe. Each line is provided an outlet to which testing apparatus and laboratory equipment can be connected. The service lines are colored as follows: gas, blue; water, green; air, orange; and drain, black. A flexible metal braided hose is also fastened to each rack. The hose can be removed and used for connecting the service lines around corners, over doorways, and wherever cabinets are not adjacent to one another (fig. 2-5).



1. Constant temperature water bath and electric oven cabinet
2. Saybolt viscosimeter cabinet
3. Double distillation apparatus cabinet
4. Single distillation apparatus cabinet
5. Muffle furnace and penetrometer cabinet
6. Gum stability apparatus cabinet; base for fume hood (19)
7. Water still cabinet
8. Tetraethyl lead apparatus and sulfur determination (lamp) apparatus cabinet
9. Glass storage cabinet
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11. Glass storage cabinet; base for fume hood (19)
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19. Fume hoods
20. Kinematic viscosimeter cabinet
21. Refrigerator cabinet
22. Cloud- and pour- point apparatus cabinet
23. Air compressor
24. Glass storage cabinet
25. Centrifuge cabinet
26. Glass storage cabinet
27. Vapor pressure bath
28. Fuel test engine
29. Oxygen cylinders
30. Shower head

Figure 2-4. Proposed Layout for Petroleum Base Laboratory in Baker Building.

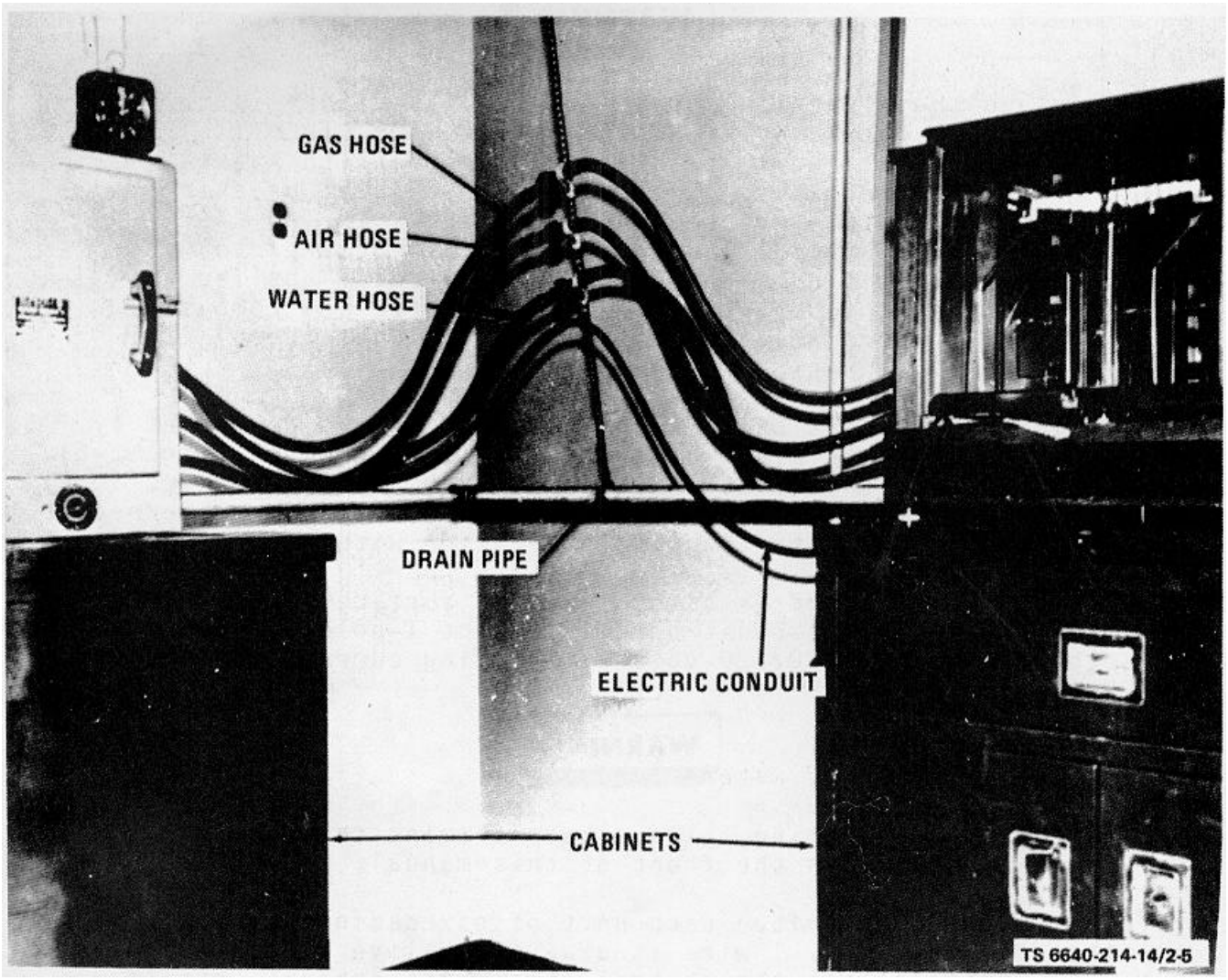


Figure 2-5. Flexible Metal Braided Hose Used to Connect Service Lines Around a Corner.

a. Electric Lines. Normally, electric power for the petroleum base laboratory is provided by a line of 220-volt, 3-phase, 60-Hz, alternating current. Inside the laboratory, wiring is arranged to provide single-phase, 2-wire, 110-volt current for all equipment. When electric power source does not have the above characteristics, electric power is provided by a 60-Hz, 120/208-240/416-volt, 30-Kilowatt, 3-phase, 4-wire, portable generator set.

WARNING

When the electrical power for the laboratory is to be supplied by a generator, the MAIN CIRCUIT BREAKER must be in the ON position prior to starting the generator. The main power circuit breaker SHOULD NOT BE SHUT OFF MANUALLY EXCEPT IN THE CASE OF AN EMERGENCY. Turning the circuit breaker to the ON position when the power is already applied can result in sparking which can ignite any combustible vapors which may be present in the laboratory.

After cabinets are positioned, electric conduits are connected by means of a 4-circuit terminal block between each cabinet (fig. 2-6). Each electric conduit consists of 1 No. 8 R.H. wire and 3 No. 10 R.H. wires. After all electric conduits of the cabinets are connected, they are then connected to the main power line within the laboratory.

When a unit of 6 cabinets is assembled, the surface-type panelboard with a 100-ampere main circuit breaker, eight 1-pole, 30-ampere circuit breakers, and 140/220-volt alternating current must be used (fig. 2-6).

WARNING

Before proceeding, always keep in mind the WARNINGS listed in the front of this manual.

(1) Six-cabinet unit. Each unit of six cabinets is wired in exactly the same way. No. 1 wire is always the live line in each unit, and No. 4 wire is always the neutral line. A 6-cabinet unit (fig. 2-6) is wired as follows:

(a) Mount the surface type panelboard at the center of the unit in order to feed three cabinets to the left and three cabinets to the right.

(b) Number the cabinets 1, 2, and 3 to left and to right of the surface-type panelboard.

(c) Connect all No. 4 wires to terminal No. 4 of terminal block and panelboard.

(d) Starting with third cabinet to right of panelboard, connect No. 1 wire to terminal No. 3 on second cabinet; connect No. 2 wire of second cabinet to terminal No. 3 of first cabinet, and connect No. 3 wire on first cabinet to circuit No. 3 in panelboard.

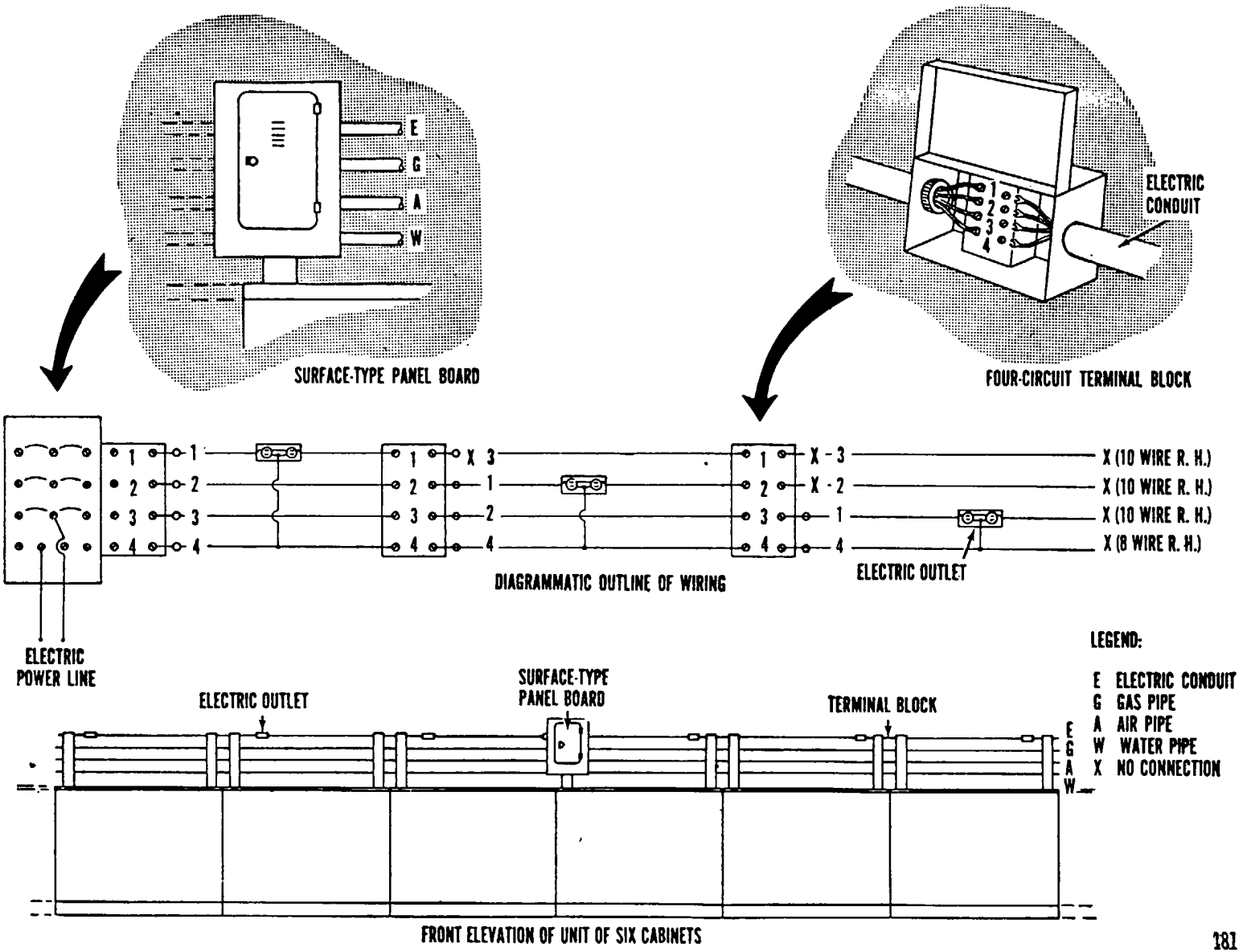


Figure 2-6. Wiring Diagram for Unit of Six Cabinets

(e) Starting with second cabinet to right of panelboard, connect No. 1 wire to terminal No. 2 on first cabinet, and connect No. 2 wire of first cabinet to circuit No. 2 in panelboard.

(f) Starting with first cabinet on right of panelboard, connect No. 1 wire to circuit No. 1 in panelboard.

(g) Procedure for connecting wiring of the three cabinets to left of panelboard is same as for connecting the three cabinets to the right of panel board.

(2) Low temperature kinematic viscosimeter apparatus. The low temperature kinematic viscosimeter apparatus (para 2-23) is wired to maintain temperatures as low as 100 degrees F (-73.3 C) (fig. 2-7). Electric power for the unit is obtained from the main 110-volt electric line within the laboratory.

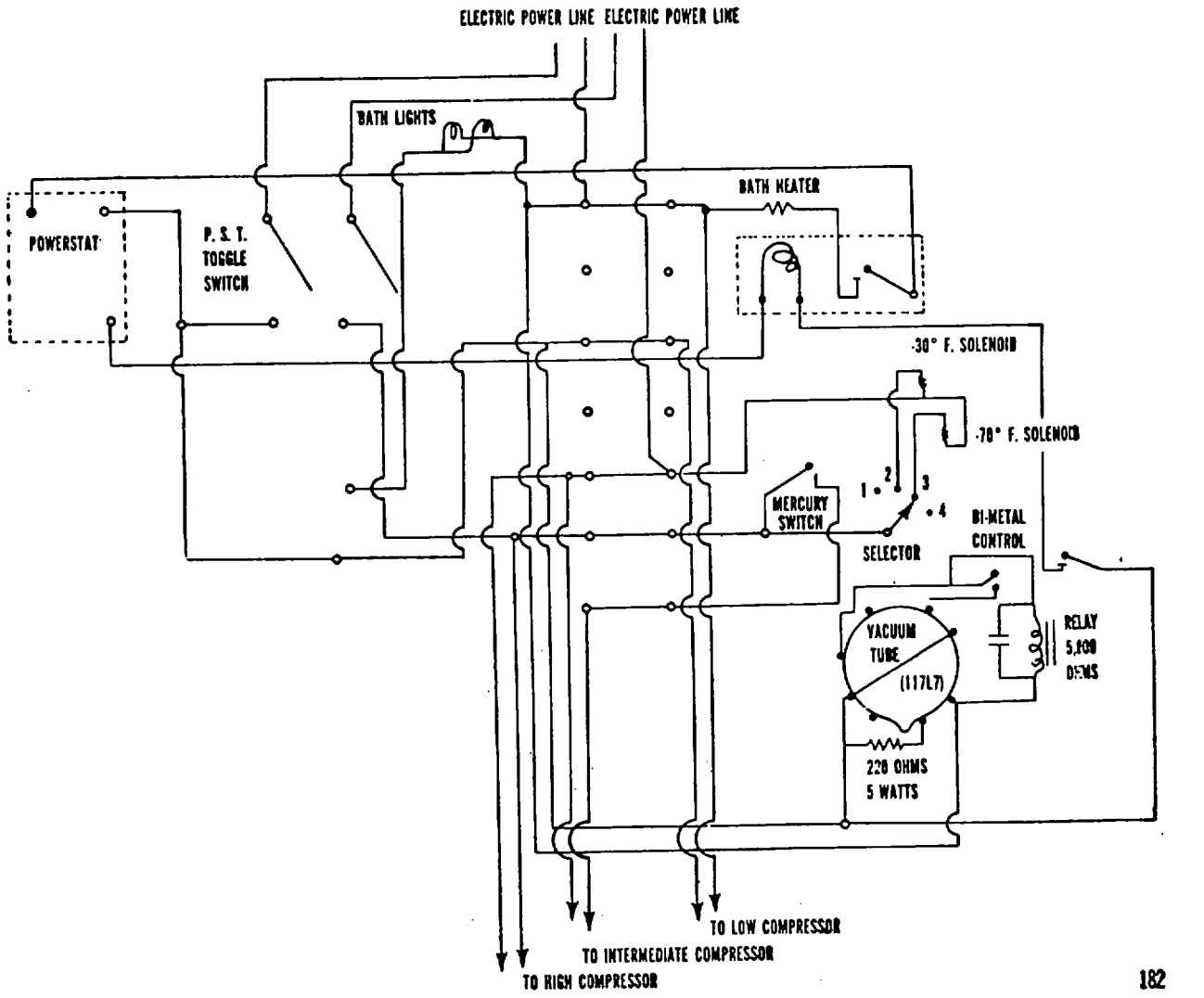


Figure 2-7. Wiring Diagram for Low Temperature Kinematic Viscosimeter.

(3) Cloud-and pour-point apparatus. The cloud- and pour-point apparatus (para 2-25) is wired (fig. 2-8) to maintain the baths of the apparatus at the temperatures prescribed for the performance of the pour-point tests (ASTM D-97). Electric power for the apparatus is obtained from the main 110-volt electric line within the laboratory.

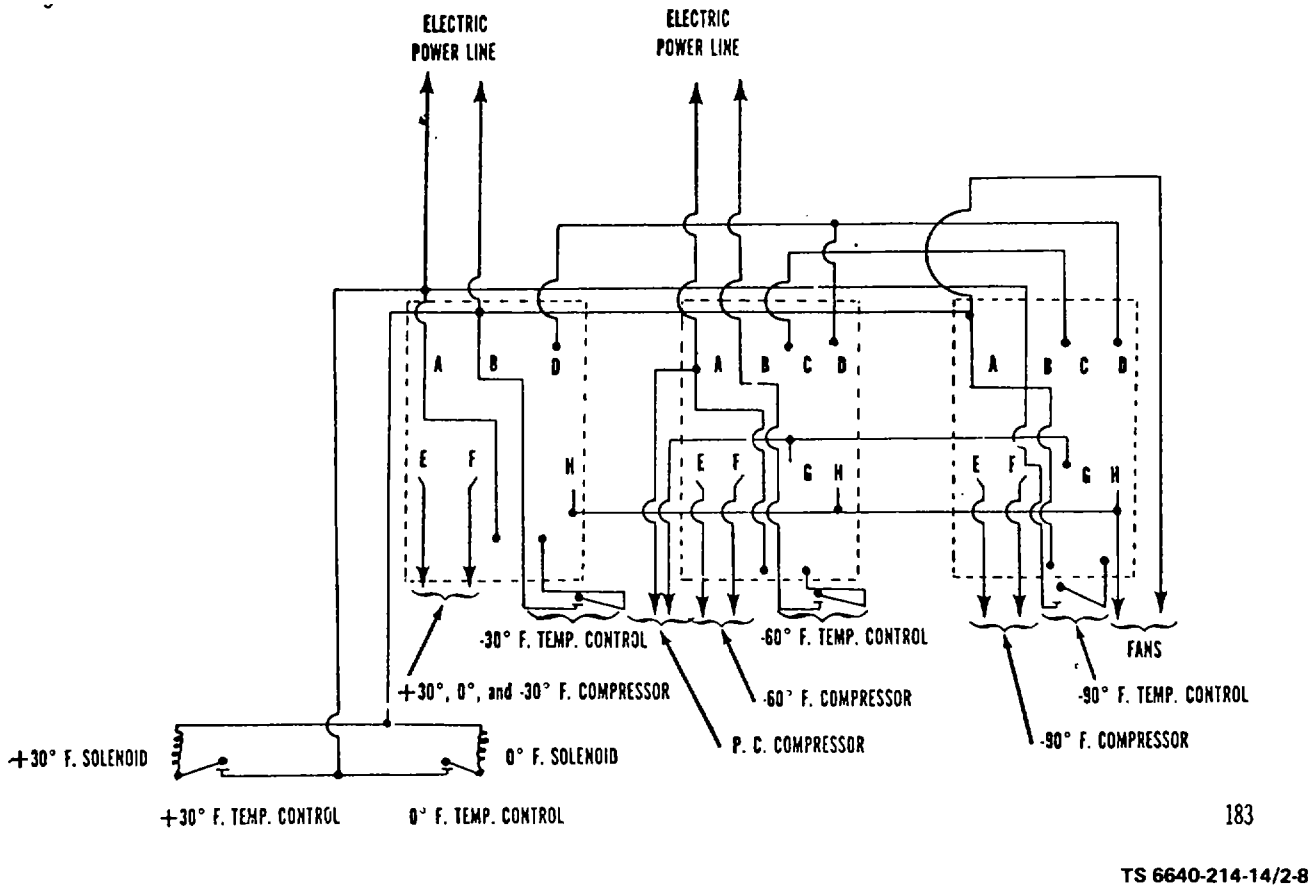


Figure 2-8. Wiring Diagram for Cloud- and Pour-Point Apparatus.

(4) Channel Point Apparatus. The channel point apparatus (para 2-27) is wired to maintain the apparatus at the temperature prescribed for the performance of the channel point test. Electric power for the apparatus is obtained from the main 110-volt electric line within the laboratory.

b. Gas Lines. The gas lines of the cabinets are connected by means of union couplings or, when necessary, by flexible metal braided hose to provide a continuos flow of gas to all parts of the laboratory. After all cabinets have been connected, the gas lines are connected to the main source of gas. Gas is supplied from cylinders or tanks containing bottled gas, such as propane gas, or from gas lines when available. Bottled gas cylinders or tanks are normally located outside of the laboratory buildings. In extremely cold climates, the gas containers must be protected by a building or shed to prevent freezing.

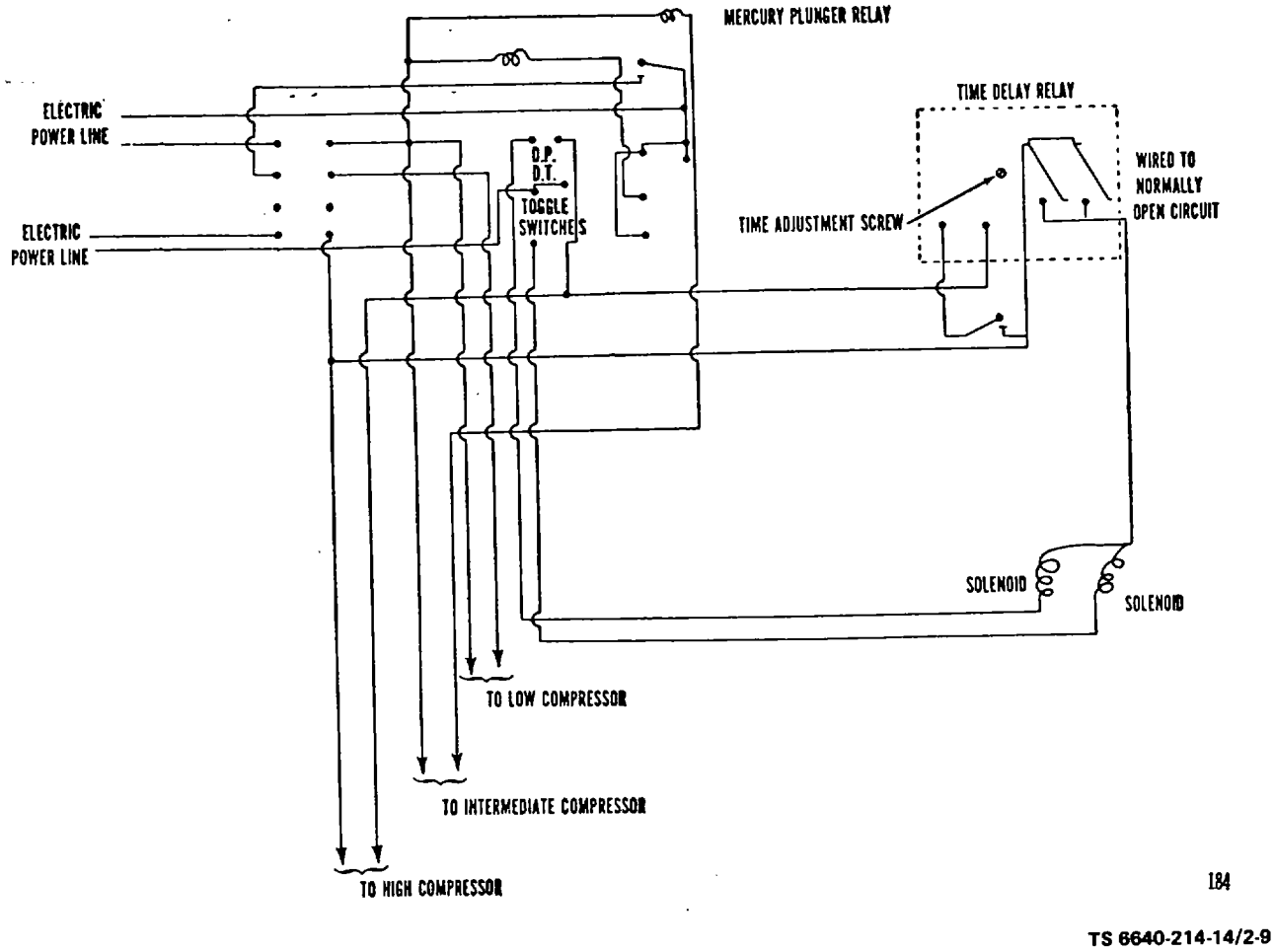


Figure 2-9. Wiring Diagram for Channel Point Apparatus.

c. Compressed Air Lines. The compressed air lines on the cabinets are connected by means of union couplings or, when necessary, by flexible metal braided hose to provide a continuous flow of compressed air to all parts of the laboratory. After all cabinets have been connected, the compressed air lines are connected to the air compressor.

d. Water Lines. The water lines of the cabinets are connected by means of union couplings or, when necessary, by flexible metal braided hose to provide a continuous flow of water to all parts of the laboratory. After all cabinets have been connected, the water lines are connected to any suitable source of water available to the laboratory.

e. Drain Lines. The drain lines on the cabinets are connected by means of union couplings or, when necessary, by flexible metal braided hose to provide drainage required by the laboratory units. After all cabinets have been connected, the drain lines are connected to any suitable drainage facilities available to the laboratory.

Section III. OPERATION AND MAINTENANCE

2-6. GENERAL.

Brief general instructions for operating and maintaining the base laboratory apparatus and equipment are given in this section. For detailed instructions concerning the setting up of testing apparatus and maintenance of laboratory equipment, refer to appropriate ASTM procedures or Federal Test Method Standard and manufacturer's instructions furnished with equipment. Responsibility for the performance of organizational maintenance service rests with the commanding officer of the base laboratory.

2-7. Test References. The primary references used at the base laboratory in the sampling and testing of petroleum products are as follows:

a. Federal Test Method Standard No. 791A, Lubricants, Liquid Fuels, and Related Products; Methods of Inspection, Sampling and Testing. Federal Test Method Standard No. 791A is the primary military standard for petroleum testing procedures. It contains detailed instructions for standard test procedures and specifications for the equipment to be used in these procedures.

b. ASTM Standards on Petroleum Products and Lubricants (With Related Information). The ASTM Standards on Petroleum Products and Lubricants is the primary nonmilitary standard for petroleum testing procedures. In most tests these procedures are almost identical with those contained in Federal Test Method Standard (FTMS) No. 791A. The ASTM and FTMS 791A are listed in the specification and the ASTM method can be performed.

c. ASTM Methods for Measurement and Sampling Method U-1085 on measurement and ASTM Method D-270 on sampling of petroleum and petroleum products are the primary standard for the measurement and sampling of petroleum and petroleum products. Copies of individual ASTM test methods can be requisitioned on a DD Form 1425 from the Naval Forms and Publications Supply Center in Philadelphia, PA.

2-8. Safety Precautions. Efficient petroleum laboratory operations depend upon observance of well established safety practices and a thorough knowledge of testing procedures, which often involves using equipment and materials that are potentially hazardous. Injury to personnel and damage to equipment caused by fire, chemicals, dangerous pressures or vacuums, toxic fumes or vapors and misuse of equipment can be avoided by alert laboratory technicians and responsible officers.

a. Observing General Safety Rules. During routine laboratory operations always observe the following rules:

(1) Always be attentive to tests in progress. Never permit horseplay or loud talking that would divert the attention of laboratory technicians. If it is necessary to leave the laboratory or to leave a test in progress, make certain no safety hazard will result because of your absence.

(2) Do not attempt to perform tests simultaneously unless each test can be given the required attention.

(3) Whenever in doubt concerning any operation, consult qualified authority for advice.

(4) Do not attempt unauthorized shortcuts and improvisations to save time, as they generally are not in accordance with safe laboratory procedures.

(5) Be prepared for any emergencies which may arise, and be familiar with the proper action to take in event of emergencies.

(6) When ending daily operations, make a thorough and systematic check of laboratory, equipment and facilities to ensure that no hazards may develop during the period that laboratory is unattended.

(7) Operationally test the safety showers at least semiannually.

b. Preventing Fires. The following fire prevention rules must be observed in all laboratory procedures:

(1) Do not allow smoking in the petroleum laboratory.

(2) Always make sure that gas jets are closed when not in use.

(3) Make sure that tubing to burners is not faulty.

(4) Never leave open flames or heating elements unattended.

(5) Never pour hot liquids into drains. Set aside hot liquids to cool thoroughly in covered containers before discarding.

(6) Do not discard solvents into sinks unless a special trap for this purpose has been installed.

(7) Do not pour volatile liquids into sink or drain unless a special trap has been installed.

WARNING

Several of the chemicals listed in the integral components of the end item list (COEIL) are EXPLOSIVE and should be handled with extreme care. These chemicals are flagged with an asterisk (*) in the Item No. Column in the COEIL.

(8) Make sure that chemicals which may react together to produce dangerous fumes, fires, or explosion are stored a safe distance from one another.

(9) Make sure that volatile liquids and flammable products are kept away from heat sources, open flames, direct sunlight and electrical switches.

(10) Make certain that there is no open flame or exposed heating element nearby when pouring highly volatile liquids.

(11) If combustible chemicals or volatile liquids are spilled, clean up the area of the spill immediately.

(12) Always pour acid into water, never pour water into acid.

(13) Waste must be stored in vapor-proof safety containers, and must be disposed of following instructions from the facilities/environmental engineers in the local SOP's.

(14) Never throw a glowing match into a refuse container.

(15) Keep oily rags in a metal, airtight, closed container. Do not store oily rags in cabinets or drawers.

(16) Keep heat and open flames away from gas cylinders. Do not bounce or drop gas cylinders.

(17) Check electrical wiring for defective insulation, sparking from loose connections, and overloaded circuits.

(18) Make certain laboratory and storerooms are adequately ventilated.

(19) Check fire fighting equipment periodically to make certain it is the proper type and ready for use. This is done by checking seals, tags, pressure gages and hoses. Refer to Appendix A for manual reference for use of hand portable fire extinguishers for Army users.

c. Extinguishing Fires. Laboratory personnel must be familiar with the nature of petroleum fires, with procedures for fighting fires, and with fire-extinguishing equipment.

(1) Dry Chemical Extinguisher. The dry chemical extinguisher contains a dry chemical powder and a carbon dioxide cartridge that forces the powder out of the extinguisher. Heat of the fire causes partial decomposition of the dry powder; the powder cools and smothers the fire. The stream of dry chemical is played at the base of the fire and then moved slowly over the fire. As dry chemical is a nonconductor of electricity, it may be used on electrical fires.

(2) Water. Water should not be used for extinguishing oil fires because it will spread the fire. Also, water is a conductor of electricity and should not be used on electrical fires or on electric motors.

d. Handling Chemicals.

WARNING

Before proceeding, always keep in mind the WARNINGS in the front of this manual.

(1) Store heavy and large containers of chemicals on or as near the floor as possible.

(2) Never fill a container with material other than that indicated on the label. Make sure that every container is properly labeled.

(3) Never place bottles containing acids or alkalies on high shelves.

(4) Always keep caustic soda solution and sulfuric acid in strong glass containers, never in galvanized iron drums.

(5) Always wear goggles when breaking up solid chemicals which might chip, or when handling quantities of corrosive liquids, such as strong acids and strong bases.

(6) When opening new bottles or carboys of acid, always wear goggles. Make certain rags are wrapped around neck of bottles.

(7) When pouring a sample from a container, hold the container cap or stopper in the hand. Never place the cap or stopper on a bench or table where is may come in contact with a contaminating agent.

(8) Never lay the stopper of an acid bottle on a surface where someone may rest his hand or arms.

(9) Keep reagent bottles stoppered tightly, and dry engraved reagent bottles before replacing them on the reagent shelf. Always wipe up any of the acid that spills or splashes on benches, tables, or floors.

(10) If any chemical is spilled or splashed on the body, immediately wash the contaminated area thoroughly with water.

(11) Always pour acid into water, especially sulphuric acid. Never pour water into acid. When diluting acids, always use Pyrex glassware, as ordinary glassware may be broken by the heat that is generated by the mixing of acid and water.

(12) Exercise caution when handling a 30 percent, or stronger, solution of hydrogen peroxide, H202 to prevent its contaminating the skin. If skin is contaminated, immediately wash the area thoroughly with water.

WARNING

Tetraethyl lead is a powerful poison. It can enter the body by inhalation or absorption through the skin. Tetraethyl lead exposed to sunlight or allowed to evaporate forms triethyl lead, which is also poisonous. Any open receptacle, container, clothing, or other object in contact with these materials must be kept clean, or personnel may be subject to serious lead poisoning.

(13) If a strong solution of tetraethyl lead is spilled, cover the spill with dry chloride of lime, CaOC12; wait 5 minutes for reaction to be completed; then flush off with water and wash area with soap and water. If the solution is spilled on clothing, remove clothing and discard contaminated articles. Do not attempt to wash contaminated clothing for reuse.

(14) Keep all sample containers that are in use capped or stoppered at all times except when pouring out test portions. Always replace the same cap or stopper in the container from which it was removed.

(15) Never handle mercury with bare hands; never heat mercury in an open container; and never shake more than 20 milliliters of mercury in a glass container.

(16) Make certain that a supply of dilute (18%X) acetic acid is available when Doctor test is being performed. Use the dilute acetic acid freely on any part of the body, except the eyes, that may be contaminated with Doctor or caustic solution. If Doctor solution or caustic should contaminate the eyes, immediately wash out with water and report to hospital.

(17) Never taste laboratory chemicals. Smell a chemical only when necessary and then only by wafting a small amount of vapor with the hand toward the nose.

(18) Dispose of all unlabeled chemicals.

e. Controlling Pressure and Vacuum.

(1) Handle cylinders of compressed gas with particular care. Never allow cylinders to drop or bounce or to come in contact with fire, sparks, or electrical circuits, as explosions may result. As compressed-gas cylinders are made of steel, such explosions have the same destructive effect as a bomb burst. Make sure that all stored cylinders are capped, are supported to prevent rolling or falling, and are stored away from heat.

(2) Never put oil or grease on the valves of cylinders or pressure regulators.

(3) Do not exceed the pressure or temperature that has been designated as the safe upper limit for the apparatus or equipment being used. Do not use cylinder without a regulator.

(4) Do not use faulty copper or rubber tubing when performing operations requiring pressure or vacuum.

(5) Make sure that glass vacuum apparatus is properly shielded when it is in use.

(6) Always wear goggles when opening air valves that are close to the face.

(7) Make sure that chemical containers having vent caps are inspected and that containers which do not have vent caps are vented periodically.

(8) Keep containers of volatile liquids as cool as possible. Exercise caution in releasing any pressure which may have formed in the container; always release the pressure gradually. Remove caps or stoppers periodically to vent the vapor. The practice of venting containers of volatile liquids does not apply to those samples collected for vapor pressure tests.

(9) Vent separatory funnels frequently when shaking volatile liquids. Always wrap the funnel with a rag when shaking an extremely volatile liquid.

(10) Store compressed gas cylinders in ventilated area away from heat or ignition sources.

f. Controlling Fumes.

WARNING

Before proceeding, keep in mind the WARNINGS in the front of this manual.

(1) Make certain the laboratory is properly ventilated and that fume hoods are operating properly.

(2) Always evaporate fuels in a fume hood.

(3) When using benzene, aniline, bromine water, or other materials producing toxic vapors, always work in a fume hood.

(4) If any material is spilled which gives off toxic fumes, all personnel should leave the area immediately and return only after the area has been adequately ventilated, or after suitable breathing equipment has been obtained.

g. Electrical Safety.

(1) Equipment producing a "tingle" will be reported promptly for repair.

(2) Keep the use of extension cords to a minimum and the cords as short as possible. Be sure insulation and wire size are adequate for the voltage and current to be carried.

(3) If it is necessary to work on "live" electrical equipment, the person doing so must be fully knowledgeable and have a second person present who is trained in first aid. Never work on "live" equipment alone.

(4) Work on electrical devices should be done after the power has been disconnected or shut off, and suitable precautions taken to keep the power off during the work.

(5) Wear safety glasses or a face shield where sparks or arcing may occur.

(6) Never use metallic pencils or rulers, or wear rings or metal watchbands when working on electrical equipment.

(7) Avoid using or storing flammable liquids near electrical equipment.

2-9. WATER BATH AND ELECTRIC OVEN CABINET.

a. Component Items. The water bath and electric oven cabinet (fig. 2-10) contains the thermostatically controlled constant temperature water bath and thermostatically controlled electric oven, permanently mounted on the elevating platform. This cabinet also contains miscellaneous items, such as rubber tubing and burners. A stainless steel collapsible laboratory stool (fig. 2-11) is sometimes mounted on the rear of the left door.

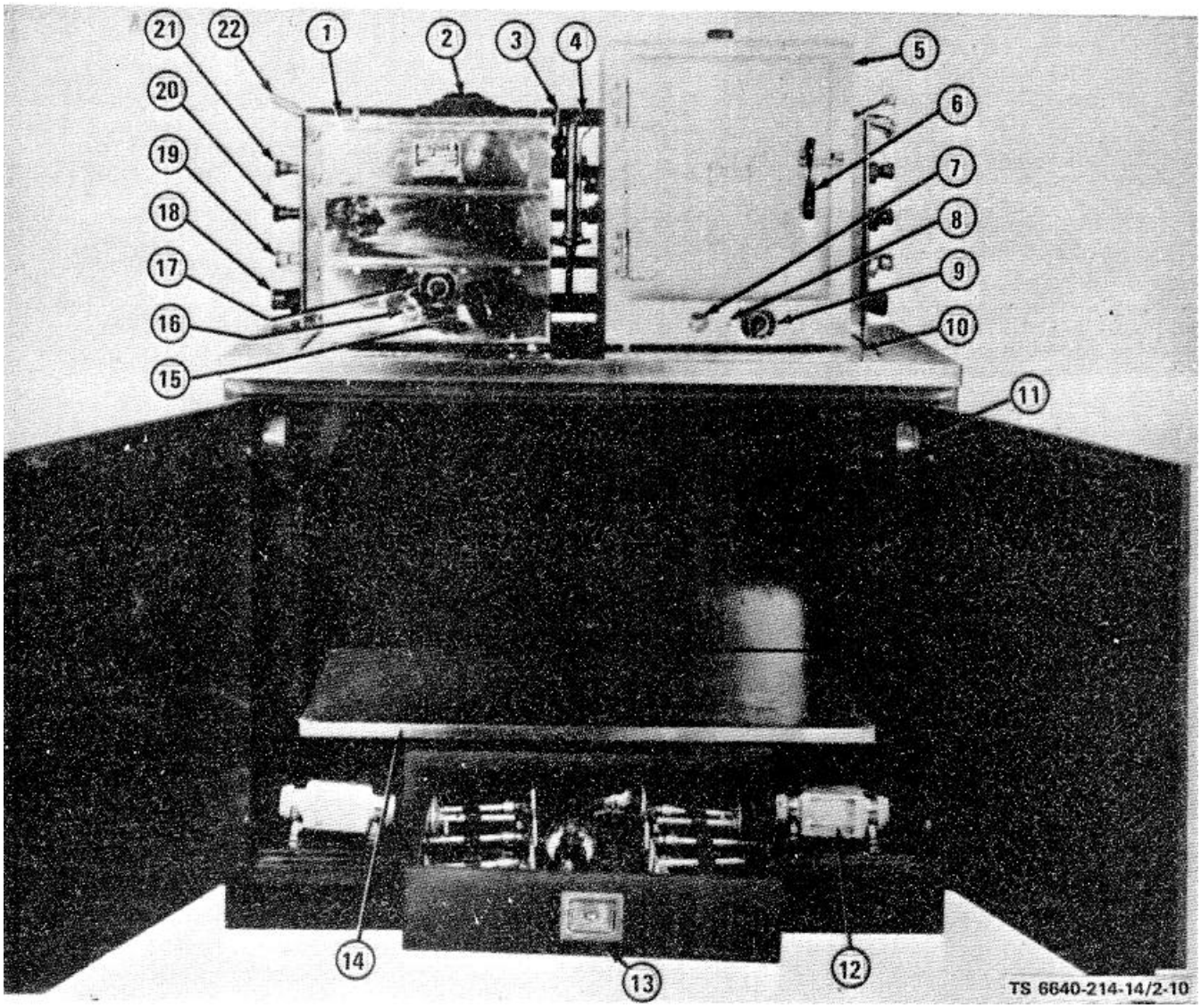
b. Operation. Before starting operation, make certain that elevating platform is securely locked in the raised position.

(1) Water Bath.

(a) Connect bath to electric source; fill bath with water to desired level, and insert suitable thermometer in space provided at top of bath.

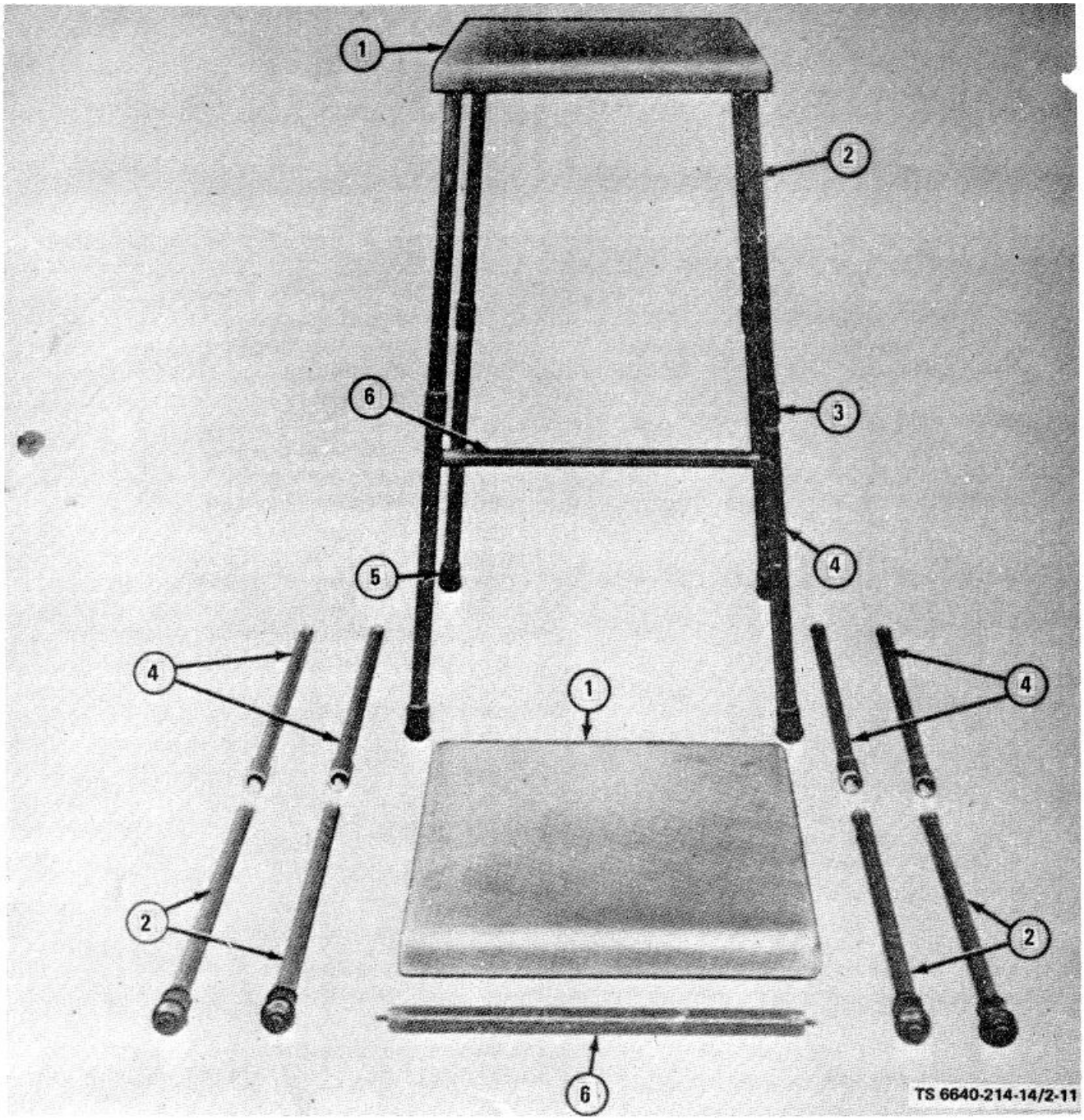
(b) Push toggle switch to ON position, and set temperature control knob for desired temperature.

(c) Make certain bath overflow is connected to drain.



1. Constant temperature water bath
2. Electric outlet
3. Hose connecter for gasline
4. Bath overflow
5. Electric oven
6. Door latch and handle
7. Pilot light
8. Electric toggle switch
9. Heat control
10. Elevating platform top
11. Elevating platform sash mechanism
12. Electric terminal block box
13. Drawer with miscellaneous equipment
14. Elevating platform cover in stored position
15. Electric toggle switch
16. Pilot light
17. Heat control
18. Drainpipe
19. Water pipe
20. Compressed air pipe
21. Gas pipe
22. Electric conduit

Figure 2-10. Water Bath and Electric Oven Cabinet.(Unit No. 1)



1. Seat
2. Upper section of leg
3. Joint
4. Lower section of leg
5. Rubber tip
6. Cross brace

Figure 2-11. Collapsible Laboratory Stool.

(2) Electric Oven.

(a) Connect electric oven to electric source, and insert suitable thermometer in spacer provided at top of oven.

(b) Push toggle switch to ON position, and set temperature control knob for desired temperature.

2-10. HIGH TEMPERATURE KINEMATIC VISCOSIMETER CABINET.

a. Component Items. The high temperature kinematic viscosimeter cabinet (fig. 2-12) consists of two kinematic viscosity baths permanently mounted on the elevating platform, two control boxes, two relays, two oil strainers, and 1-quart capacity viscosimeter pan with lip. The control boxes are mounted for storage on the rear of the two cabinet doors. Other component items are stored in the cabinet drawer. Miscellaneous items for other testing apparatus may also be stored in the drawer of this cabinet.

b. Operation. Before starting operation, make certain that elevating platform is securely locked in the raised position.

(1) Remove control box from door and mount on bath bracket. Connect relay switch and connect control to electric outlet.

(2) Connect bath stirrer; insert oil tubes, and position and connect thermoregulator.

(3) Fill bath to proper level with special bath oil, and place viscosity flasks in flask holders.

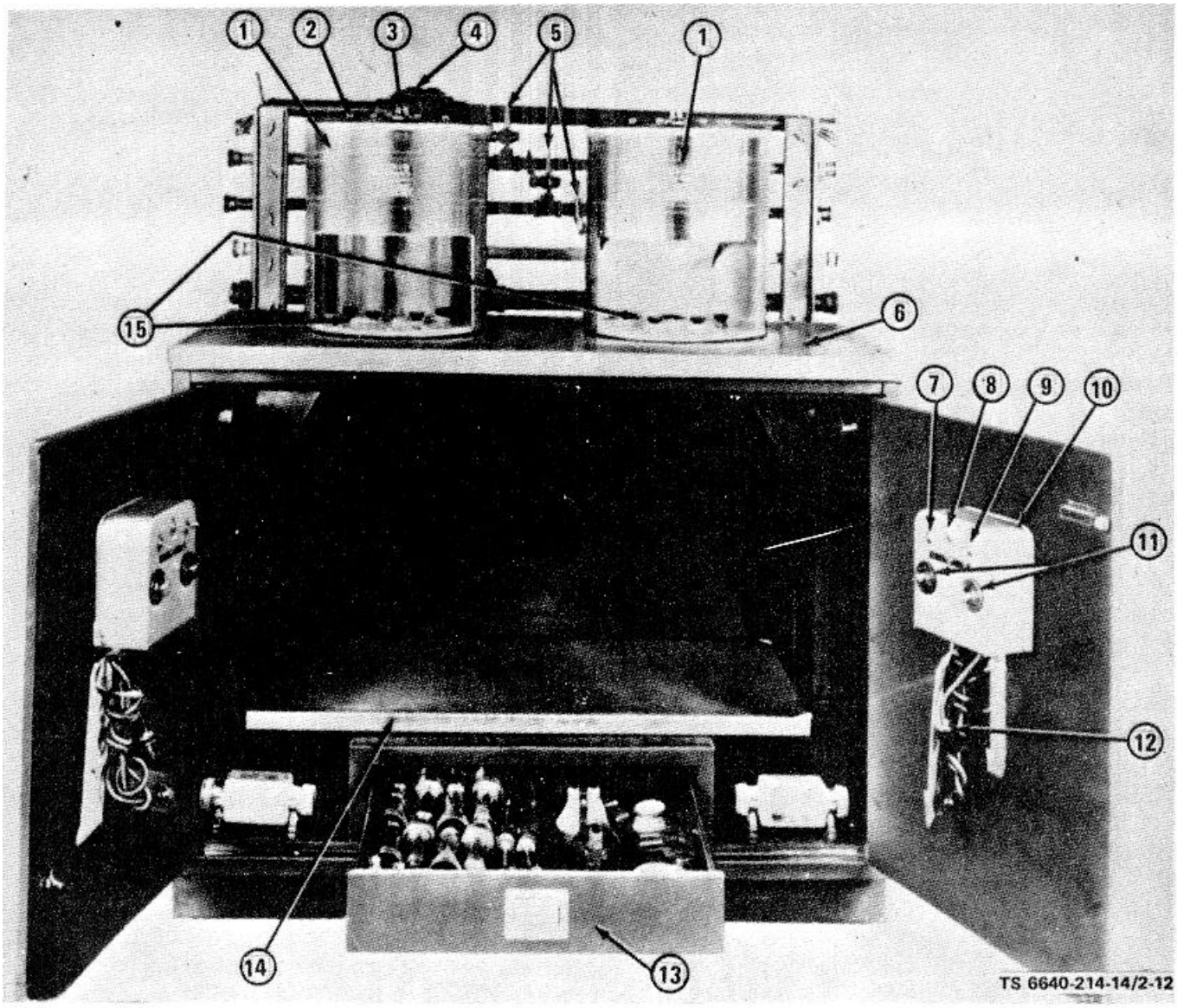
(4) Push toggle line switch to ON position. Push quick heat toggle switch to ON position. When the quick heat switch is pushed on, both the red warning and the clear pilot lights turn on. The relay switch, controlling bath heaters, prevents bath from exceeding set temperature.

(5) When required temperature is reached, push the quick heat switch to OFF position. The thermoregulator then maintains close temperature control of the bath.

(6) If higher temperatures than those maintained by above procedures are desired, push the continuos heat toggle switch to the ON position.

(7) To drain bath, attach hose to nipple at lower end of overflow tube. Lift bath cover and unscrew overflow tube, allowing oil to drain quickly.

(8) For detailed descriptions of operation of the high temperature kinematic viscosimeter, and for information on test procedures, consult applicable petroleum testing references.



1. High temperature kinematic viscosity bath
2. Oil tube cover handle
3. Thermoregulator knob
4. Electric outlet
5. Hose connectors to service lines
6. Elevating platform top
7. Line toggle switch
8. Continuous heat toggle switch
9. Quick heat toggle switch
10. Control box
11. Pilot lights
12. Electric cord for control box
13. Drawer with miscellaneous equipment
14. Elevating platform cover in stored position
15. Viscosity flask holders

Figure 2-12. High Temperature Kinematic Vicosimeter Cabinet. (Unit No. 2)

c. Preventive Maintenance. Do not attempt other than organization preventive maintenance on the apparatus. Defective heaters, motors, and thermoregulators should be replaced or repaired by higher echelon.

(1) Lubricating. Oil stirrer motor every 1,000 hours of use, applying light lubricating oil "(Military Symbol L0)".

WARNING

Most cleaning solvents are hazardous. Avoid prolonged skin contact and breathing of vapors. Check container label for warnings.

(2) Cleaning. Clean exterior of bath, using clean, damp cloth. When required, clean bath interior as follows: Completely drain oil and use suitable solvent to remove remaining oil; clean bath using standard solvent PD 680. Clean the capillary tube of the thermoregulator, when required, by pushing a cotton-covered wire through the tube. Make certain that no trace of oil contaminates either mercury or tube.

2-11. DISTILLATION CABINETS.

a. Component Items. Distillation cabinet (Unit No. 3) consists of two distillation units (fig. 2-13), and distillation cabinet (Unit No. 4) consists of one distillation unit (fig. 2-14). The distillation apparatus is permanently mounted on the elevating platforms. The apparatus is the front-view type consisting of 115-volt, 750-watt, heater; heater shield, condenser, condenser tube and outlet, overflow tube, condenser drain outlet, flasks, cylinders, refractory blocks, and wooden blocks for supporting graduated or cooling cylinders. Drawers of each cabinet contain miscellaneous testing equipment and apparatus.

b. Operation. Make certain that elevating platform is properly locked in raised position before starting operation.

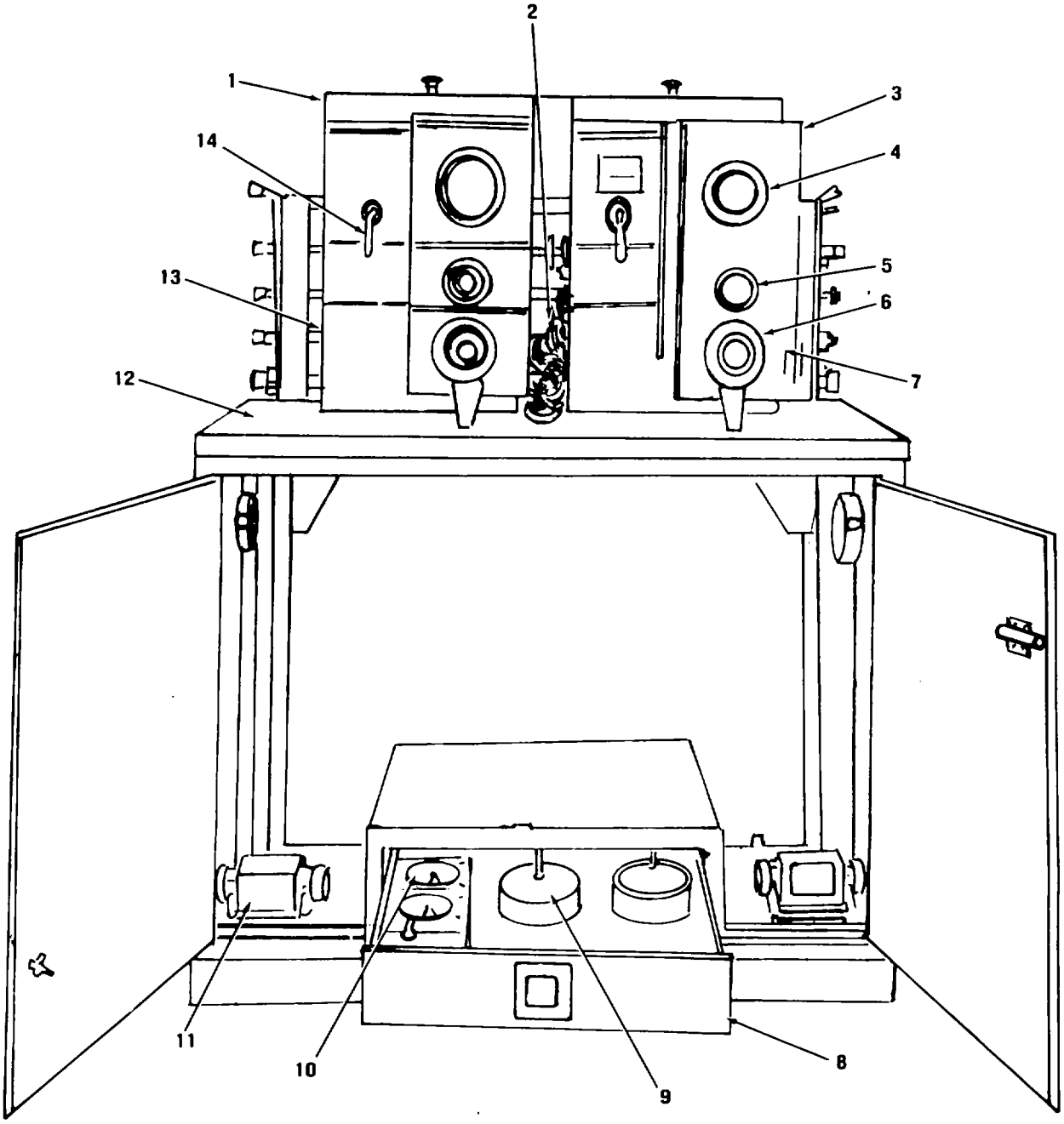
(1) Connect overflow tube and condenser drain outlet to drain.

(2) Connect electric heater cord to electric outlet.

(3) Place refractory block on heater, and place distillation flask on refractory block. To adjust height of refractory block and heater, turn elevating control knob clockwise to raise; counterclockwise to lower.

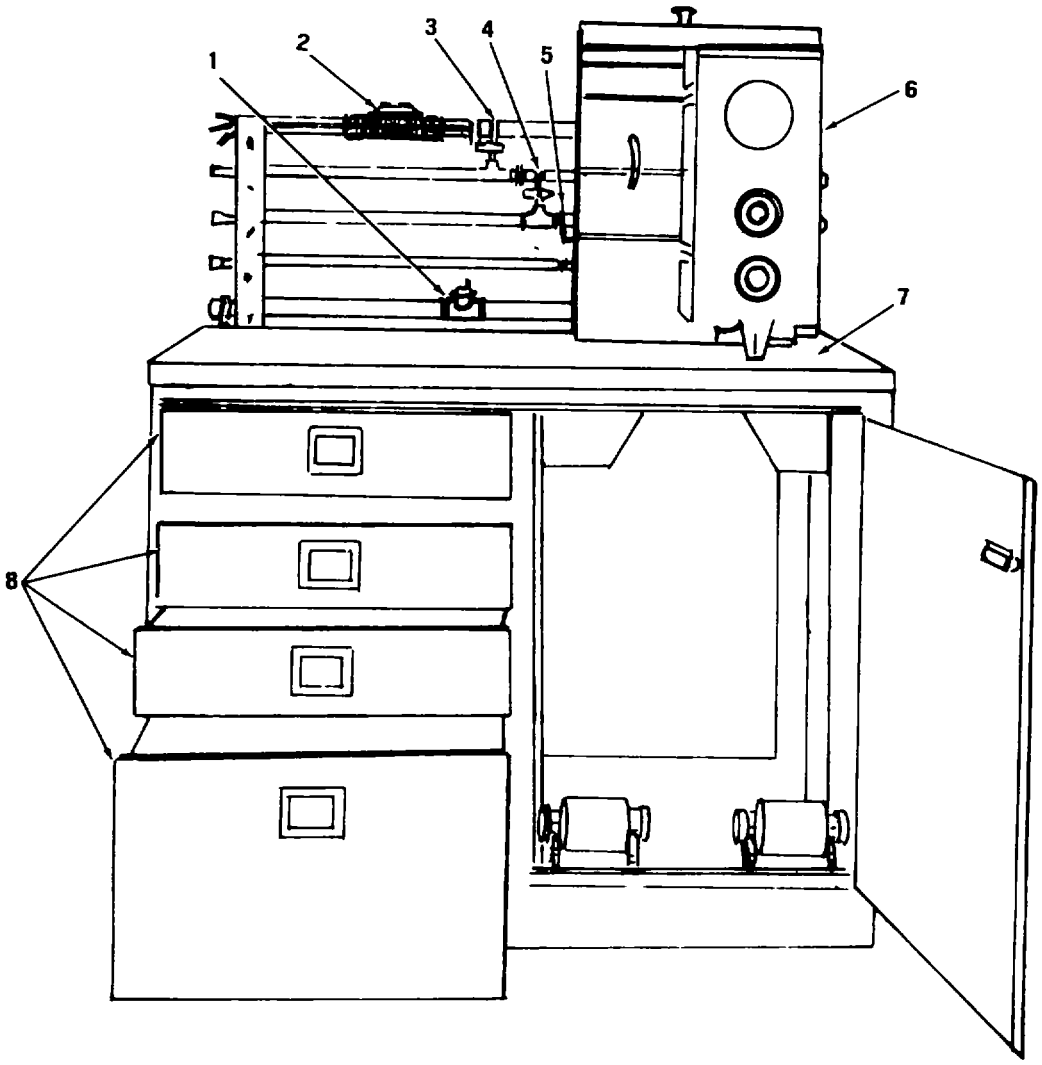
(4) Place cylinder on wooden block under condenser outlet.

(5) Push toggle switch to ON position, and set temperature control knob at desired heat. Turn knob clockwise to increase temperature, counterclockwise to decrease temperature.



1. Distillation unit cover
2. Electric heater cord
3. Electric heater shield
4. Window
5. Elevating control knob
6. Temperature control knob
7. Toggle switch
8. Wooden blocks
9. Drawer containing miscellaneous equipment
10. Refractory blocks
11. Electric junction block cover
12. Elevating platform top
13. Distillation unit
14. Distillation outlet

Figure 2-13. Distillation Cabinet (Double) (Unit No. 3)



1. Drain outlet
2. Electric outlet
3. Gas outlet, hose connector
4. Compressed air outlet, hose connector
5. Water outlet, hose connector
6. Distillation unit
7. Elevating platform top
8. Drawers containing miscellaneous equipment

Figure 2-14. Distillation Cabinet (Single) (Unit No. 4)

(6) For detailed information on assembling and operating the distillation apparatus, and for information on test procedures in which petroleum distillation unit is used, consult applicable petroleum testing references.

c. Preventive Maintenance. Use clean cloth and mild soap and water solution to clean interior and exterior of distillation apparatus.

2-12. MUFFLE FURNACE AND PENETROMETER CABINET.

a. Component Parts. A muffle furnace and penetrometer are permanently mounted on the elevating platform of the cabinet (fig. 2-15). The muffle furnace consists of muffle chamber with door and steel tray, and a base housing a temperature gage (pyrometer) with both Celsius and Fahrenheit scales, percentage timer, pilot light, ON-OFF toggle switch, and electric cord. The penetrometer consists of base, support rod, dial, indicator, plunger, penetration plunger, and weights.

Penetration cone and needle for use with penetrometer, along with other miscellaneous equipment, are stored in a drawer at the bottom of the cabinet.

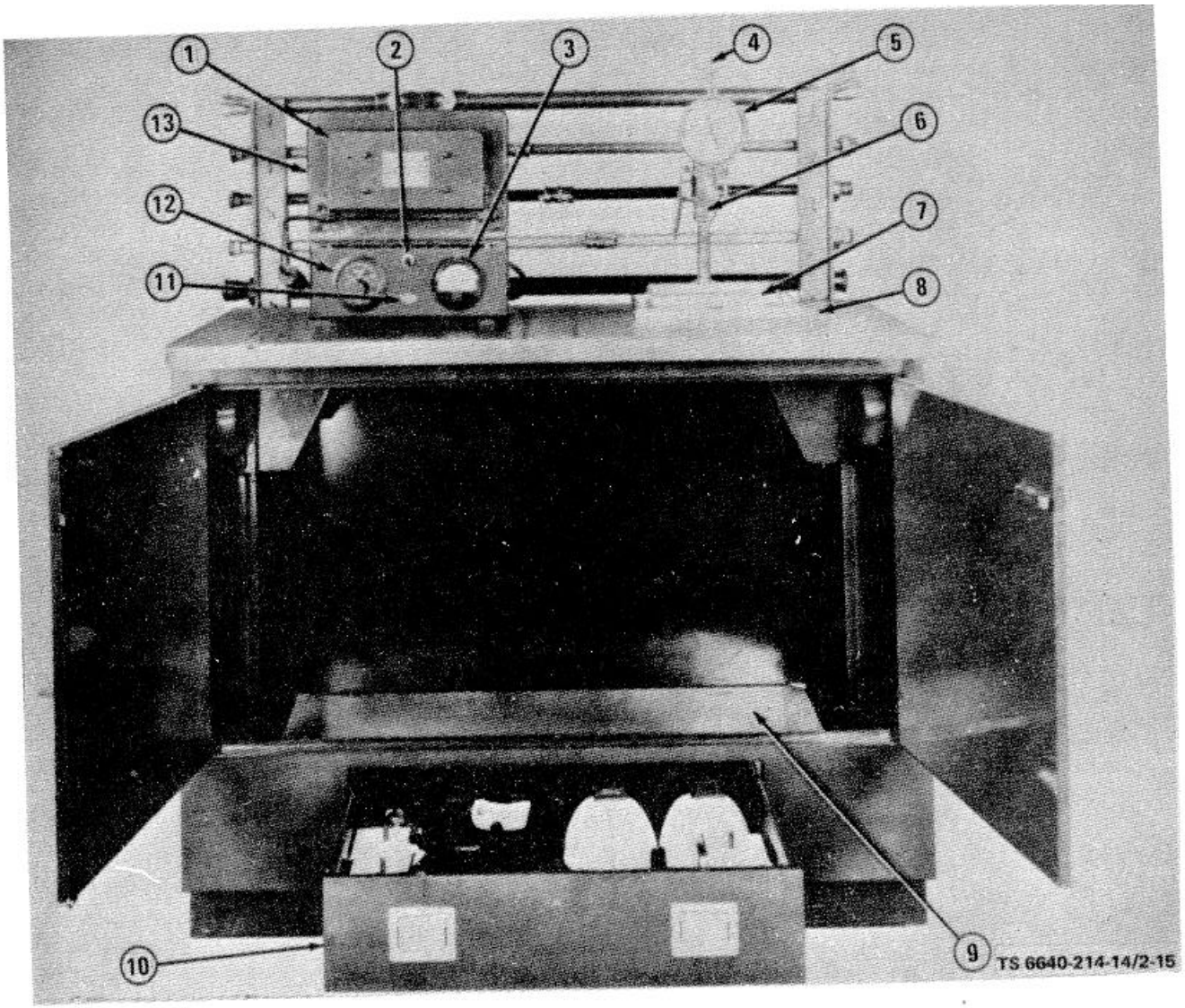


Figure 2-15. Muffle Furnace and Penetrometer Cabinet (Unit No. 5).

Legend for figure 2-15:

1. Muffle chamber door
2. Pilot light
3. Pyrometer
4. Penetrometer
5. Dial
6. Support rod
7. Base
8. Elevating platform top
9. Elevating platform cover in stored position
10. Miscellaneous equipment drawer
11. Toggle switch
12. Percentage timer
13. Muffle furnace

b. Operation. Make certain that the elevating platform is securely locked in the raised position before starting operation.

(1) Muffle furnace.

(a) Connect electric furnace to electric outlet of cabinet, and push toggle switch to ON position.

(b) Set percentage timer. The timer operates so that heat is on for a set percentage of 1 minute and off the remaining time. For example, with the timer set at 20, the heat is on for 20 percent of 1 minute and off 80 percent. A setting at 60 controls temperature at approximately 1800 degrees F (982 degrees C). For quick heat up, set timer at 100 to provide continuous heating, but make sure to turn back timer when pyrometer shows temperature reading at 1800 degrees F (982 degrees C). Excessive temperatures will cause heaters, refractories, etc., to burn out.

(2) Penetrometer.

(a) Prepare sample by use of the grease working machine.

(b) Place sample cup in proper position on penetrometer base.

(c) Insert needle or cone, as required, into chuck and tighten ,securely. Set dial needle to zero, add weights to test rod as required, and adjust penetrometer by means of the coarse and micrometer adjustments.

(d) For detailed descriptions on setting up and operating penetrometer, and for information on testing procedures, refer to applicable petroleum testing references.

c. Maintenance. Do not attempt other than organization preventive maintenance on the muffle furnace or penetrometer. Defective parts should be referred to maintenance level specified in the maintenance allocation chart.

(1) Muffle Furnace.. Clean steel tray and muffle interior, using a clean cloth and mild soap-and-water solution. Check to make sure that all electrical connections are tight.

(2) Penetrometer.

(a) Lubricating. Lubricate stem, adjusting and locking screws, depth gage and needle gears, and clutch mechanism as often as required, using light lubricating oil (LO).

(b) Cleaning. Remove test product with solvent. Air-dry or wipe dry with clean, lintless cloth. Use mild soap-and-water solution if necessary, and dry thoroughly to prevent rust.

WARNING

Most cleaning solvents are hazardous. Avoid prolonged skin contact and breathing of vapors. Check container label for warnings.

2-13. GUM APPARATUS CABINET.

a. Component Parts. The gum apparatus cabinet (fig. 2-16) consists of a stability gum bath, and a gum bath, copper dish method, mounted on the top of the elevating platform. Drum sampling thiefs are mounted on the rear of the left door. The two drawers of the cabinet contain miscellaneous gaging and testing equipment.

b. Operation. Before any testing procedures are begun with this cabinet, a fume hood (para 2-22) must be mounted on the top.

(1) Stability Gum Bath. The bath must have other equipment connected to it before starting testing procedures.

(a) Connect bath heater electric cord to cabinet electric outlet; fill bath to proper level with proper fluid, and place beakers containing gasoline in bath openings.

(b) Connect conical adapters; connect reflux condenser, and connect flowmeter to bath and air supply.

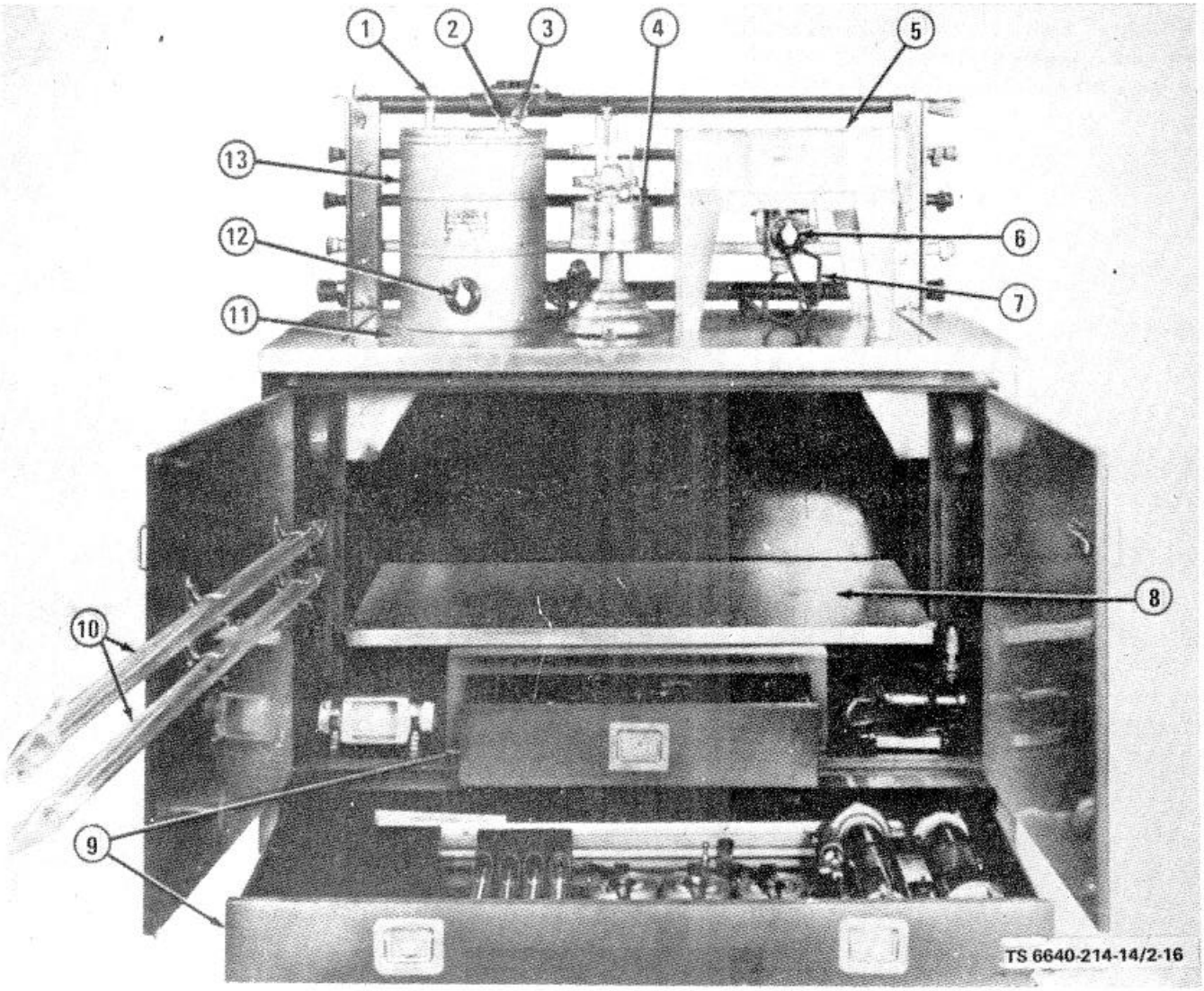
(c) Turn bath heater switch to desired position; regulate flow of air to adapters, and turn on water to reflux condensers.

(d) For detailed descriptions on setting up the apparatus, and for information on test procedures, refer to applicable petroleum testing references. All equipment for the apparatus, other than bath equipment, is located in gum apparatus cabinet or other cabinet drawers.

(2) Gum Bath, Copper Dish Method.

(a) Fill bath to desired level with liquid, and place copper dish containing sample in bath opening.

(b) Connect heater electric cord to outlet, and set temperature control knob at desired setting.



1. Reflux condenser fitting
2. Conical adapter fitting
3. Flowmeter fitting
4. Burning test of kerosene apparatus, lamp and gage (not normally a part of the cabinet)
5. Gum bath, copper dish method
6. Heat control knob
7. Heater electric cord
8. Elevating platform cover in stored position
9. Miscellaneous equipment drawers
10. Drum sampling thiefs
11. Elevating platform top
12. Heat control knob
13. Gum bath, stability

Figure 2-16. Gum Apparatus Cabinet. (Unit No. 6)

(c) For detailed description of test procedure, refer to applicable petroleum testing reference.

(d) Preventive Maintenance. Clean exterior of baths by using a clean cloth and mild soap-and-water solution. Clean allied equipment using standard solvent PD 680. Drain and clean baths periodically. Check to make sure that all electrical connections are tight.

WARNING

Most cleaning solvents are hazardous. Avoid prolonged skin contact and breathing of vapors. Check container label for warnings.

2-14. WATER STILL CABINET.

a. Component Parts. The water still cabinet (fig. 2-17) consists of a water still, permanently mounted on top of the elevating platform; an automatic cutoff; and a 5-gallon capacity (18.93 L) distilled water bottle.

b. Operation. Make certain elevating platform is properly raised and locked in position before starting operation.

(1) Remove automatic cutoff from cabinet and hang on pipe rack of adjacent unit to left of water still. Connect electric cord to water still heater and automatic level control, and connect cord to electric power outlet.

(2) Connect water inlets to still; connect condenser to waterline, and connect overflow to drain.

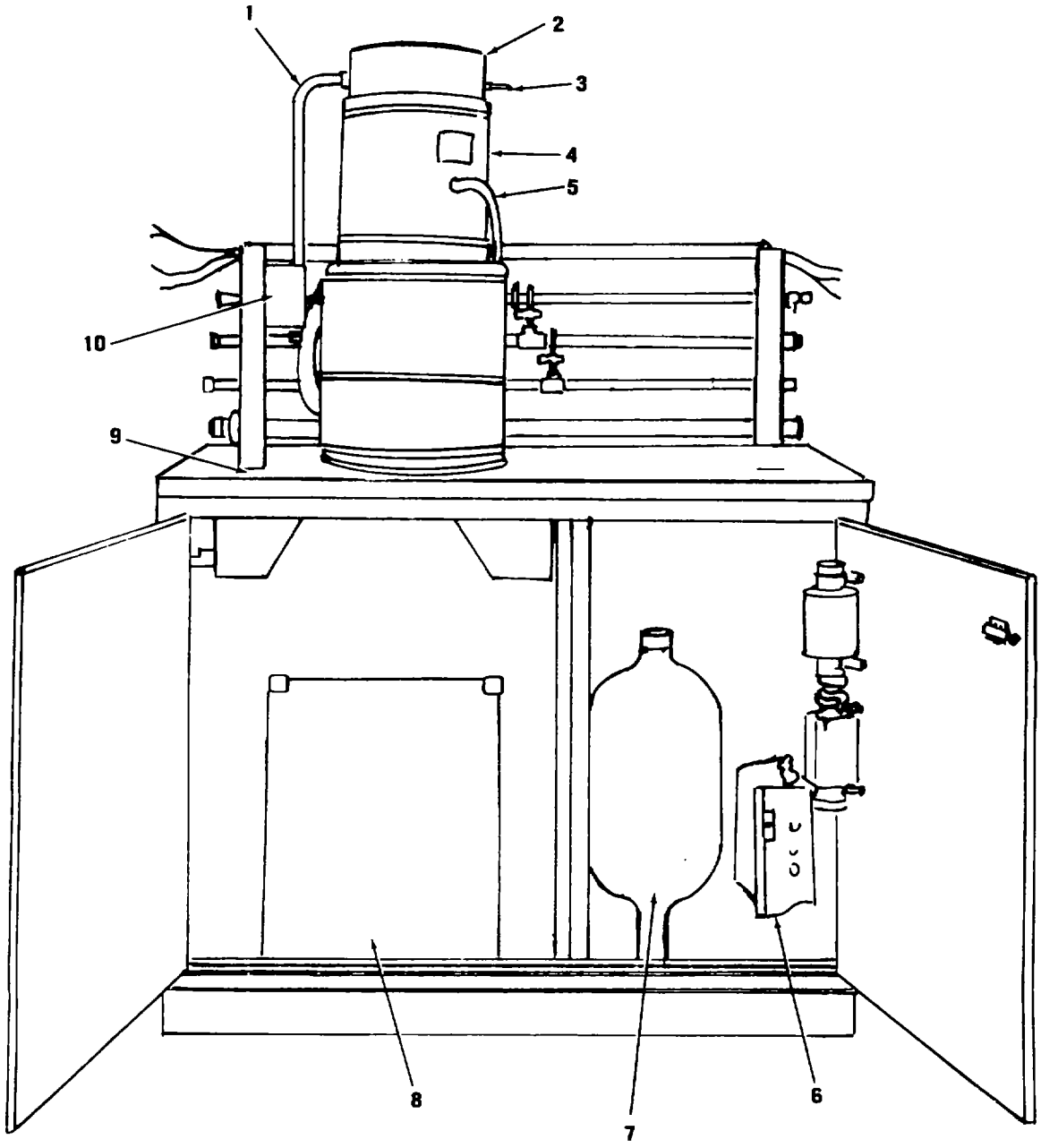
(3) Connect rubber tubing to distilled water outlet and run through hole in top of cabinet. Connect tubing to 5-gallon capacity distilled water bottle in cabinet.

(4) Open water valves to still and turn on water still heater and automatic cutoff.

c. Preventive Maintenance.

(1) Repair or replacement. Do not attempt other than organization preventive maintenance. If heater element burns out it must be replaced. Other defective parts of water-still must be replaced or turned in to higher echelon for repair.

(2) Cleaning. Remove dome cover of water-still after daily use, and wipe away accumulated soft sludge. If sludge has hardened into a crust, leave a dilute (about 10 percent) solution of acetic acid in the evaporator overnight. After this treatment, operate still for about 2 hours to remove all traces of acid. Make sure that no distilled water produced during this period is used.



1. Overflow
2. Dome cover
3. Water inlet
4. Evaporator
5. Distilled water outlet
6. Automatic cutoff (heat control) box
7. Distilled water bottle
8. Elevating platform cover in stored position
9. Elevating platform top
10. Constant level control

Figure 2-17. Water Still Cabinet (Unit No. 7)

Tetraethyl lead is a powerful poison. It can enter the body by inhalation or absorption through the skin. Tetraethyl lead exposed to sunlight or allowed to evaporate forms triethyl lead, which is also poisonous. Any open receptacle, container, clothing or other object in contact with these materials must be kept clean, or personnel may be subject to serious lead poisoning.

2-15. TETRAETHYL LEAD AND SULFUR DETERMINATIOUN APPARATUS CABINET.

a. Component Parts. The tetraethyl lead apparatus and sulfur determination apparatus are contained in the drawers of the cabinet (fig. 2-18). The tetraethyl lead extraction apparatus consists of boiling flask with heating tube wound with nichrome heating coil, Hopkins reflux condenser, rheostat, pipette, thistle tube, beaker, and supports. The sulfur determination apparatus, lamp method, consists of lamp flask, burner with air inlet, wick, chimney, absorber, spray trap with vacuum connection, and base. A vacuum pump, with a 1/4-horsepower, 110-volt, 60-cycle alternating current motor, is mounted on a common base, which in turn is mounted to the inside bottom of the left part of the cabinet (fig. 2-18). The pump is driven by means of a pulley to the pump motor.

b. Operation.

(1) Tetraethyl Lead and Sulfur Determination Apparatus. Refer to appropriate test references for complete directions for assembling apparatus and preparing samples, and for information on testing procedures for determining tetraethyl lead in gasoline and for determining sulfur in petroleum products.

(2) Vacuum Pump.

(a) Connect vacuum pump motor electric cord to electric outlet.

(b) Connect rubber tubing to vacuum pump and to testing equipment requiring vacuum.

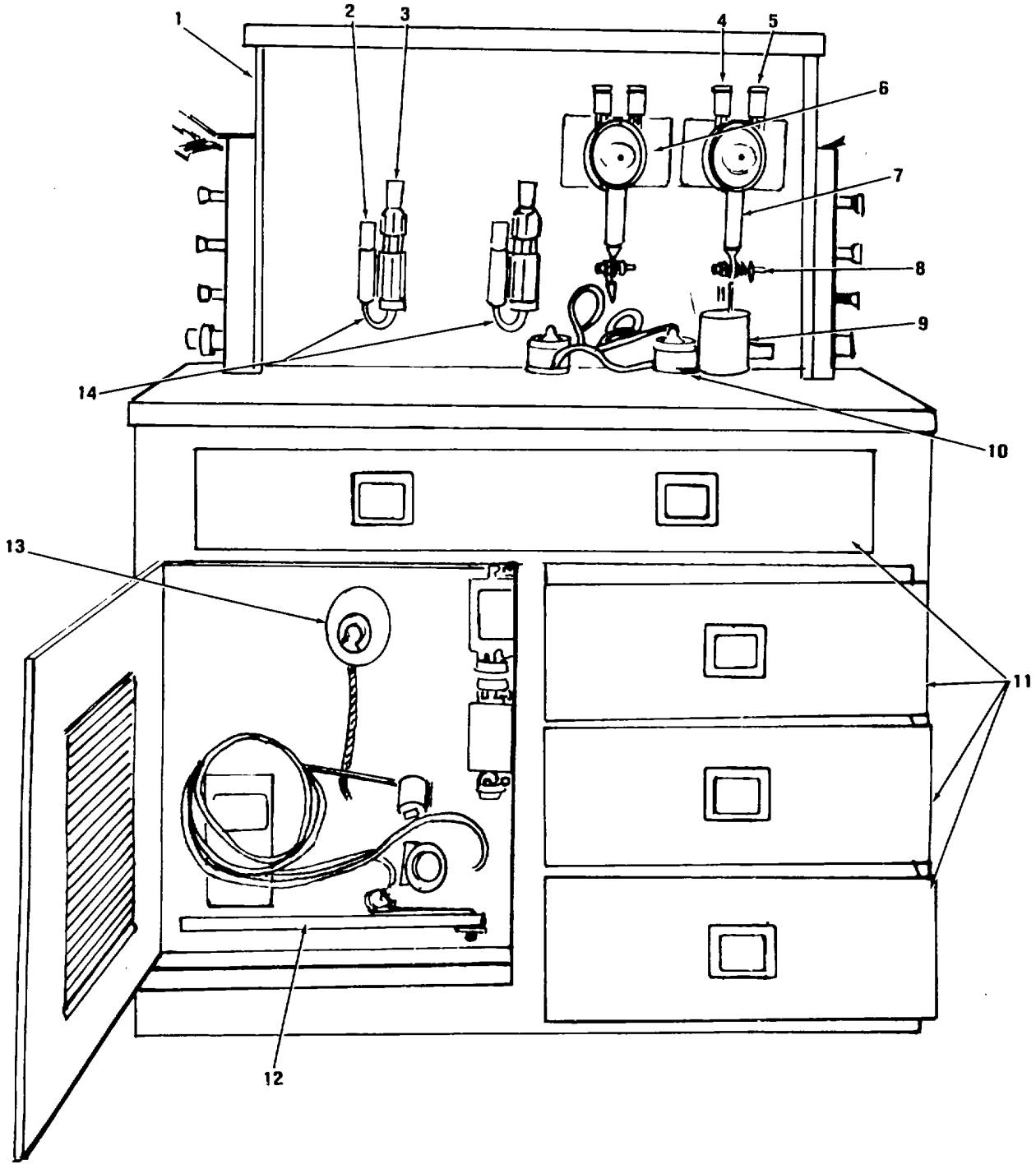
(c) Turn vacuum pump switch to ON position. Be sure to check oil level in vacuum pump prior to starting.

c. Preventive Maintenance.

(1) Tetraethyl lead and Sulfur-determination Apparatus. Clean all glassware with suitable solvent. Wash with soap and water, rinse, and air-dry. Clean all metal equipment, and wipe dry with clean cloth.

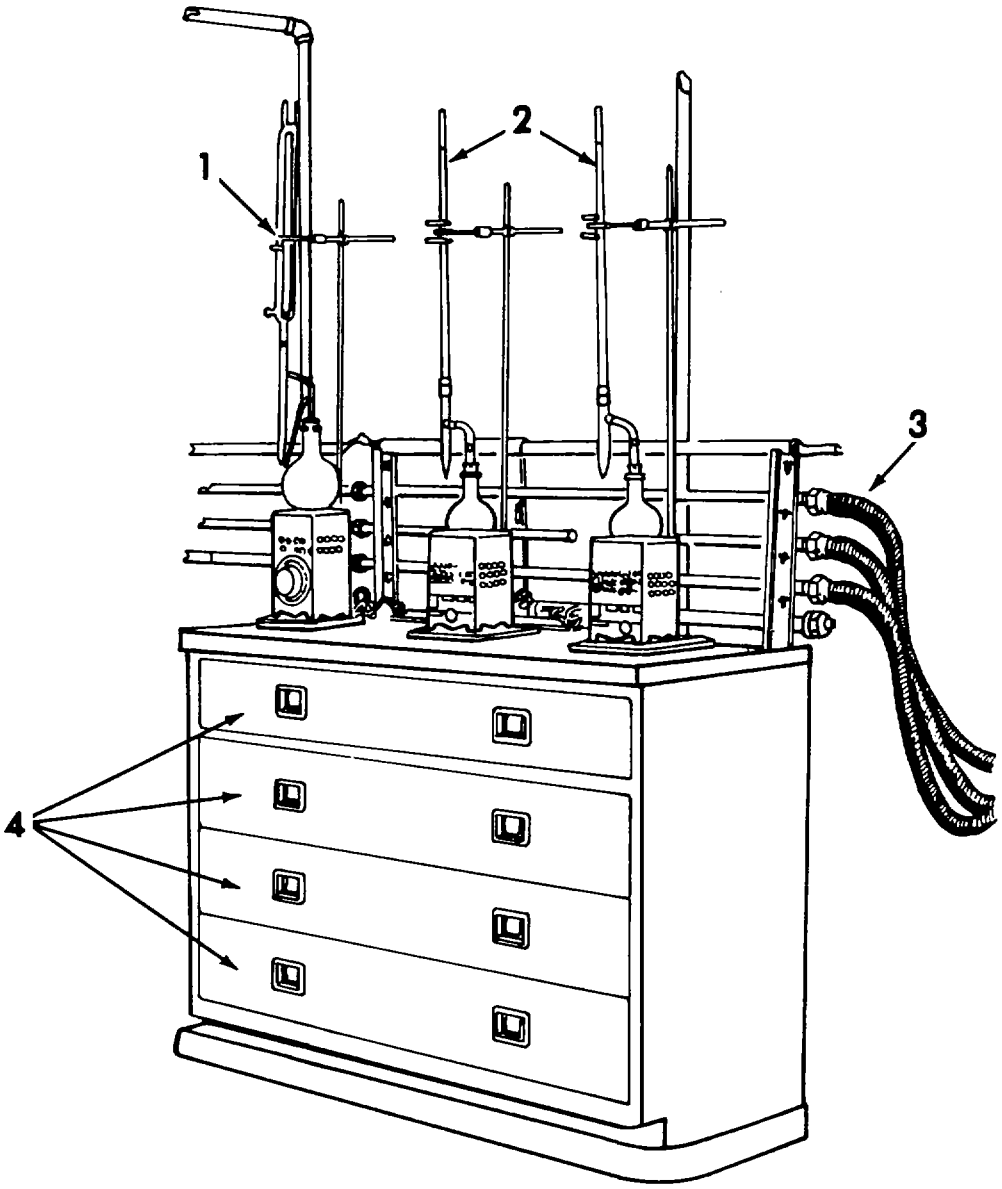
(2) Vacuum Pump. Preventive maintenance is restricted to lubrication, adding or changing oil, tightening bolts and connections and adjusting drive belts.

(a) Motor. Lubricate monthly with oil, lubricating engine crankcase, OE/HDO-10.



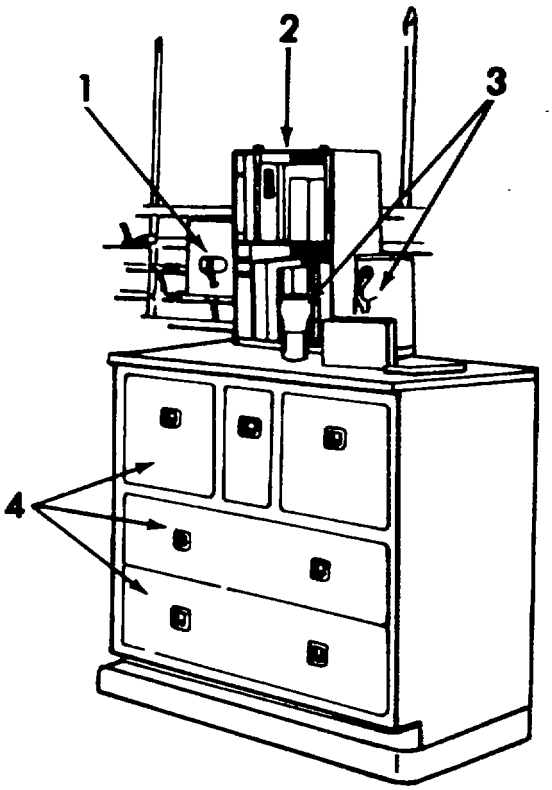
1. Apparatus support
2. Chimney connection
3. Spray trap connection
4. Condenser connection
5. Thistle tube connection
6. Boiling flask of tetraethyl lead apparatus
7. Heating tube
8. Stopcock
9. Beaker
10. Rheostats
11. Equipment drawers
12. Vacuum pump and motor
13. Rheostat
14. Absorbers of sulfur determination apparatus

Figure 2-18. Tetraethyl Lead and Sulfur Determination Apparatus Cabinet (Unit No. 8)



1. Crankcase dilution apparatus
2. Water determination apparatus
3. Flexible metal braided hose
4. Equipment drawers

Figure 2-18.1. Glassware Storage Cabinet (Units No. 9 thru 14, 24 and 26)



1. Automatic control for water still
2. Bookcase
3. Sulfur determination apparatus, bomb method
4. Equipment drawers

Figure 2-18.2. Chemical Storage Cabinet (Unit No. 15)

(b) Pump. Remove top plate and fill with special vacuum-pump oil until it is slightly above oil level as indicates in window on side of pump. In operation, the oil should be even with or slightly above the oil level. If insufficient oil is used, a good seal around the vanes will not be maintained. If too much oil is used, oil may back through the pump trap into the vacuum line. Whenever oil in pump is changed, pump must run for some time or a closed system before lowest pressure is obtained. Check to make sure that electric wiring is tight, check mounting bolts for tightness, and check drive belt periodically to make certain that it is not too tight or too loose. Belt should be just tight enough to prevent slippage when pump is operating.

2-16. STORAGE CABINETS.

a. Component Part. The storage cabinets (Units No. 9 thru 14, 24, and 26) contain much of the glassware, metal equipment, porcelain ware, tubing, stoppers, etc., which are component parts of the testing apparatus or which are used in testing procedures.

b. Operation. For detailed directions on assembling specific types of testing apparatus, and for information on testing procedures, refer to test methods in the appropriate test references.

2-17. CHEMICAL STORAGE CABINET.

The chemical storage cabinet (Unit No. 15) contains many of the chemicals and some miscellaneous equipment necessary for the testing of petroleum products.

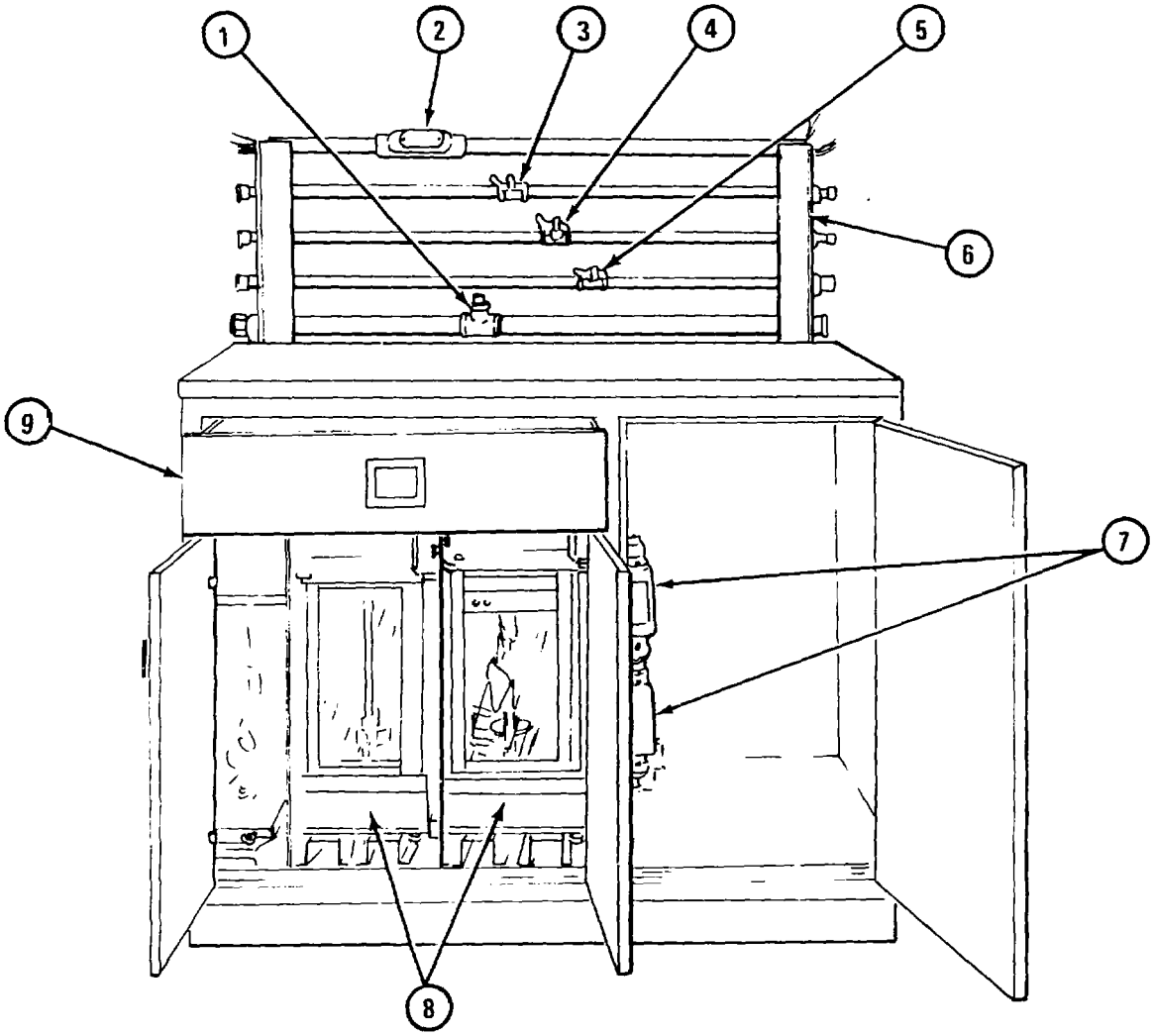
2-18. BALANCE TABLE CABINET.

a. Component Parts. The balance table cabinet (fig. 2-19) contains the analytical balances, complete U with weights; torsion balance, complete with weights; and foam test apparatus, consisting of cylinder, glass tube with diffusion stone, flowmeter, constant temperature bath with heating elements, thermoregulator and control box.

b. Operation.

(1) Balances. Remove balances and cases from within cabinet; remove component parts from drawer, and assemble on top of cabinet. Adjust balances and level.

(2) Foam Test Apparatus. Remove component parts of foam test apparatus from cabinet, and assemble on top of cabinet. For complete directions on assembling apparatus and for detailed procedure for testing foaming characteristics of crankcase oils, refer to testing methods in appropriate testing references.



1. Drainpipe outlet
2. Electric conduit outlet
3. Gas pipe hose connector
4. Compressed air pipe hose connector
5. Water pipe hose connector
6. Pipe rack in raised position
7. Electric terminal block boxes
8. Analytical balances
9. Equipment drawer

Figure 2-19. Balance Cabinet (Unit No. 16)

c. Preventive Maintenance.

(1) Balances. Do not attempt other than minor adjustment and cleaning of balances. Inaccurate or defective balances should be replaced or turned in for repair to higher echelon.

(2) Foam-test apparatus. Clean and dry equipment after use. Check to make sure that electrical connections are tight.

2-19. BOOKCASE.

The bookcase and books are normally stored in the tetraethyl lead and sulfur determination apparatus cabinet (Unit No. 8). When the laboratory is set up, the bookcase is removed from cabinet in which it is stored and is mounted on top of the balance cabinet. For list of books contained in bookcase, refer to Appendix D.

2-20. SINK CABINET.

a. Component Parts. The sink cabinet (fig. 2-20), includes a stainless steel sink, drainpipe, backsplash pipe rack, and miscellaneous equipment.

b. Operation.

(1) When sink cabinet has been positioned and pipe rack raised, connect the sink drain to laboratory drain by means of a 1-inch flexible metal hose.

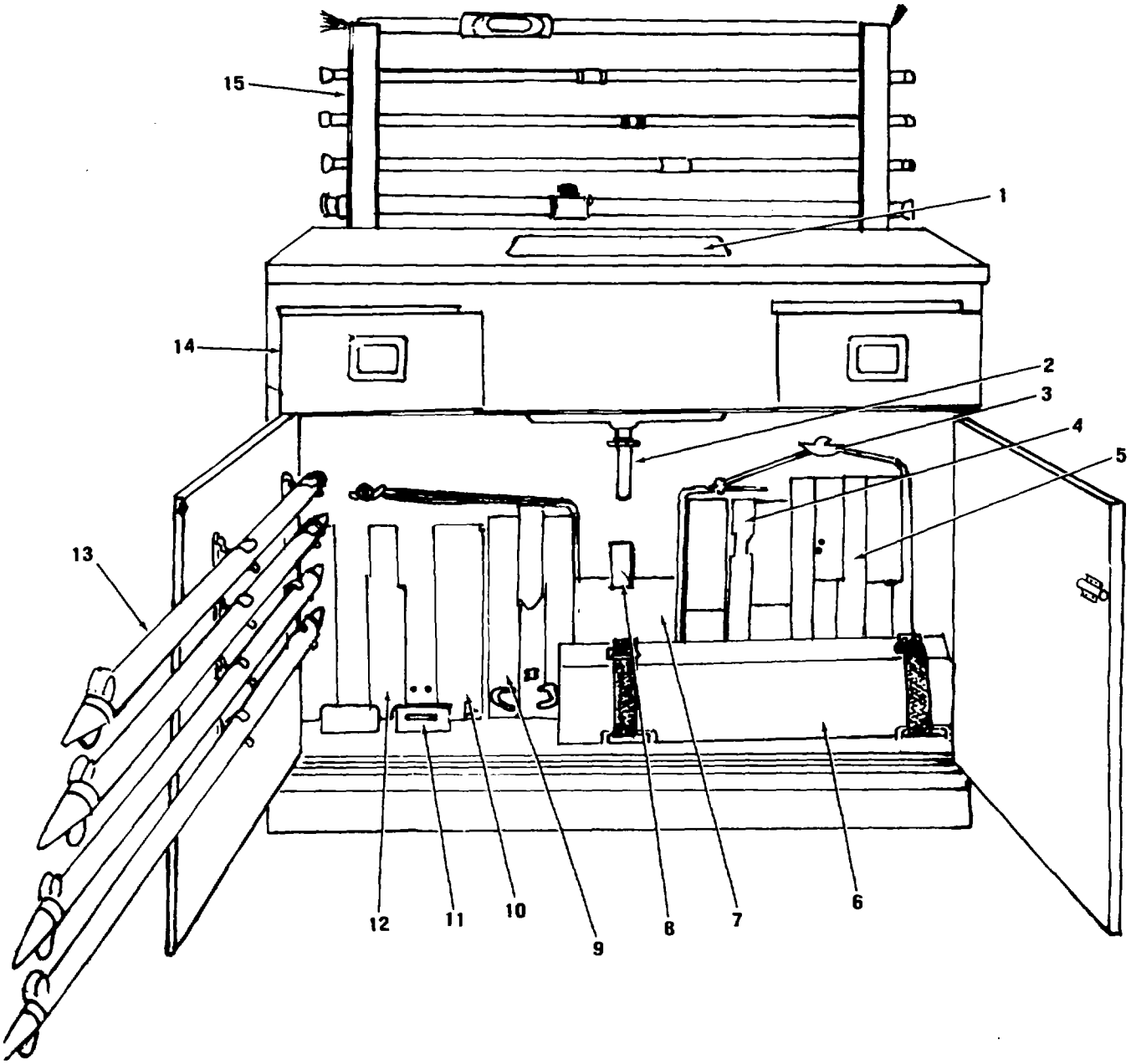
(2) Remove backsplash from stored position in cabinet and mount at rear of top of cabinet.

(3) For description of operating and testing procedures for the miscellaneous equipment, refer to appropriate testing methods in the test references.

c. Preventive Maintenance. Preventive maintenance of the sink and cabinet consists of cleaning. The majority of the miscellaneous items contained in the sink cabinet are precision instruments which require replacement or repair by higher echelons when defective, damaged or broken.

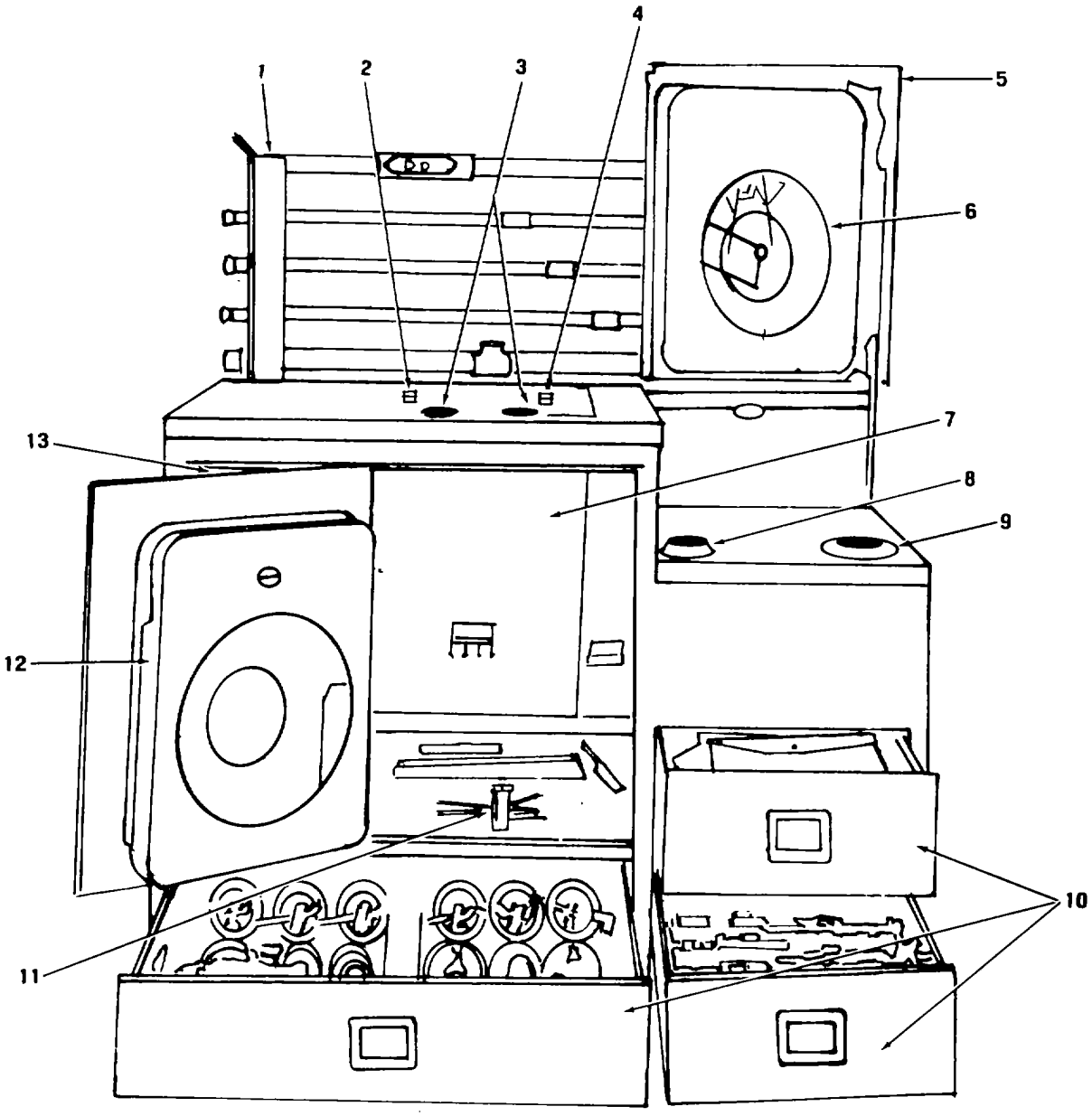
2-21. OXIDATION STABILITY CABINET.

a. Component Parts. The oxidation stability cabinet (fig. 2-21) contains a complete oxidation stability of gasoline apparatus consisting of a 2-hole bath with 115-volt, alternating current, heater; two 2-pen type pressure recording gages, one mounted on hinged cover at left top of the cabinet, and the other mounted on rear of door in the center of the cabinet; condensers for bath; oxidation stability bombs; bomb socket and wrench for tightening bomb covers; recording paper and ink; and copper and rubber tubing for assembling apparatus.



1. Sink
2. Sink drainpipe
3. Nonslip safety belt buckle
4. Case for Tag-Robinson colorimeter
5. Case for microscope
6. Case for Saybolt chromometer
7. Sink backsplash, stored position
8. Backsplash clamp
9. Case for Tag closed cup flash point tester
10. Case for Pensky-Martens flash point tester
11. Angle belt fastener
12. Webbed belt
13. Drum sampling thief
14. Equipment drawer
15. Pipe rack in raised position

Figure 2-20. Sink Cabinet, with Equipment Prepared for Shipment or Storage (Unit No. 17)



1. Pipe rack
2. Condenser connector
3. Bath openings for bombs
4. Thermometer holders
5. Hinged cover
6. Two-pen type pressure recording gage
7. Bomb bath
8. Switch for bath heater
9. Bomb socket
10. Miscellaneous equipment drawers
11. Copper and rubber tubing
12. Two-pen type pressure recording gage
13. Storage section for component items

Figure 2-21. Oxidation Stability Cabinet (Unit No. 18)

b. Operation.

(1) Raise hinged cover and open center door to make pressure gages available for testing procedures.

(2) Fill bath, and connect to electric power.

(3) Connect condensers and place thermometer in position.

(4) Remove bombs from cabinet and prepare them for testing procedures.

(5) In order to perform oxidation stability tests, an oxygen cylinder (Units No. 47 and 48) must be used. For detailed directions on assembling apparatus and preparing samples, and for information on testing procedures, refer to the applicable test methods in test procedures.

WARNING

Acute poisoning by carbon tetrachloride can result in death. Its use should be prevented, if possible. The Threshold Limit Value (TLV) established by the Occupational Safety and Health Act of 1970 standards (29CFR1910.1000) is 10 ppm, a level which can not be detected by odor. If used it must be contained within a laboratory hood.

c. Preventive Maintenance. Detailed instructions for cleaning apparatus are described in applicable test procedures. Clean pressure-recorder pens when clogged, using either carbon tetrachloride or de-natured alcohol. Do not attempt other than minor adjustments on the pressure-recording gage. Defective apparatus, especially bombs, must be replaced.

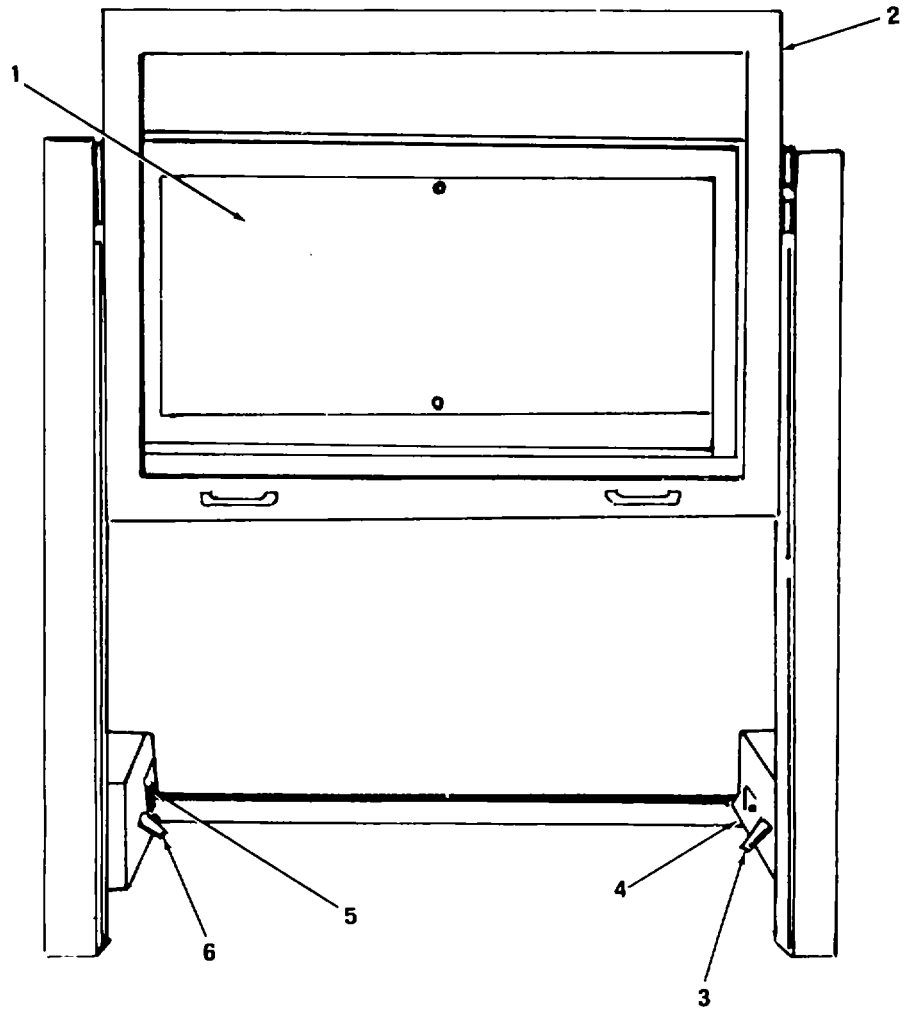
2-22. FUME HOODS.

a. Component Parts.

Each fume hood (fig. 2-22) consists of a cabinet and electric motor with blower. The cabinet is equipped with a sliding glass door and with gas and compressed air outlets, water and electric outlets, a blower switch, and electric cord. The 1/20-horsepower electric motor with blower is capable of exhausting 212 cubic feet (6 cubic meters) of air per minute. Exhaust ducts are mounted in the top interior portion of the cabinet. Ducts are provided for connecting exhaust blower opening to an outside wall of the laboratory.

b. Operations.

(1) Mount one of the fume hoods on gum apparatus cabinet (para 2-13), and mount the other hood on one of the storage cabinets.



1. Blower chamber
2. Sash
3. Compressed air outlet
4. Gas outlet
5. Electric outlet
6. Water outlet

Figure 2-22. Fume Hood (Unit No. 19)

(2) Connect electric cord to electric outlet, and connect the gas, air, and water outlets to proper service lines.

(3) Connect exhaust ducts to blower opening at top of hood and to a suitable opening in exterior wall of laboratory.

(4) To start exhaust blower motor, push switch at left exterior base to ON position.

c. Preventive Maintenance. Preventive maintenance consists of lubricating the fan motor as required, cleaning equipment and checking fittings and connections for tightness.

2-23. LOW TEMPERATURE KINEMATIC VISCOSIMETER CABINET.

a. Component Parts. The low temperature kinematic viscosimeter cabinet (fig. 2-23) contains the bath, control panels, and a refrigeration unit. The kinematic viscosimeter bath consists of an evacuated Dewar jar, thermoregulator, heater, stirrer motor, and lights. One control panel, containing the bath heater switch and pilot light, is mounted at the rear of the bath on the elevating platform. It also serves as a splash guard. A second control panel, mounted at the top right front of the cabinet, contains the powerstat, selector switch, mercury switch bulb, toggle switch for compressor motors, toggle switch for bath lights, and electronic relay. The refrigeration unit consists of three motor compressors, a condenser assembly, and a fan and motor assembly. The high compressor is filled with 3 pounds (1.36 kg) of Refrigerant -12; the intermediate compressor, with 10 ounces (283 gm) of Refrigerant -22 and the low compressor, with 2 ounces (56.6 gm) of Refrigerant -22.

b. Operation. Make certain that elevating platform is properly raised and locked in position. Connect powerline of apparatus to power source. For detailed directions for assembling apparatus and preparing samples, and for information on testing procedures, consult the appropriate test methods in test reference.

c. Preventive Maintenance. Preventive maintenance consists of defrosting the ice cube compartment, lubricating the fan motor, and checking lines and fittings.

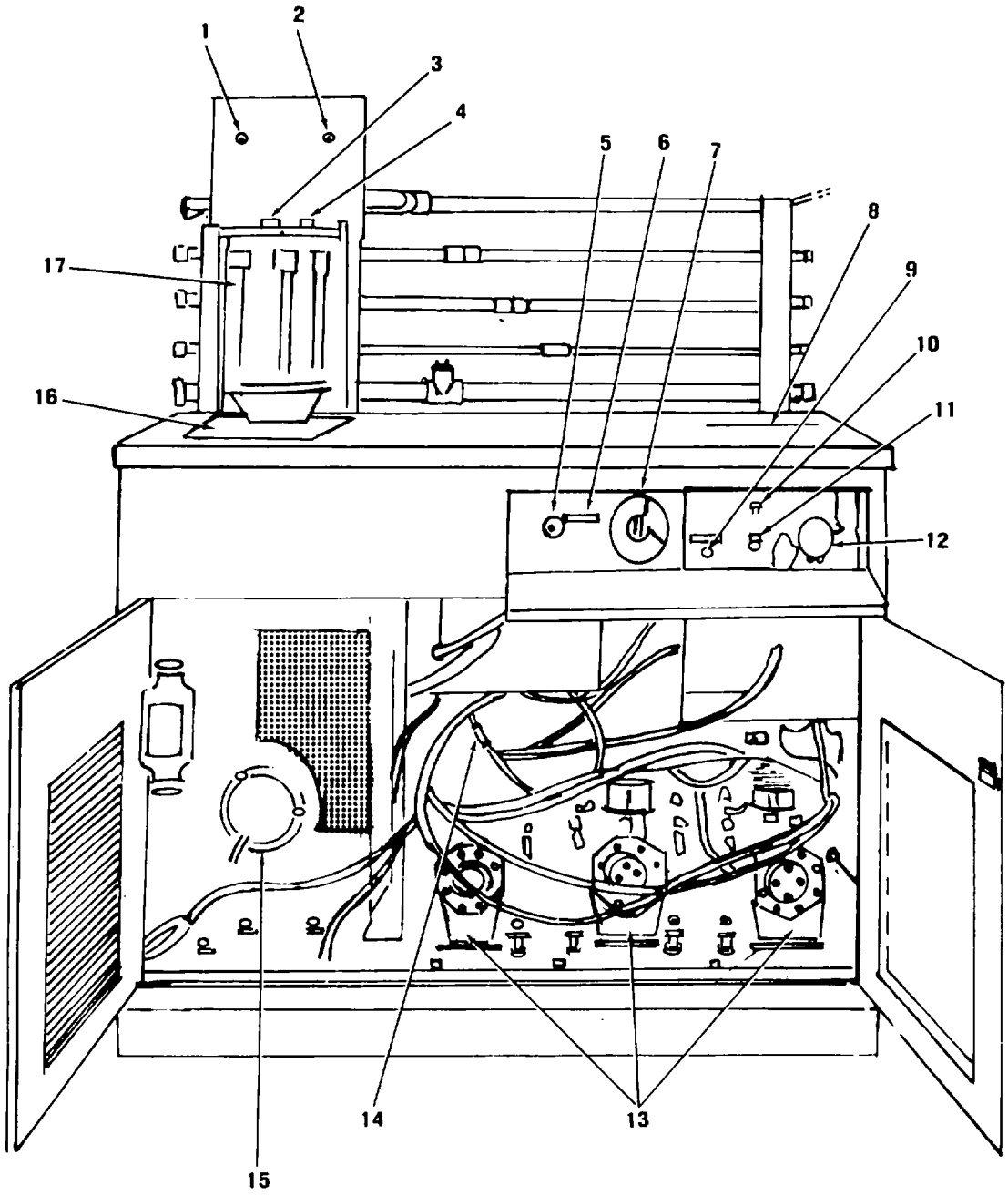
2-24. REFRIGERATOR CABINET.

a. Component Parts. The refrigerator cabinet (fig. 2-24) consists of a storage compartment, ice cube compartment, and motor compartment. The cold storage compartment contains the thermostat control; the ice-cube compartment contains 12 ice cube trays; and the motor compartment contains the condensers, controls, relays, and power cord.

b. Operation. Set the temperature control in the motor compartment to desired temperature and connect power cord to power source. Refrigeration unit is designed for continuous automatic operation.

2-25. CLOUD- AND POUR-POINT APPARATUS CABINET.

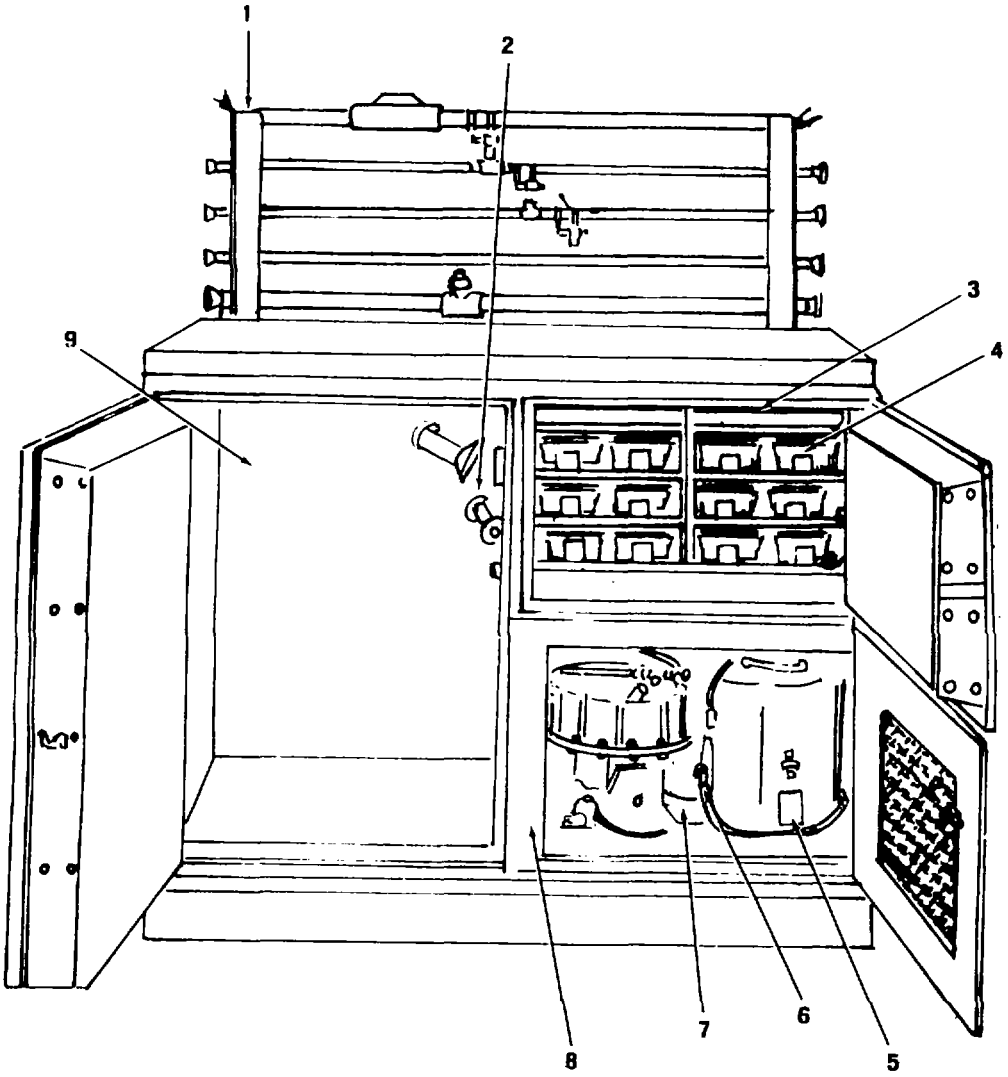
a. Component Parts. The cloud- and pour-point apparatus cabinet (fig. 2-25) consists of a bath compartment and motor compartment. The bath compartment contains five bath units: +30 degrees F (1.1 degrees C), 0 degrees F (-17.8 degrees C), -30 degrees F (-34.4 degrees C), -60 degrees F (-51.1 degrees C), and -90 degrees F (-68 degrees C) baths. The bath openings in the cabinet top are equipped with sliding covers. Two hinged doors at the front of the cabinet permit access to the bath compartment. Components contained in the motor compartment area motor compressor containing 9 pounds (4.09 kg) of refrigerant -12, a condenser, and thermostats for the +30 degrees F, 0 degrees F, and -30 degrees F baths; a precooler motor compressor



1. Pilot light
2. Heater switch
3. Thermoregulator
4. Heater
5. Powerstat
6. Switch for compressor motors
7. Selector switch
8. Bath opening
9. Viscosimeter switch
10. Pilot light
11. Mercury switch
12. Electronic relay
13. Compressors
14. Powerline and plug
15. Fan and motor
16. Elevating platform top
17. Dewar jar

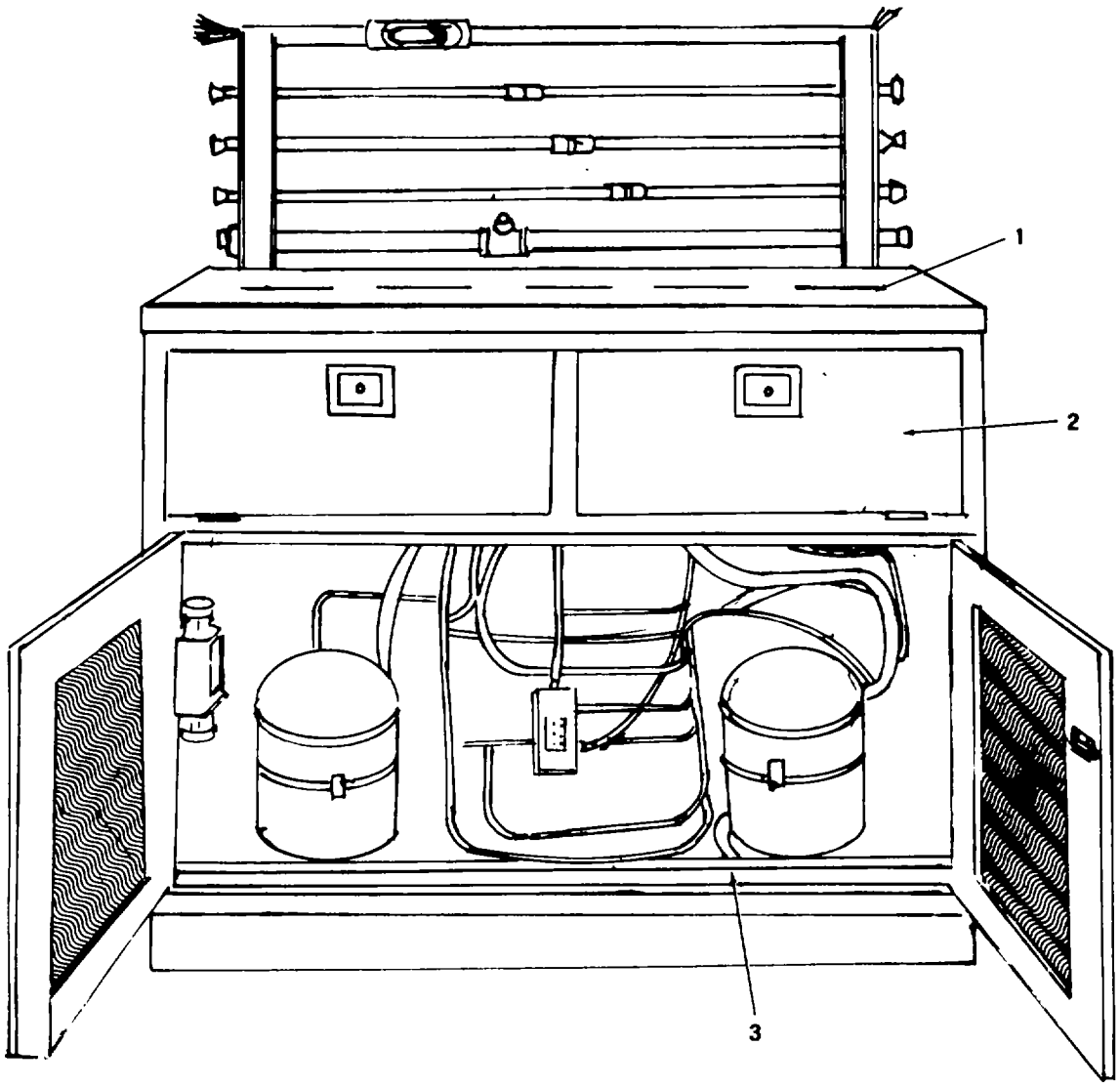
Figure 2-23. Low Temperature Kinematic Viscosimeter Cabinet (Unit No. 20)

with 3 pounds (1.36 kg) of refrigerant -12 for the -60 degrees F (-51.1 degrees C) and -90 degrees F (-68 degrees C) baths; a motor compressor with 1-1/2 ounces (0.042 kg) of refrigerant 22 and thermostat and controls for the -60 degrees F (-51.1 degrees C) bath; a motor compressor with 2 ounces (0.057 kg of refrigerant 2- and thermostat and controls for the -90 degrees F (-68 degrees C) bath; and two fans and motors.



1. Pipe rack
2. Thermostat
3. Ice cube compartment
4. Ice cube tray
5. Temperature control
6. Electric cord and plug
7. Refrigeration unit
8. Motor compartment
9. Cold storage compartment

Figure 2-24. Refrigerator Cabinet (Unit No. 21)



1. Bath openings
2. Bath compartment front panel
3. Motor compartment containing compressors, condensers, fans, and controls

Figure 2-25. Cloud- and Pour-Point Apparatus Cabinet (Unit No. 22)

b. Operation. For detailed directions on preparing samples and for information on testing procedures, refer to the appropriate test references. The unit is a continuous automatic operating type which requires connections to the power source to operate the equipment.

c. Preventive Maintenance. Preventive maintenance on this equipment consists of cleaning baths and component parts, and of checking fittings for tightness. The units are of the sealed type, which, when defective, require replacement or repair by higher maintenance echelons.

2-26. AIR COMPRESSOR.

a. Component Parts. The air compressor (fig. 2-26) consists of a 2-stage, 200-pound per square inch, air cooled, splash lubricated, belt driven compressor; a pressure gage; and a continuous service 1-horsepower, 60-Hz single phase, 110-220-volt alternating current motor. The compressor, gage, and motor are mounted on a common base, which in turn is mounted on a receiver tank. The compressor is connected to the receiver tank, which is equipped with safety valve, service valve, and draincock. The receiver tank is mounted on a metal base equipped with four casters. After the compressor is positioned, the casters are raised by bolts and the base is bolted to the floor. The motor is connected to a single phase, 110-volt starting switch, which provides protection to the motor against burning out because of the momentary high starting current.

b. Operation. After the air compressor is positioned, electric and service lines connected, and power turned on, the unit will operate automatically, maintaining the prescribed air pressure in the receiver tank.

WARNING

Do not direct compressed air against the skin. Do not use compressed air for cleaning except where reduced to less than 30 psi (2.11 kg/cm^2) and then only with chip guarding and eye protection.

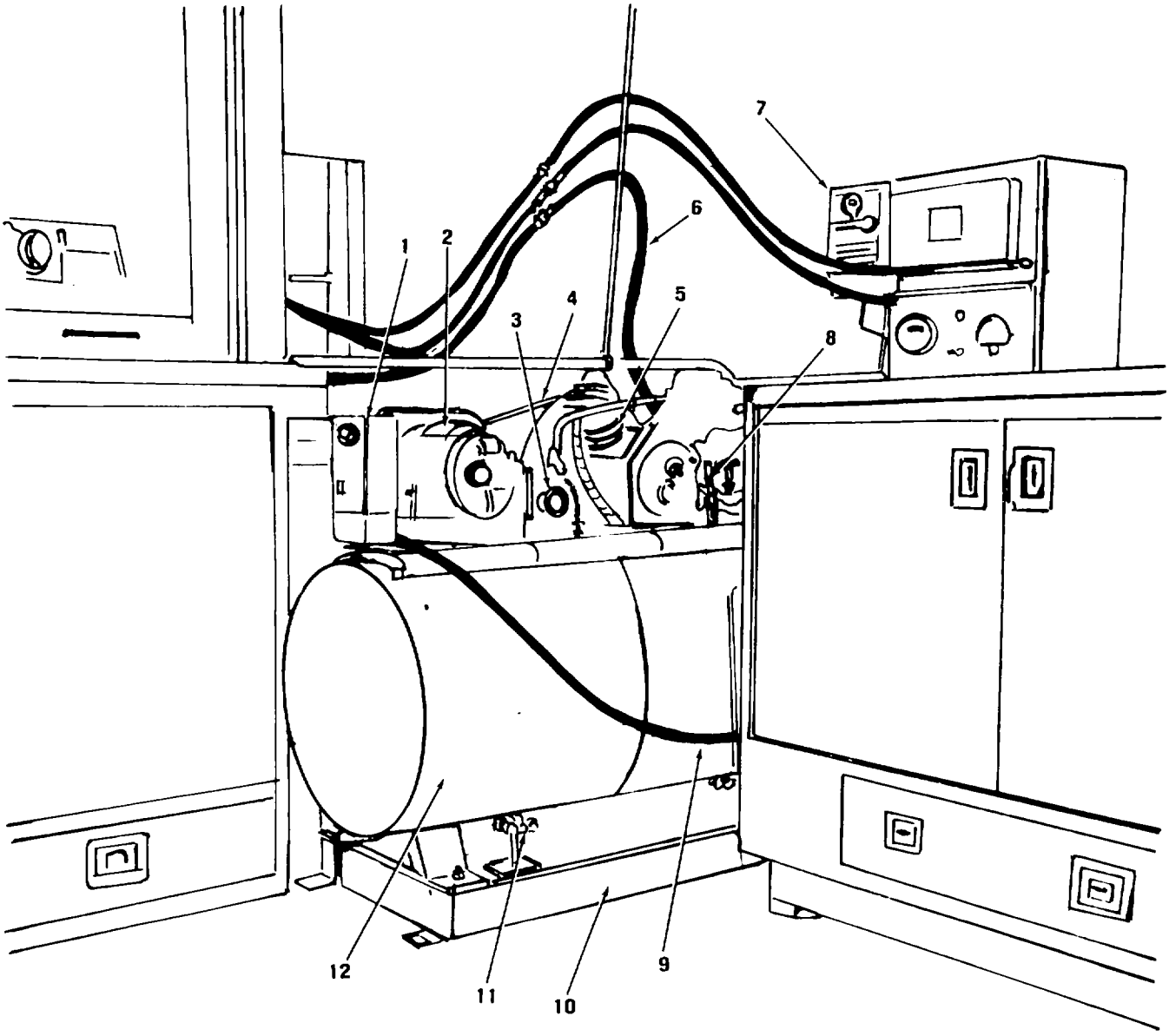
(1) Before starting air compressor for first time, fill the crankcase with oil, lubricating engine crankcase, "OEA".

(2) Check motor bearings for lubrication, and check tension of belts.

(3) Turn compressor over a few revolutions by hand to make certain unit is in operating condition.

(4) Start compressor motor and note direction of arrow on belt wheel to make sure direction of rotation is correct. Never put hands on the belts of an idle unit unless the main motor switch is off. Operate air compressor on a closed circuit until proper pressure is built up in the air receiver tank.

c. Maintenance. After the first few days of operating the air compressor, tighten the cylinder-flange and cylinder-head nuts to prevent their working loose and wrecking the compressor. Inspect the air compressor and motor once a week to make certain they are in proper operating condition.



1. Starting position
2. Electric motor
3. Pressure switch and gage
4. Drivebelt
5. Compressor
6. Compressed air service line
7. Main power switch
8. Air receiver tank outlet valve and safety valve
9. Powerline
10. Base
11. Caster control
12. Air receiver tank

Figure 2-26. Air Compressor (Unit No. 23)

(1) Air Compressor

(a) Check the oil level of the crankcase weekly and replenish if necessary. Change oil at least every 500 hours of actual operation. When compressor is installed in a heated room where temperature is above freezing, use oil, lubricating, engine crankcase, OE-30; when installed in unheated room where temperature is below freezing, use oil, lubricating, engine crankcase, "OEA".

(b) Clean valves are essential. Inspect and clean valves at least once a year or more often if operating conditions are severe. Make certain valves are thoroughly dry before replacing.

(c) Remove filter element of air intake filter at least once a month and clean with a blast of compressed air. If kerosene is used for cleaning the air intake filter, make certain filter is thoroughly dry before replacing; otherwise it might cause an explosion when air compressor is operated.

(d) Major repairs of the compressor are beyond the scope of organization maintenance and require replacement of the unit or repair by level specification in maintenance allocation chart.

(2) Electric Motor.

(a) If motor is a sleeve-bearing motor, oil at least every 3 months with oil, lubricating "OEA". Do not use an excessive amount of oil, as the excess oil is likely to work out on the commutator. If motor is a ball bearing motor, repack once a year using a grease of about the same consistency as, or slightly stiffer than, Vaseline.

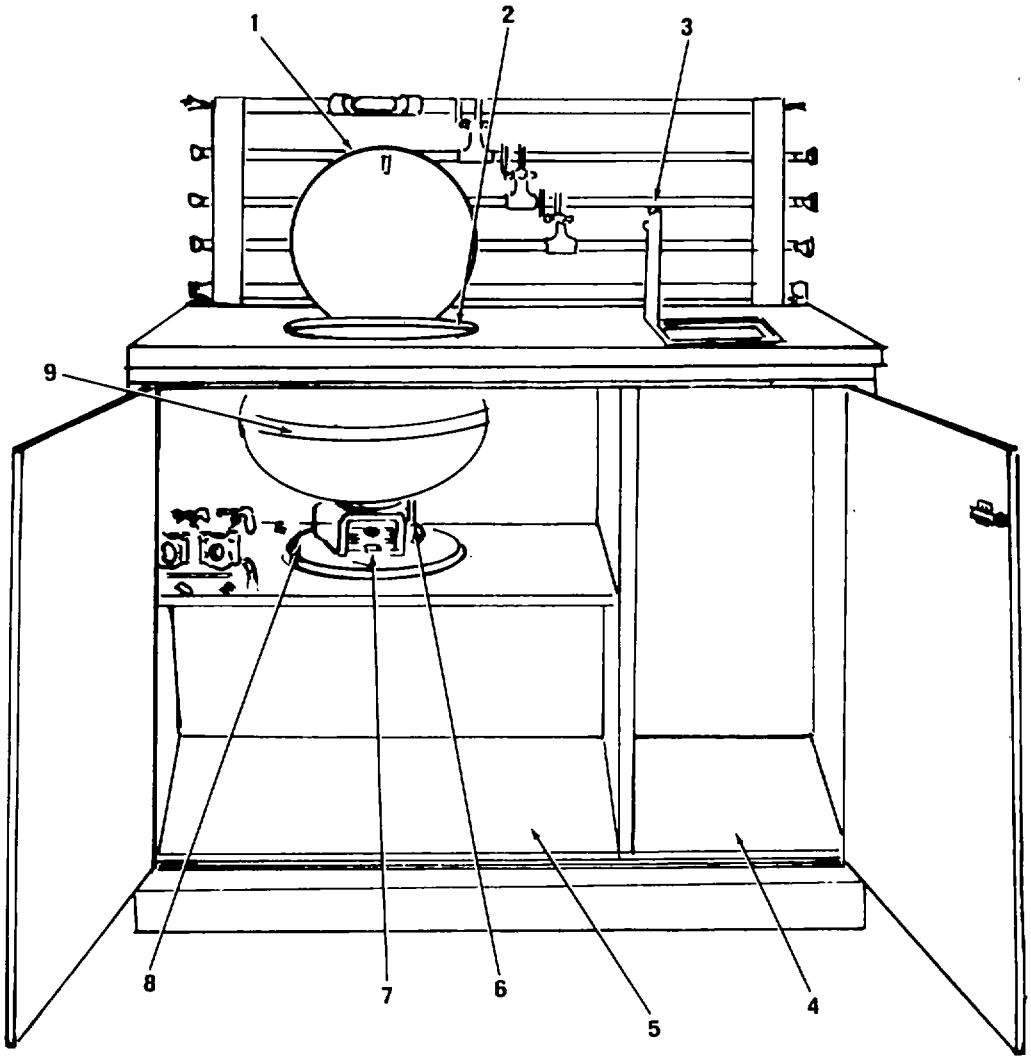
(b) Never oil the commutator; keep it dry and clean.

(c) Periodically blow off the motor windings with a jet of compressed air to prevent an accumulation of foreign matter.

(d) Adjust belt tension, when necessary, by sliding motor along its base and tightening in proper position.

2-27. CENTRIFUGE AND CHANNEL POINT APPARATUS CABINET.

a. Component Parts. The centrifuge and channel point apparatus cabinet (fig. 2-27) consists of three compartments: the centrifuge compartment, which houses the centrifuge and contains a unit of the cloud- and pour-point apparatus; the channel point apparatus compartment, which contains the channel point apparatus; and the refrigeration compartment, which contains the compressors, controls, and blowers for the channel point apparatus. The refrigeration compartment is located in the lower left portion of the cabinet beneath the centrifuge compartment. Openings in the top of the cabinet are equipped with hinged covers to provide access to the centrifuge and channel point apparatus.



1. Hinged cover of centrifuge compartment
2. Centrifuge access opening
3. Hinged cover of channel apparatus compartment
4. Channel apparatus compartment (normally contains channel apparatus)
5. Refrigeration compartment (normally contains channel apparatus controls, and blowers for refrigeration equipment)
6. Centrifuge toggle switch
7. Centrifuge speed control knob
8. Electric cord and plug
9. Centrifuge

Figure 2-27. Centrifuge and Channel Point Apparatus Cabinet (Unit No. 25)

b. Operation.

(1) Centrifuge.

(a) Place tubes containing samples in centrifuge, and close centrifuge cover.

(b) Connect electric cord to power source, set speed control at desired speed, and push toggle switch to ON position.

(c) To stop centrifuge, push toggle switch to OFF position. Never attempt to stop centrifuge with the hands.

(d) For complete directions on preparing samples and for information on testing procedures, refer to the applicable test methods in the test references.

(2) Channel Point Apparatus.

(a) Place sample in channel point apparatus.

(b) Make certain refrigeration equipment is connected to power source, and push toggle switches to ON position.

(c) For complete directions on preparing samples and for information on testing procedures, refer to applicable test method in the test references.

2-28. CONSTANT TEMPERATURE BATH, REID VAPOR PRESSURE (RVP).

a. Component Parts. The Reid Vapor Pressure (RVP) constant temperature bath (13, fig. 1-5) is assembled aid installed at a convenient location on the floor of the laboratory. The equipment consists of the bath with heating elements, thermoregulator, motor stirrer, overflow standpipe, and drain. Heating elements and motor are designed for 110-volt, 60-Hz alternating current. The RVP bombs and thermometer for use in the bath are stored in storage cabinets in the laboratory.

WARNING

When filling the Reid Vapor Pressure (RVP) bomb bath, exercise extreme caution in adding the required 10 parts per million (ppm) of copper sulfate. Do not exceed this proportion as 12ppm of copper sulfate is poisonous.

b. Operation. For detailed directions for preparing samples and assembling apparatus, and for information on test procedures, refer to appropriate test methods in the test references.

c. Maintenance. Maintenance consists of cleaning apparatus and oiling the motor.

2-29. GAS CYLINDERS.

WARNING

Before proceeding, always keep in mind the WARNINGS listed in the front of this manual.

WARNING

Store flammable gases away from other gases and secure cylinders to prevent falling.

WARNING

Freon-12 will freeze tissue upon which it is directed. When directed onto a red-hot surface or flame, it emits highly toxic fumes of phosgene and fluoride.

a. Types. Four types of gas cylinders are included in the base laboratory and are part of the major component units: 220-240-cubic foot capacity oxygen gas cylinders (Units 47 and 48); 100-pound capacity liquefied petro propane gas cylinders (Units No. 58 and 59); and a 5-pound capacity Refrigerant -12 gas cylinder (Unit No. 60). Each type is equipped with cylinder valve, valve protection cap, and outlet connection cap. Pressure regulators are provided for use with the oxygen and the propane gas cylinders. Do not attempt to attach flammable gas regulators to oxygen cylinders (by forcing the connection), or to use "homemage" adaptors of any kind.

b. Operation.

(1) Oxygen Gas Cylinders.

(a) Position cylinder in the desired location and make certain that it is firmly supported to prevent falling or rolling.

(b) Remove valve protection cap from cylinder and remove outlet connection cap from valve outlet connection.

WARNING

Never attempt to refill a cylinder, return it to the supplier.

(c) To clear the valve of particles of dust or dirt that might enter pressure regulator, open cylinder valve one quarter turn counterclockwise, and close immediately.

(d) Attach oxygen gas pressure regulator to cylinder valve outlet and to oxygen line of equipment.

(e) Turn pressure regulator adjusting screw counterclockwise until pressure regulator valve is fully open, and slowly open cylinder valve to full OPEN position.

(f) Turn pressure regulator adjusting screw clockwise until desired working pressure is reached.

(g) To shut down, close cylinder valve. If pressure regulator is to be removed, release all oxygen from regulator and disconnect. Replace outlet connection cap and valve protection cap.

(2) Liquified Petro Propane Gas Cylinders.

(a) Place cylinder or cylinders firmly in position. Normally cylinders should be located outside of the building.

(b) Operate cylinder as in (1) above, using propane gas pressure regulator rather than oxygen gas pressure regulator. Connect regulator to gas service lines of the laboratory.

(3) Carbon Dioxide Gas Cylinder.

(a) Remove valve protection cap and outlet connection cap. Connect cylinder to equipment to be charged with carbon dioxide gas, and slowly open the cylinder valve.

(b) To shut down carbon dioxide cylinder, close cylinder valve; disconnect cylinder from equipment, and replace outlet connection cap and valve protection cap.

(c) Replace cylinder in proper position in storage.

(4) Refrigerant -12 Gas Cylinder.

(a) Remove valve protection cap and outlet connection cap; connect outlet connection to equipment to be charged, and slowly open cylinder valve.

(b) Close cylinder valve as soon as equipment is charged or cylinder is empty; disconnect cylinder from equipment, and replace outlet connection cap and valve protection cap.

c. Preventive Maintenance.

(1) Before using cylinders, check to make certain that cylinders are undamaged, that connection threads are clean and undamaged, and that all connections are tight. Do not attempt any repairs on defective cylinder or cylinders with defective connection threads. Turn in defective cylinders to issuing agency for replacement.

(2) Do not use or attempt to repair defective pressure regulators; if defective, turn in to issuing agency for replacement.

(3) Do not lubricate cylinder valve or pressure regulator.

(4) When cylinders are empty, take cylinders outdoors or to a well-ventilated area and open cylinder valves. Never open valves while cylinders are in the laboratory. When certain that cylinders are empty, close valves and replace outlet-connection caps and valve protection caps. Turn in cylinders to issuing agency.

WARNING

Before proceeding, always keep in mind the WARNINGS listed in the front of this manual.

WARNING

Never attempt to refill a cylinder, return it to the supplier.

2-30. ANEROID BAROMETER.

a. Description. The aneroid barometer, designed to comply with the requirements specified in ASTM Method D86, is wall mounted in the laboratory. It is a temperature-compensated instrument and is graduated in both English and metric systems, from 26 to 31 inches (72mm to 78mm) of mercury. Pressure graduation is 0.10 inch (0.254 mm) of mercury. It can be used for altitudes sea level to 3500 feet (1066 meters).

b. Operation. Figures on dials 26 through 31 represent inches of mercury, the standard means of expressing atmospheric pressure. Read the indicating hand closest to the dial which responds readily to any change in atmospheric pressure. Use the set hand to note any change in pressure. Position the set hand directly over the indicating hand. A few hours after setting, note any change in pressure. A rise in pressure is indicated by movement of the indicating hand to the right. A fall in pressure is indicated by movement of the indicating hand to the left.

2-31. MANOMETER.

The manometer is the primary basic standard of pressure measurement. It is used in the laboratory to calibrate the Reid Vapor Pressure gages. To fill the mercury reservoir:

a. Remove the fill plug.

b. Vent the instrument on the low pressure side; assure zero adjustment at midscale.

c. Using a glass funnel, slowly pour the mercury in the unit until the indicating level is at approximately the zero graduation on the scale.

WARNING

Mercury is a poisonous material which may enter the body by ingestion, inhalation, or skin absorption. Mercury has such density, high surface tension, and low viscosity that pouring without splashing and spilling is almost impossible. When mercury is poured, always use a funnel and make the transfer over spill trays. If a mercury spill occurs, do not vacuum or sweep the area. This will disperse mercury throughout the laboratory. Spills may be cleaned up by using a glass tube of about 6mm diameter drawn out to an opening of about 1mm and connected by rubber tubing to a filter flask connected with a vacuum pump or aspirator, the flask acting as a trap. Control of mercury vapor should not be attempted with Flowers of Sulfur as this is not affective. Spills must be reported to the Environmental Science Officer providing services to the unit.

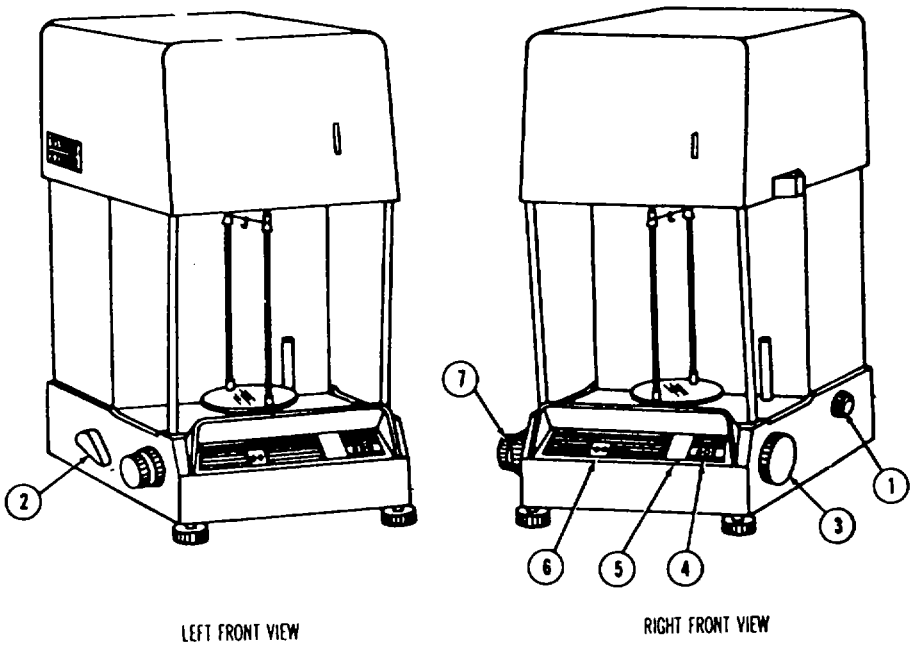
d. Replace the fill plug tightly.

e. Adjust the scale for the correct zero position in relation to the mercury meniscus.

f. For consistent results in reading the manometer the same way, always read the meniscus at eye level. The accuracy of the manometer is verified by using a certified master gage. Recommended A-level calibration frequency is 180 days.

2-32. ANALYTICAL BALANCE.

Figures 2-28 through 2-30 give various views of the analytical balance. The cleaning procedures explained below refer to these figures.



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1. Zero control knob
2. Arrestment lever
3. Micrometer drum knob
4. Micro scale
5. Optical scale
6. Macro weight scale
7. Weight control knob

Figure 2-28. Analytical Balance.

a. Cleaning

(1) From time to time clean the weights of the balance with a camel's hair brush or chamois leather. To remove the weights, arrest the beam and take off the hood. Move all knobs to the maximum setting. Remove the weighing pan from the weighing compartment. Lift the weight carriage and swing the weight carriage bridle forward to detach it from the bearing (stirrup) plate. Unscrew two large knurled head screws in the ceiling on the weighing compartment and remove the partition. Unscrew knurled knob (5, fig. 2-30), and knurled nut (4). Separate the upper part of the weight carriage from the lower, while holding the lower to prevent it from falling into the weighing compartment. Take out the lower part and switch the weight decade slowly from 9 to 8 to 7, etc., to zero. While doing this, remove the corresponding weights which will be lying freely in their respective hooks. Clean the weights thoroughly. Do not leave fingerprints on the surface. Handle weights with forceps only. After cleaning, reassemble the balance check, zero, calibrate, and adjust sensitivity, if necessary.

(2) To clean the weighing compartment interior, arrest the balance; remove the weighing pan and wipe the interior clean, using a water damp chamois. Wring the chamois dry and wipe again, removing all traces of water. Remove dust particles, using a camel's hair brush. Clean and replace the weighing pan. Sliding glass doors may be removed for cleaning. Wipe the exterior of the balance clean, using the water damp chamois. Do not attempt to clean the balance mechanism, other than the weights and knives.

CAUTION

DO NOT ATTEMPT TO REPAIR THE BALANCE. Only a skilled service repairman with factory facilities available should attempt repairs.

b. Scale Illumination. Scale illumination can be increased by adjusting bulb contact to provide maximum bulb brightness. If additional illumination is desired, remove the hood and loosen the knurled head screw (7, fig. 2-30) which holds the cover on the recessed lamp housing in the left rear of the balance. Slide the cover from side to side and up and down until the desired illumination is obtained. Tighten the knurled head screw firmly while holding the cover in position. A replacement bulb is available and is stored in the lower spare mount.

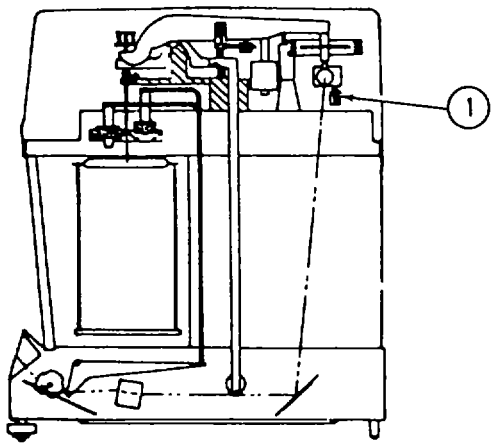

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Figure 2-29. Analytical Balance, Side View.

Legend for figure 2-30

1. Screw
2. Knurled screw
3. Knurled nut
4. Knurled nut
5. Knurled knob
6. Knurled knob
7. Knurled knob

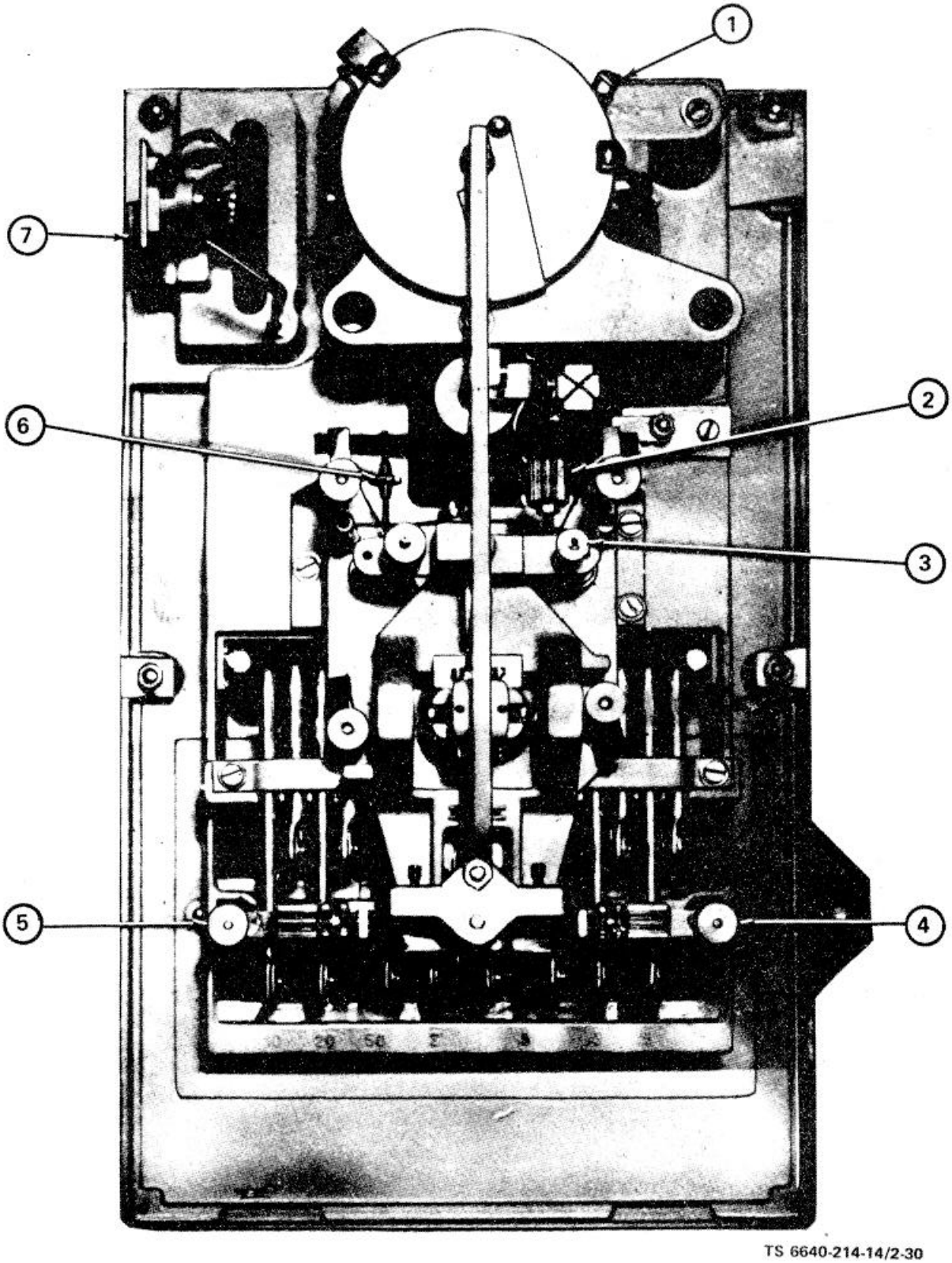


Figure 2-30. Top View of Analytical Balance

c. Scale focusing in controlled by the long knurled knob (fig. 2-29) at the rear of the scale. Carefully adjust the knob until the desired focus is achieved on the optical scale.

d. Zero point adjustment is accomplished by first rotating the weight control knobs and micrometer drum knob until the macro weight scale and optical scale are returned to zero. Move the arrestment lever into PRE-WEIGHT position and adjust the micro scale to zero by turning screw (1, fig. 2-30).

(1) Range adjustment of the zero control knob has the effect of recentering the knob. Set the knob in the center of its adjusting range without regard to micro scale reading. Arrest the beam by moving the arrestment lever to horizontal position. Remove the balance hood and adjust the knurled knob (6, fig. 2-30) until optical and micro scales are zeroed. If the scale deviation is so great that this method cannot be used to zero the knob midrange, it is necessary to zero the macro system as described in (6) below.

(2) To perform macro zero adjustments, check zero calibration as described in (d) above; then arrest the beam and remove the hood. Loosen the locking screw or knurled screw (2, fig. 2-30), and adjust the scale by turning the knurled screw as required to zero the macro scale. Retighten the locking screw, release the beam, and check zero again. Repeat the correction if the deviation exceeds one scale division. As soon as the deviation is reduced to one scale division, replace the hood and use the zero control knob to adjust to zero.

(3) Check sensitivity by rotating the weight control knobs until 01 appears on the macro scale while the beam is arrested. Place a 1-g weight on the pan, release the beam, and check zero on the optical scales as described in (d) above. Rotate the weight control knobs to show zero on the macro scale. Let the optical scale swing in and read the result. If the full deflection of 0100 is not obtained, adjust the sensitivity by turning the knurled nut (3, figure 2-30) to adjust the scale accordingly.

Turn weight control knob so that 01 appears on the macro scale and set zero point as described in (4) above. Recheck the sensitivity. If required, readjust the sensitivity, set the zeropoint, and recheck. Continue the sequence until the balance is correctly adjusted.

CHAPTER 3

OPERATOR/CREW MAINTENANCE INSTRUCTIONS

Section I. PREVENTIVE MAINTENANCE CHECKS AND SERVICES

3-1. GENERAL.

To ensure that the petroleum base laboratory assembly is ready for operation at all times, it must be inspected systematically so that defects may be discovered and corrected before they result in serious damage or failure. The necessary preventive maintenance checks and services to be performed are listed and described in paragraph 3-2.

Defects discovered during operation of the unit will be noted for future correction to be made as soon as operation has ceased. Stop operation immediately if a deficiency is noted during operation which would damage the equipment if operation were continued. All deficiencies and shortcomings will be recorded together with the corrective action taken on DA Form 2404 (Equipment Inspection and Maintenance Worksheet) at the earliest possible opportunity.

3-2. PREVENTIVE MAINTENANCE CHECKS AND SERVICES.

Refer to table 3-1 for a listing of operator's preventive maintenance checks and services.

Table 3-1. Preventive Maintenance Checks and Services

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

B - Before **A - After** **M - Monthly**
D - During **W - Weekly** **C - Combat Operability Check**

Item No.	Interval					C	Item to be Inspected	Procedures Check for and have repaired or adjusted as necessary.	Equipment will be reported Not Ready (Red) if:
	B	D	A	W	M				
	X						Balances	Clean with lint free cloth.	
	X						Foam test apparatus	Clean and dry, check electrical connections are tight.	
					X		Sink and cabinet	Clean with mild soap and water solution	
	X						Oxidation stability of gasoline apparatus	Detailed instructions for cleaning apparatus are described in applicable test procedures. Clean pressure recorder pins when clogged, using alcohol. Do not attempt other than minor adjustments on the pressure-recording gage. Defective apparatus, especially bombs, must be replaced.	
					X		Fume Hoods	Lubricate fan motor, clean equipment and check fittings and connections for tightness.	

Table 3-1. Preventive Maintenance Checks and Services

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

B - Before **A - After** **M - Monthly**
D - During **W - Weekly** **C - Combat Operability Check**

Item No.	Interval					C	Item to be Inspected	Procedures Check for and have repaired or adjusted as necessary.	Equipment will be reported Not Ready (Red) if:
	B	D	A	W	M				
			X				Tetraethyl lead and Sulfur determi-nation Apparatus	Clean all glassware with suitable solvent, wash with soap and water, rinse and air-dry Clean all metal equipment and wipe dry with clean cloth	
					X		Vacuum pump	Tighten bolts and connections.	
					X		Vacuum pump motor	Lubricate with oil, lubricating engine crank-case (Military Symbol OE/HDO- 10)	
					X		Vacuum pump drive-belts	Adjust drivebelts to make certain that belt is not to tight or too loose. Belt should be just tight enough to prevent slippage when pump is operating.	

Table 3-1. Preventive Maintenance Checks and Services

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

B - Before **A - After** **M - Monthly**
D - During **W - Weekly** **C - Combat Operability Check**

Item No.	Interval					C	Item to be Inspected	Procedures Check for and have repaired or adjusted as necessary.	Equipment will be reported Not Ready (Red) if:
	B	D	A	W	M				
		X					Water still Cabinet (Unit No. 8)	Remove dome cover of water still after daily use, and wipe away accumulated soft sludge. If sludge has hardened into a crust, leave a dilute (about 10%) solution of acetic acid in the evaporator overnight. After this treatment operate still for about 2 hours to remove all traces of acid. Make sure that no distilled water produced during this period is used.	
			X				Centrifuge	Use damp cloth to clean interior and exterior of centrifuge. Use suitable solvent or mild soap and water solution for cleaning centrifuge tubes. Rinse tubes with clear water, and air-dry.	
			X				Channel Point Apparatus	Clean with suitable solvent or mild soap and water solution, wipe dry or air-dry. Periodically check electrical connections for tightness.	

Table 3-1. Preventive Maintenance Checks and Services

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

B - Before **A - After** **M - Monthly**
D - During **W - Weekly** **C - Combat Operability Check**

Item No.	Interval						Item to be Inspected	Procedures Check for and have repaired or adjusted as necessary.	Equipment will be reported Not Ready (Red) if:
	B	D	A	W	M	C			
					X		Pump	Remove top plate and fill with special vacuum pump oil until it is slightly above oil level as indicated in window on side of pump. In operation, the oil should be even with or slightly above the oil level. If insufficient oil is used, a good seal around the pump vanes will not be maintained. Too much oil may back up through the pump trap into the vacuum line. Whenever oil in pump is changed, pump must run for some time on a closed system before lowest pressure is obtained.	
					X		Low Temperature Kinematic Viscosimeter Cabinet	Defrost the ice cube compartment and lubricate. the fan motor, check lines and fittings.	

Table 3-1. Preventive Maintenance Checks and Services

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

B - Before **A - After** **M - Monthly**
D - During **W - Weekly** **C - Combat Operability Check**

Item No.	Interval						Item to be Inspected	Procedures Check for and have repaired or adjusted as necessary.	Equipment will be reported Not Ready (Red) if:
	B	D	A	W	M	C			
	X						Pene-trometer	**WARNING** Most cleaning solvents are hazardous. Avoid prolonged skin contact and breathing of vapors. Check container label for warnings.	
			X					Remove test product with solvent. Air-dry or wipe dry with clean, lintless cloth. Use mild soap and water solution if necessary, and dry thoroughly to pre-vent rust.	
					X			Lubricate stem, adjusting and locking screws, depth gage and needle gears, and clutch mechanism as often as required, using light lubricating oil (LO)	
			X				Gum Appa-ratus Cabinet (Unit No. 6)	Clean exterior of baths by using a clean cloth and mild soap and water solution. Clean allied equipment and wipe dry. Remove any gum with proper solvent and wipe dry. Drain and clean baths periodically. Check to make sure that all electrical connections are tight.	

Table 3-1. Preventive Maintenance Checks and Services-Cont

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

B - Before **A - After** **M - Monthly**
D - During **W - Weekly** **C - Combat Operability Check**

Item No.	Interval					C	Item to be Inspected	Procedures Check for and have repaired or adjusted as necessary.	Equipment will be reported Not Ready (Red) if:
	B	D	A	W	M				
			•					Clean exterior of bath using clean, damp cloth, when required, clean bath interior as follows: (1) Completely drain oil and use suitable solvent to remove remaining oil, wash bath with mild soap and water solution, rinse thoroughly with clean water and air dry or wipe dry with clean, lintless cloth.	
			•		X		Distillation Cabinet	Use clean cloth and mild soap and water solution to clean interior and exterior of distillation apparatus.	
			•		X		Muffler Furnace	Clean steel tray and muffler interior using a clean cloth and mild soap and water solution. Check to make sure that all electrical connections are tight.	

Table 3-1. Preventive Maintenance Checks and Services-Cont

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

B - Before **A - After** **M - Monthly**
D - During **W - Weekly** **C - Combat Operability Check**

Item No.	Interval					C	Item to be Inspected	Procedures Check for and have repaired or adjusted as necessary.	Equipment will be reported Not Ready (Red) if:
	B	D	A	W	M				
					X		Air receiver tank and fittings	Check all piping between compressor and receiver tank, and between receiver tank and compressor air pipe for any presence of leaks. Make certain that all connections are tight.	
					X		Air receiver drain	Drain receiver tank at least once a week to remove the accumulation condensate, make certain drain valve is completely open.	
					X		Safety valve	Check for damage and any accumulated dirt. Do not change setting or remove safety valve, the valve is set by the manufacturer.	
				X			Pressure switch	Check for damage and any accumulated dirt. Do not change setting of the pressure switch.	
				X			Cylinders	Check to make sure that cylinders are undamaged, that connection threads are clean and undamaged, and that all connections are tight. Do not attempt any	

Table 3-1. Preventive Maintenance Checks and Services-Cont

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

B - Before **A - After** **M - Monthly**
D - During **W - Weekly** **C - Combat Operability Check**

Item No.	Interval					C	Item to be Inspected	Procedures Check for and have repaired or adjusted as necessary.	Equipment will be reported Not Ready (Red) if:
	B	D	A	W	M				
								repairs on defective cylinders, or cylinders with defective connection threads. Turn in defective cylinder to issuing agency for replacement.	
					X		Regulators	Check for damage, but do not use or attempt to repair defective pressure regulators. If defective, turn in to issuing agency for replacement. Do not lubricate cylinder valve or regulator.	
					X		High Temperature Viscosimeter cabinet	Lubricate the oil stirrer motor every 1,000 hours of use, applying light lubricating oil (Military Symbol LO) **WARNING** Most cleaning solvents are hazardous. Avoid prolonged skin contact and breathing of vapors, check container label for warnings.	

Table 3-1. Preventive Maintenance Checks and Services-Cont

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

B - Before **A - After** **M - Monthly**
D - During **W - Weekly** **C - Combat Operability Check**

Item No.	Interval B	D	A	W	M	C	Item to be Inspected	Procedures Check for and have repaired or adjusted as necessary.	Equipment will be reported Not Ready (Red) if:
								where temperature is below freezing, use oil, lubricating, engine crankcase OEA/APG-PD-1.	
					X		Compressor valves	Inspect and clean valves at least once a year, or more often if operating conditions are severe. Make certain valves are thoroughly dry before replacing.	
					X		Compressor filter	**WARNING** Do not direct compressed air against the skin. Do not use compressed air for cleaning except where reduced to less than 30 psi (2.11 kg/cm^2) and then only with chip guarding and eye protection. Remove filter element of air intake filter at least once a month and clean with a blast of compressed air. If petroleum cleaning solvents are used for cleaning the air intake filter, make certain filter is thoroughly dry before	

Table 3-1. Preventive Maintenance Checks and Services-Cont

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

B - Before **A - After** **M - Monthly**
D - During **W - Weekly** **C - Combat Operability Check**

Item No.	Interval B	D	A	W	M	C	Item to be Inspected	Procedures Check for and have repaired or adjusted as necessary.	Equipment will be reported Not Ready (Red) if:
								replacing otherwise it might cause an explosion when air compressor is operating. Major repairs of the compressor are beyond the operator's level.	
					X		Compressor motor	If there is a sleeve bearing motor, oil with oil lubricating OEA, do not use an excessive amount of oil, excess oil is likely to work out on the commutator. If motor is ball bearing type, repair once a year using a grease of about the same consistency as, or slightly stiffer than Vaseline.	
					X		Compressor commutator	Clean and keep dry, never use oil.	
					X		Motor windings	Blow off the motor windings with a jet of compressed air to prevent air accumulation of foreign matter.	
					X		Compressor belt	Adjust belt tension when necessary, by sliding motor along its base and tightening in proper position.	

Section II. TROUBLESHOOTING

3-3. GENERAL.

a. This section contains troubleshooting information for locating and correcting most of the operating trouble which may develop in the Petroleum Base Laboratory Assembly. Each malfunction for an individual component, unit, or system is followed by a list of tests or inspections which will help you to determine probable causes and corrective actions to take. Perform the tests/inspections and corrective actions in the order listed.

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

WARNING

Before proceeding, always keep in mind the WARNINGS listed in the front of this manual.

3-4. OPERATOR/CREW MAINTENANCE TROUBLESHOOTING CHART.

Refer to table 3-2 for troubleshooting which is allocated to operator/crew maintenance levels.

NOTE

Before you use this table, be sure you have performed all applicable operating checks.

Table 3-2. Troubleshooting

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
1. OVEN HEAT LOSS
Step 1. Check for improperly positioned door strike. Adjust door strike for tighter closure.
2. OVEN TEMPERATURE VARIES (VENT CLOSED)
Step 1. Check for improperly loaded oven. Test oven empty.
Step 2. Check to see if hot oven is stabilized. Allow 1 to 2 hours for oven to stabilize.
Step 3. Inspect for faulty electrical connections. Check all electrical lines and connections.
3. OVEN NO HEAT
Step 1. Check for loss of power. Check line voltage and connections.
4. MANOMETER NO PRESSURE (READING)
Step 1. Check if pressure is not being applied to either or both sides of the instrument. Check for slugged or leaking pressure lines. Make applicable corrections.
Step 2. Inspect atmosphere pressure connection for proper venting to atmosphere. Make applicable connection to ensure proper venting.

Table 3-2. Troubleshooting - Continued

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

5. MANOMETER HIGH OR LOW PRESSURE READING

Step 1. Check for improper zero setting.
Check zero setting. Make proper adjustment.

Step 2. Check for leaks or obstructions.
Locate leaks or obstructions, make applicable corrections.

6. VACUUM PUMP INSUFFICIENT PRESSURE

Step 1. Check for low oil level.
Fill pump to prescribed level.

Step 2. Check for leakage in line.
Locate leak and repair line.

Step 3. Check if motor is functioning properly.
Check for loose connections.

7. AIR COMPRESSOR PUMPING OIL

Step 1. Check for clogged intake filter.
Change filter element.

8. AIR COMPRESSOR KNOCKS OR RATTLES

Step 1. Check for loose belts or pulleys.
Tighten belt or pulley.

9. AIR COMPRESSOR AIR DELIVERY DROPPING

Step 1. Check for clogged intake filter.
Change filter element.

Table 3-2. Troubleshooting - Continued

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

10. EXCESSIVE STARTING AND STOPPING OF AIR COMPRESSOR

Step 1. Check for water in receiver tube.
Remove power from air compressor, and drain the air receiver tank, when air has escaped leave draincock open for a few minutes to allow condensation to escape. Close draincock, apply power and recheck operation.

Step 2. Check for air leaks in piping.
Make solution of soapy water and apply to fittings. If a leak is present at a fitting try tightening fitting. If leak is not corrected refer to higher maintenance.

11. AIR COMPRESSOR RUNNING HOT

Step 1. Check for blockage of air to fan wheel.
Remove any object that is blocking the air passage. Clean up and remove any accumulated dust or dirt.

12. AIR COMPRESSOR RUNNING SLOW

Step 1. Check for low line voltage.
Correct line voltage if low.

13. REID VAPOR PRESSURE BOMB BATH LOSS OF TEMPERATURE (CONTROL OF BATH WATER)

Step 1. Check if stirrer motor is malfunctioning.
a. Check electrical connections to stirrer motor.
b. Check stirrer rod (may be bent) and propeller (may be missing).
c. Insure proper water circulation, correct applicable defect.

Step 2. Check for improper water level.
Add water as required up to overflow tube level.

Table 3-2. Troubleshooting - Continued

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

14. BATH DRAIN HAS BEEN OPENED BUT WATER DOES NOT RUN OUT

Step 1. Check for plugged drain or bent tube under trailer.
Check drain and tube. Make applicable corrections.

15. REFRIGERATOR WILL NOT RUN

Step 1. Check for blown fuse.
Replace fuse.

16. REFRIGERATOR COMPRESSOR CYCLES (INTERMITTENTLY)

Step 1. Check for low voltage.
Check line voltage, eliminate cause.

Step 2. Inspect for dirty condenser.
Clean condenser.

Step 3. Check loose electrical connection.
Check wiring.

17. REFRIGERATOR RUNS BUT DOES NOT COOLOR FREEZE TO PROPER TEMPERATURE

Step 1. Check for dirty condenser.
Clean condenser.

Step 2. Check if unit is too close to wall or to a heat emitting appliance.
Move out from wall, or to a cooler spot.

Table 3-2. Troubleshooting - Continued

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

18. REFRIGERATOR EVAPORATOR OR COILS WITH EXCESSIVE FROST BUILDUP

Step 1. Check for dirty condenser.
Clean condenser.

Step 2. Check if controls are set too high.
Set to lower number.

19. REFRIGERATOR COMPRESSOR RUNS CONTINUOUSLY

Step 1. Check if excessive heat in room, or too close to heat generating equipment.
Reduce heat or relocate.

Step 2. Check for improper ventilation.
Allow more air space or install cooling fan.

CHAPTER 4

ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

Section I. ORGANIZATIONAL TROUBLESHOOTING

4-1. GENERAL.

a. This section contains troubleshooting information for locating and correcting most of the operating troubles which may develop in the laboratory. Each malfunction for an individual component or apparatus is followed by a list of tests or inspections which will help you to determine the probable causes and corrective actions to take. You should perform the tests/inspections and corrective actions in the order listed.

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

4-2. REPAIR PARTS AND EQUIPMENT FOR THE LABORATORY ASSEMBLY .

Repair parts and equipment for the laboratory assembly will be requisitioned by standard nomenclature and stock number listed in the Department of the Army Supply Catalog.

4-3. GENERAL INSTRUCTIONS FOR USE OF MULTIMETERS.

a. Introduction. In electrical troubleshooting, the Simpson 160, the TS-352B/U, and the AN/URM-105 will do the same job. Therefore, your shop sets may contain any one of these multimeters (fig. 4-1). Any of these three multimeters can be used to troubleshoot your equipment's electrical system. This section shows how.

NOTE

The Simpson 160 is only available in new shop sets as a substitute for TS-352B/U or AN/URM-105.

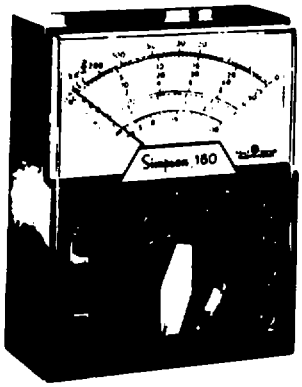
b. Using the Ohms Scale. The ohms scale is used to make tests for continuity, shorts and resistance.

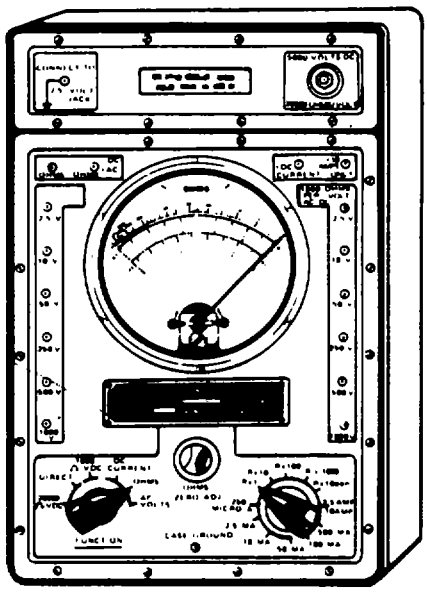
(1) “Zeroing" the Meter (fig. 4-2). The multimeter must be set up and "zeroed" before making these tests. Do the following steps that match the multimeter you have:

NOTE

If the needle will not "zero", replace the batteries. If the needle still will not "zero" after replacing the batteries, turn the meter in for repair.

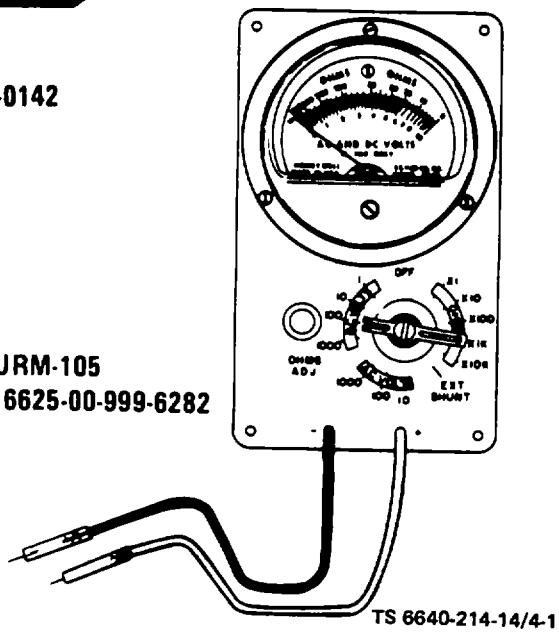
SIMPSON 160
NSN 6625-00-935-1333





TS-352B/U
NSN 6625-00-553-0142

AN/URM-105
NSN 6625-00-999-6282



TS 6640-214-14/4-1

Figure 4-1. Types of Multimeters

AN/URM-105

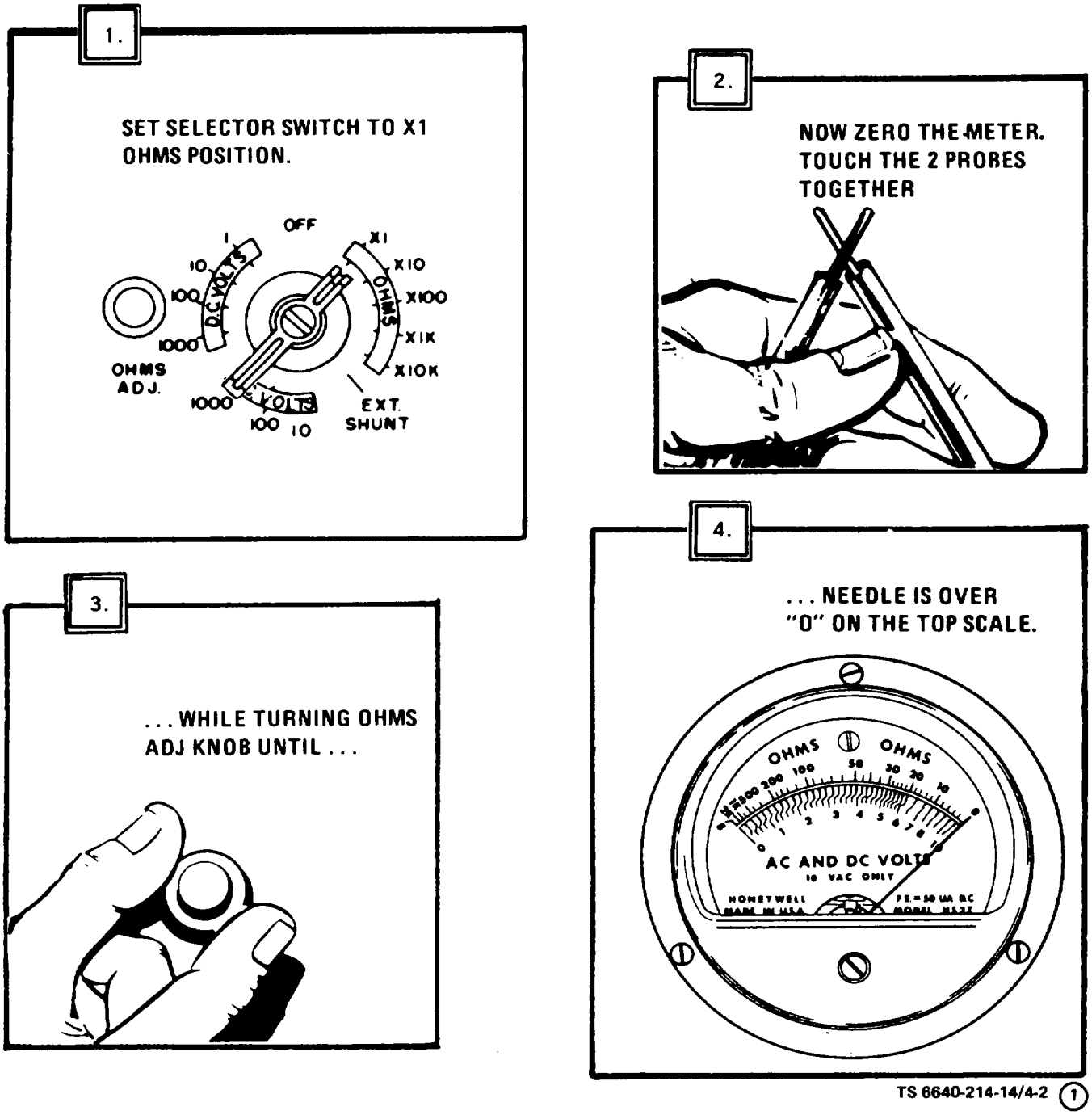


Figure 4-2. Zeroing the AN/URM-105 Meter (Sheet 1 of 3)

TS-352B/U

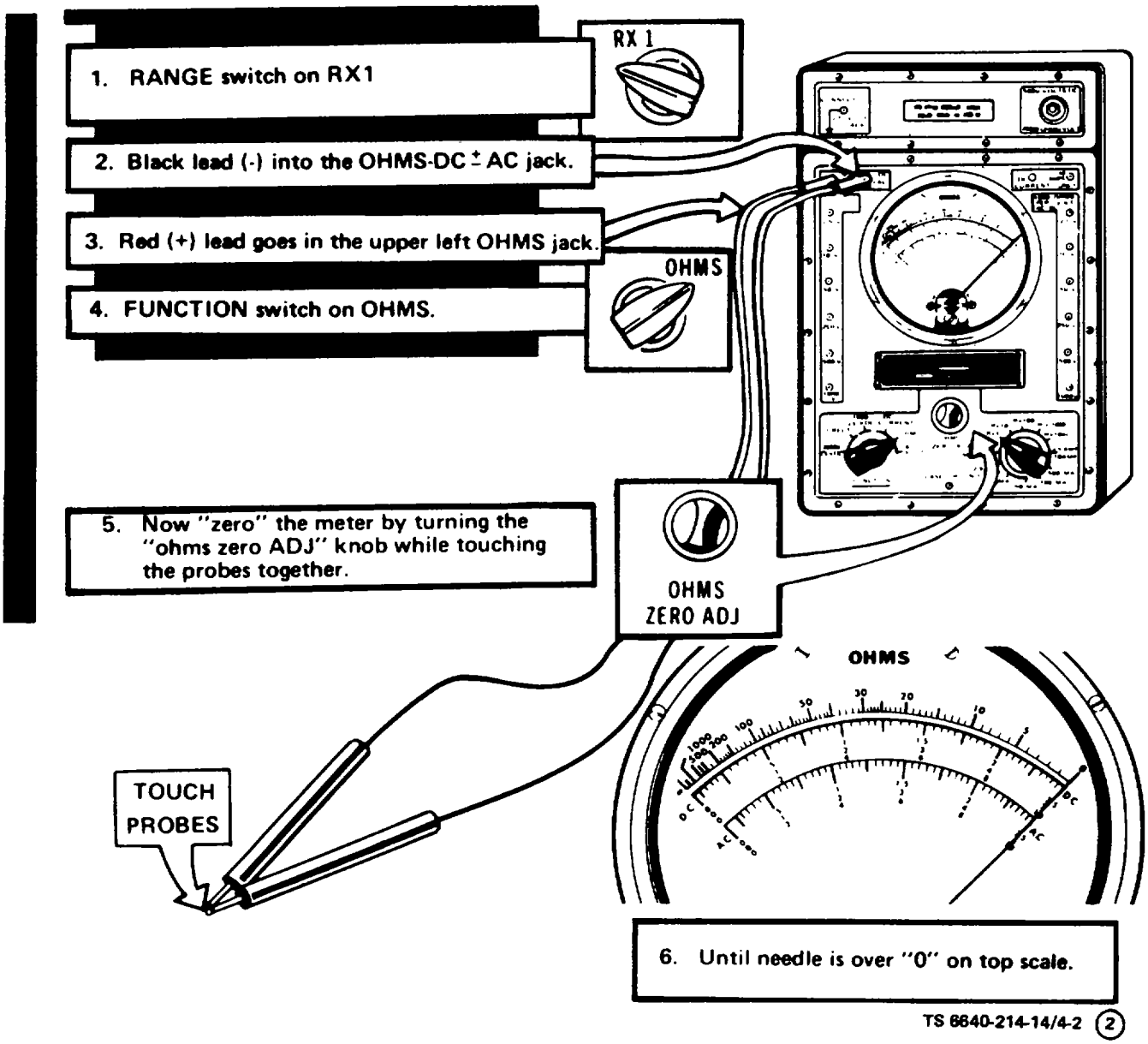


Figure 4-2. Zeroing the TS-352B/U (Sheet 2 of 3)

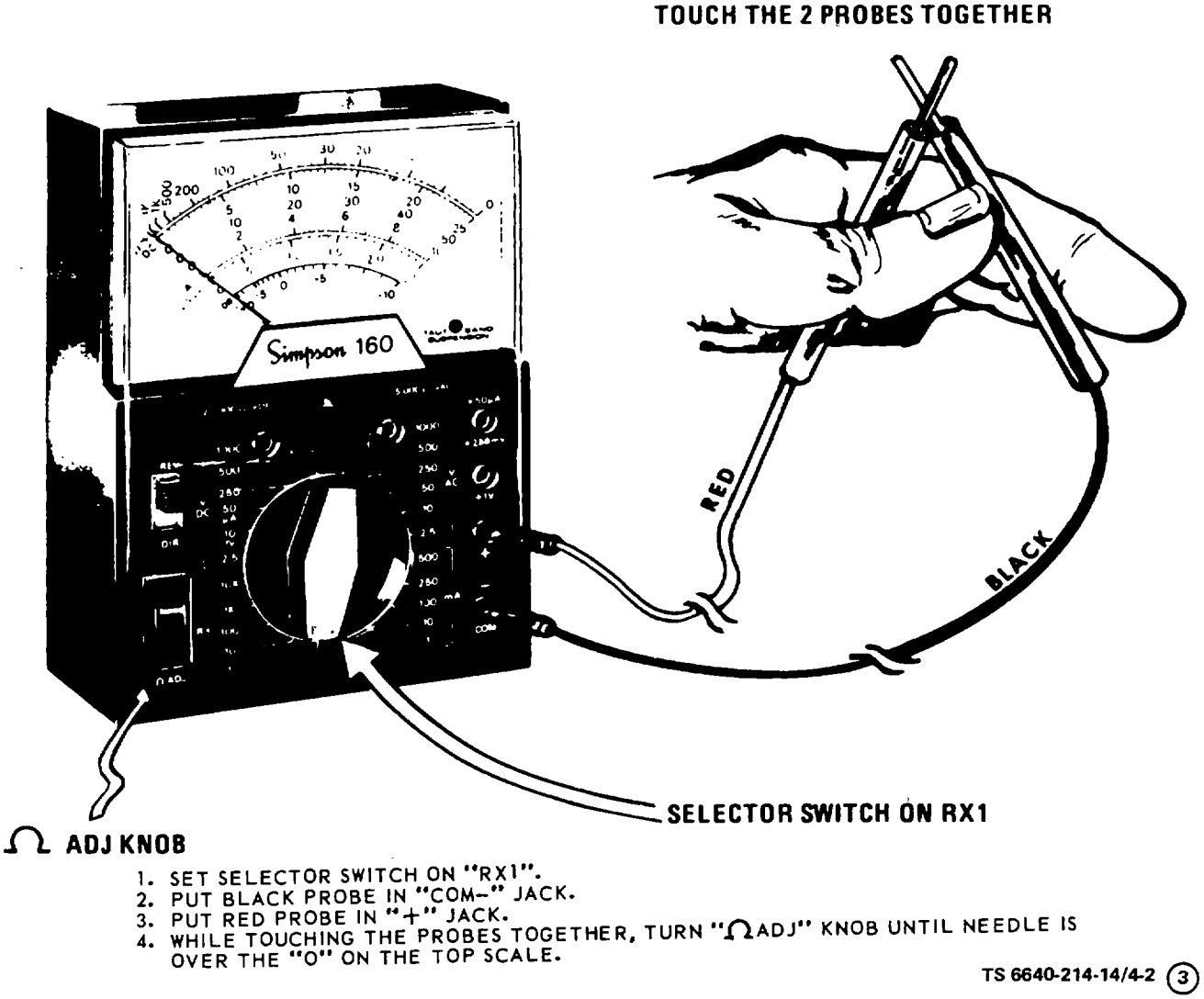


Figure 4-2. Zeroing the Simpson 160 (Sheet 3 of 3).

(2) Continuity Tests. Continuity tests are made to check for breaks in a circuit (such as the switch, light bulb, or electrical cable) (fig. 4-3). To make a continuity check, perform the following steps:

(a) Set up and "zero" the multimeter (fig. 4-2).

CAUTION

Failure to do the following steps can damage the multimeter.

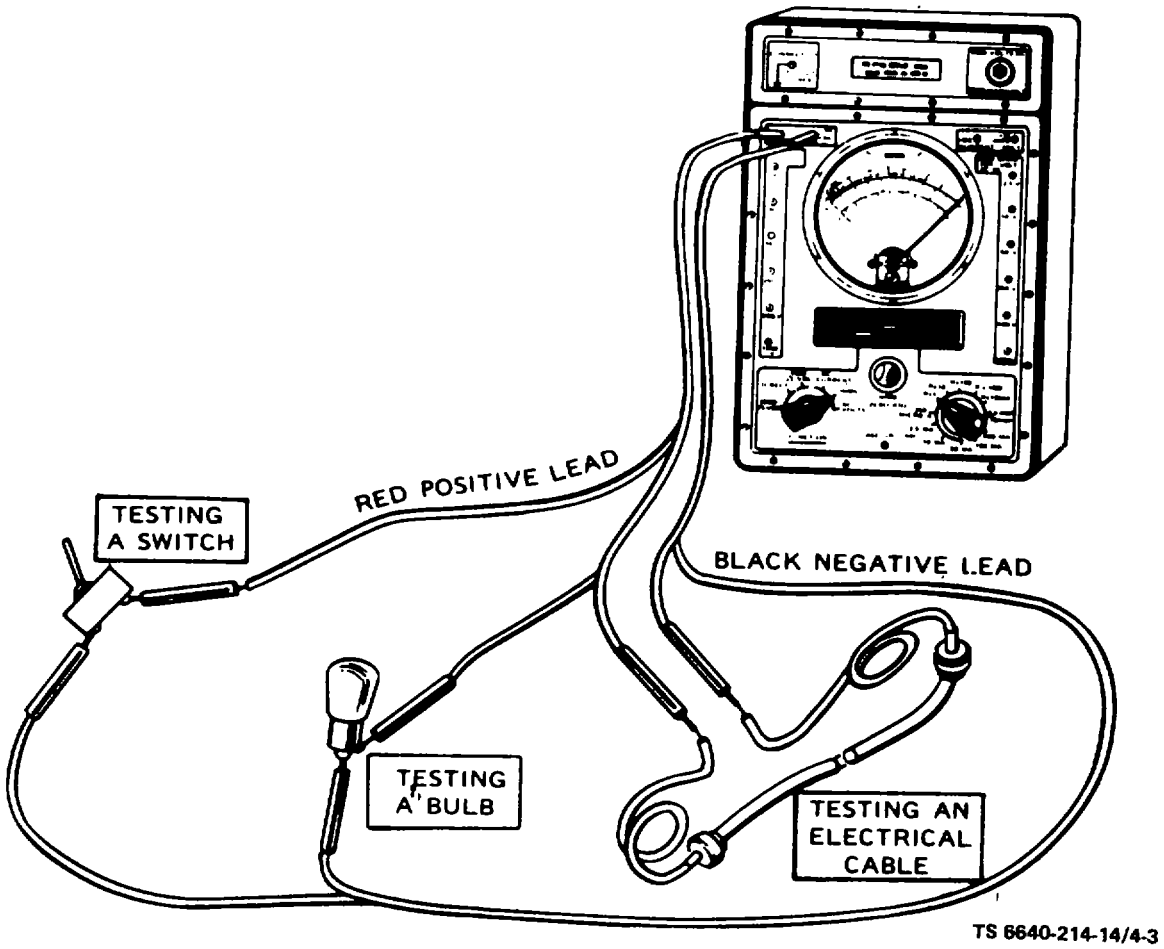


Figure 4-3. TS-352 Continuity Test

(b) Disconnect the circuit being tested.

(c) Connect the meter probes to both terminals of the circuit being tested. (The TS-352B/U is illustrated (fig. 4-3), but the probes are connected to the circuit the same way with all three multimeters.)

(d) Look at the meter needle.

1. If the needle swings to the far right over the "zero" on the top scale (on all three multimeters), the circuit has continuity.

2. If the needle doesn't move, the circuit is open (broken).

3. If the needle jumps or flickers, there is a loose connection in the circuit being tested.

(3) Testing for Shorts. A short (or short circuit) occurs when two circuits that should not be connected have metal-to-metal contact with each other. A short also occurs when a circuit that should not touch ground has metal-to-metal contact with ground. To check for shorts, do the following steps:

(a) Set up and "zero" the multimeter (fig. 4-2).

CAUTION

Failure to do the following steps can damage the multimeter.

(b) Disconnect the circuit being tested.

(c) With all three multimeters, connect one probe to one circuit and the other probe to the other circuit or ground (if checking for a short to ground). The example below (fig. 4-4) shows a check to see if wire "A" is shorted to wire "B" in the wiring harness.

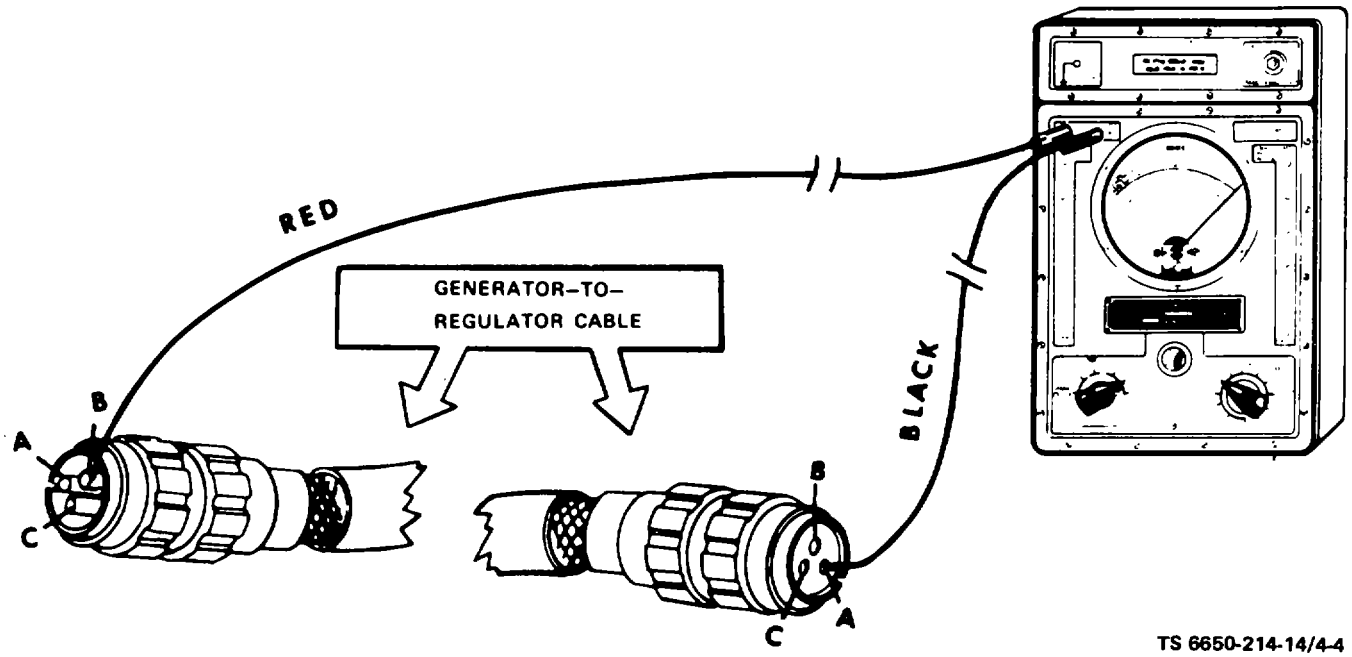


Figure 4-4. Testing for Shorts.

(d) Look at the needle.

1. If the needle swings to the far right over the "zero" on the top scale (on all three multimeters), the circuits are shorted.

2. If the needle doesn't move, the circuits are not shorted.

3. If the needle jumps or flickers, the circuits are occasionally shorted.

(4) Testing Resistance. To measure resistance in a circuit, do the following steps:

(a) Set up and "zero" the multimeter (fig. 4-2).

CAUTION

Failure to do the following steps can damage the multimeter.

(b) Disconnect the circuit being tested.

(c) If the test in this manual calls for an "ohms range" different than "RX1" or X1", set the selector switch to that range (such as "RX10" or "X10").

NOTE

"Zero" the meter whenever you change range.

(d) With all three multimeters, connect the probes across the circuit or item to be measured. The example (fig. 4-5) shows measuring the resistance of a temperature sending unit.

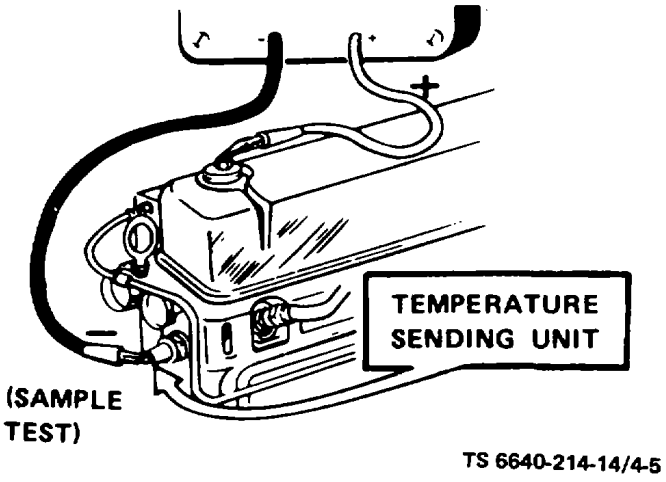


Figure 4-5. Testing Resistance

(e) Read the meter (fig. 4-6). If the meter switch is on the "RX1" or "X" range, the reading is taken directly from the top scale If the meter switch is on a different range, multiply the reading on the scale according to the table below:

Ohms Switch Setting	
X1 or RX1	Read number on scale
X10 or RX10	Multiply reading by 10
X100 or RX100	Multiply reading by 100
X1K or RX1K	Multiply reading by 1000
X10K or RX10K	Multiply reading by 10,000

Remember: K=1000

c. Using the DC Volts Scale (fig. 4-7). The dc volts scale is used to measure all voltage on the equipment except the 115 ac and 220 ac voltage.

(1) Before using the multimeter to measure dc voltage, do the following steps that match the multimeter you have:

(a) AN/URM-105. Set meter switch to dc volts range given in TM (To measure 24 volts dc, set switch on "100 dc VOLTS" range).

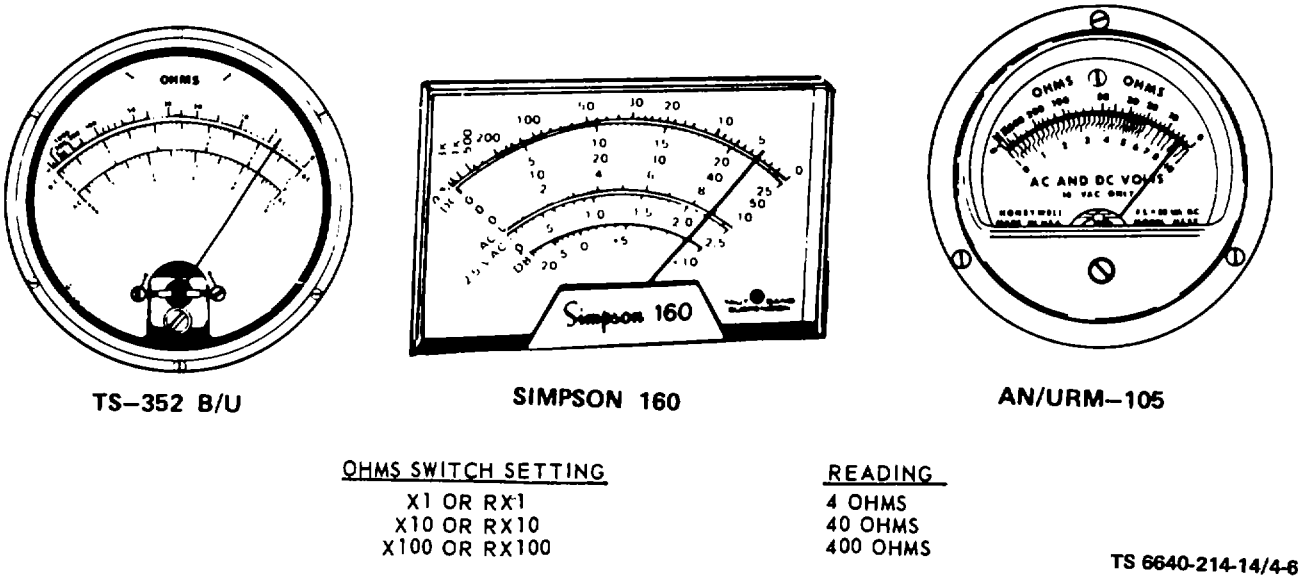


Figure 4-6. Reading the Ohm Scale.

1. Set FUNCTION switch to "DIRECT". (RANGE switch can be at any position).

2. Put black lead in "DC/+AC/UHMS" jack.

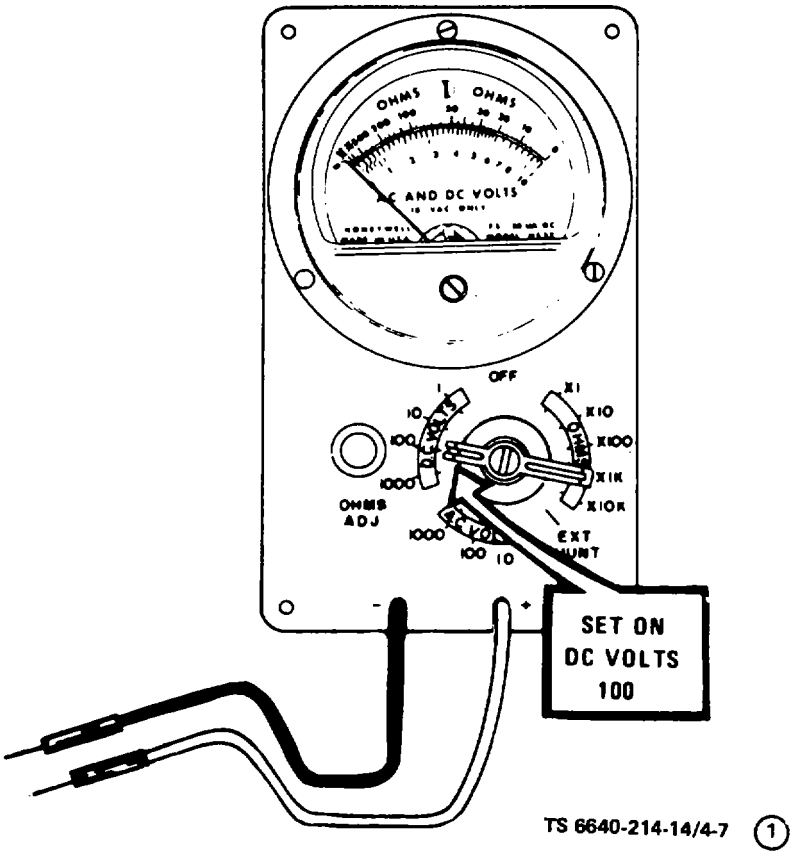


Figure 4-7. DC Volts Scale (AN/URM-105) (Sheet 1 of 3).

3. To measure 24 volts dc, plug red lead into "50V" jack on left side of meter. (If measuring less than 10 volts dc, use "10V" jack. If measuring less than 2.5 volts dc use 2.5V jack.)

(b) Simpson 160.

1. Connect black lead to "COM-" jack.

2. Connect red lead to "+" jack.

3. To measure 24 volts dc, set selector switch to "V/DC 50" position. (If measuring less than 10 volts dc, set selector switch to "V/DC 10" position. If measuring less than 2.5 volts, dc, set selector switch to "V/DC 2.5" position).

4. Set polarity reversing switch to the "+dc" position.

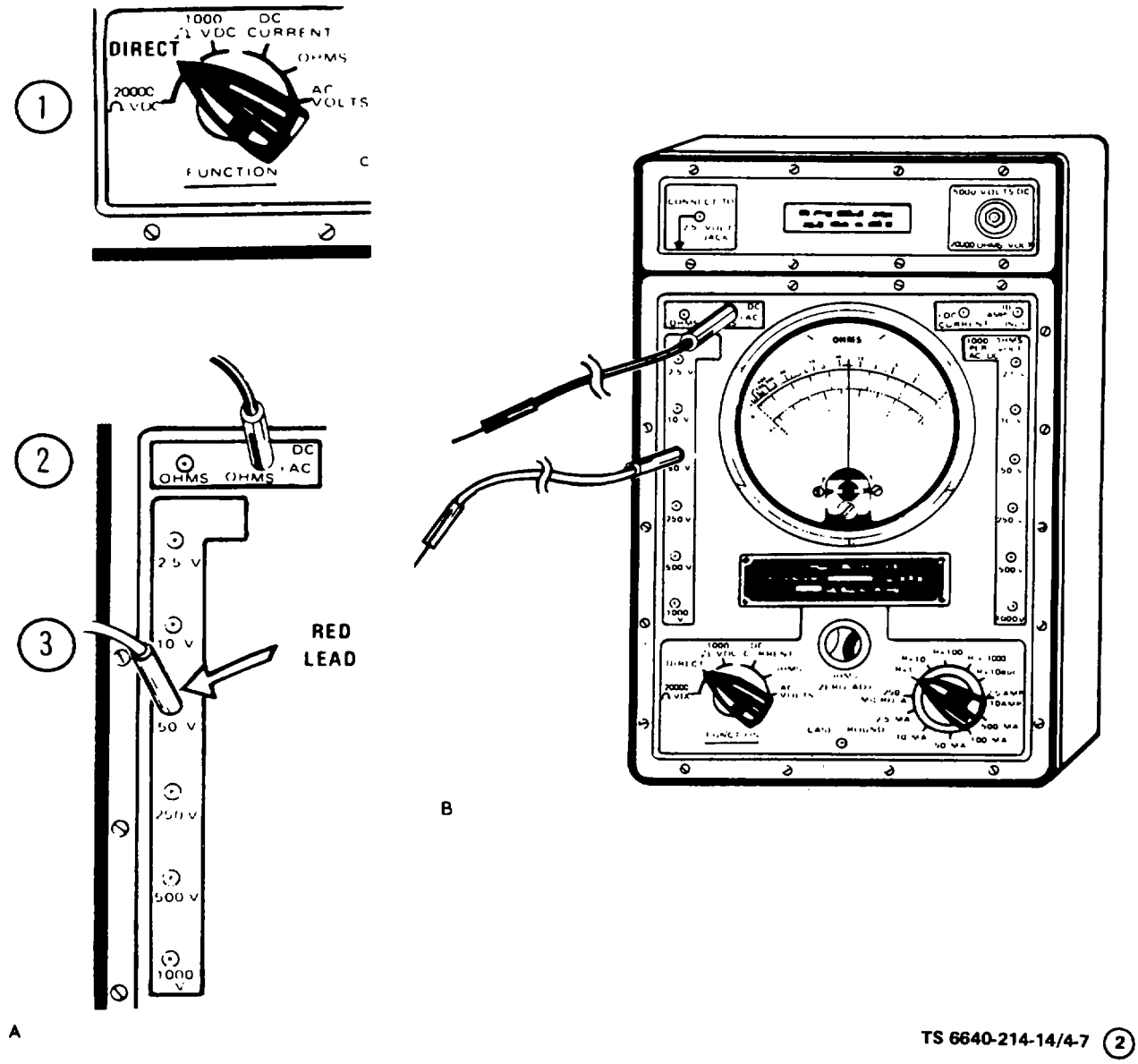


Figure 4-7. DC Volts Scale (TS-352B/U) (Sheet 2 of 3).

(2) To measure dc volts, do the following steps:

(a) Set up multimeter (para 1 above).

If you are unsure of the voltage to be measured on the equipment, always start on the highest range. This will protect the meter.

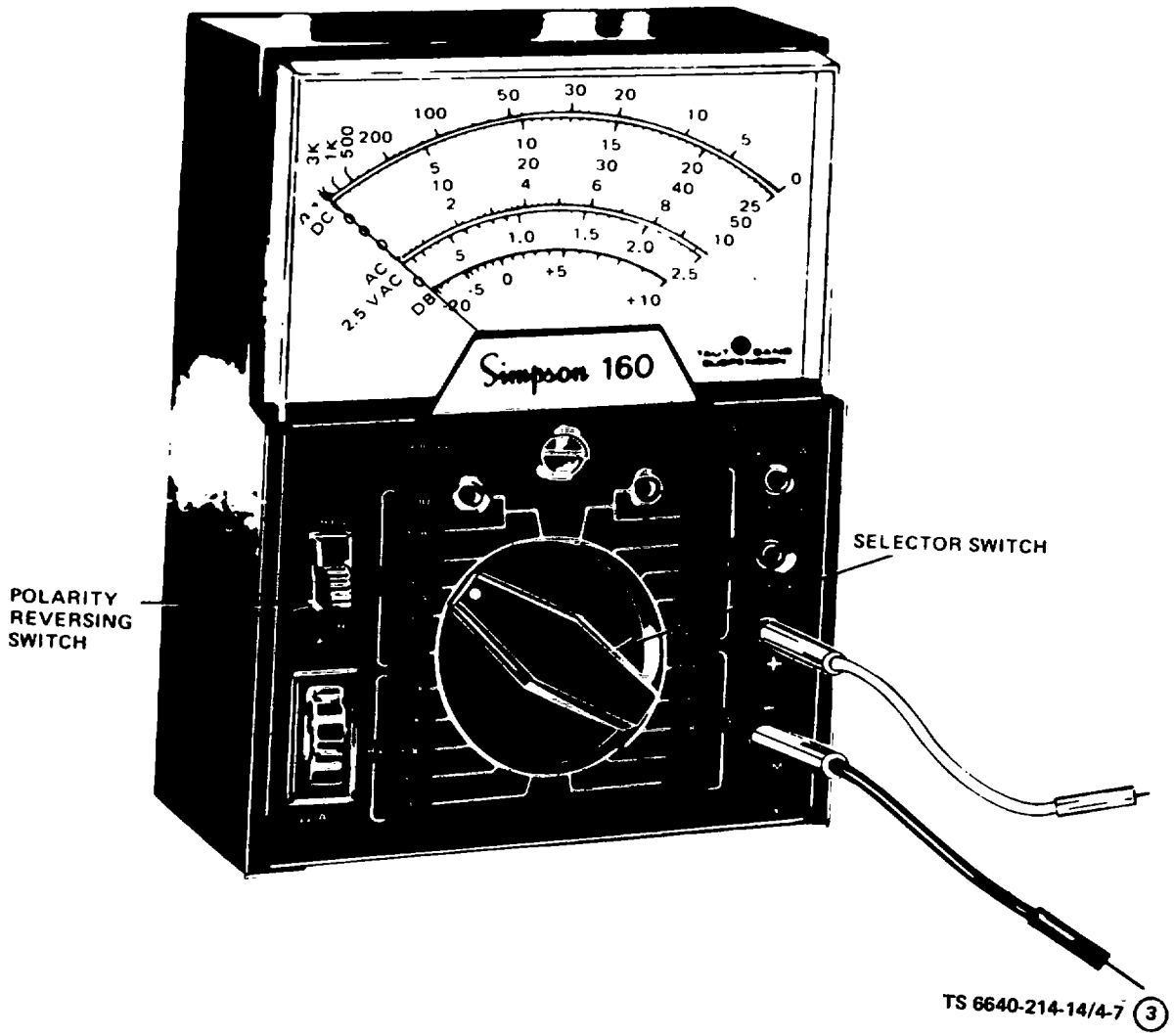


Figure 4-7. DC Volts Scale (Simpson 160) (Sheet 3 of 3)

(b) With all three multimeters, connect the red probe to the positive (+) side of the circuit and the black probe to the negative (-) side. The example (fig. 4-8) show 24 volts dc being measured across the batteries.

(c) Read the Meter. (The examples (figs. 4-9, 4-10 and 4-11) show how to read all three multimeters.) If the needle tries to move off scale to the left, reverse the probes on the circuit.

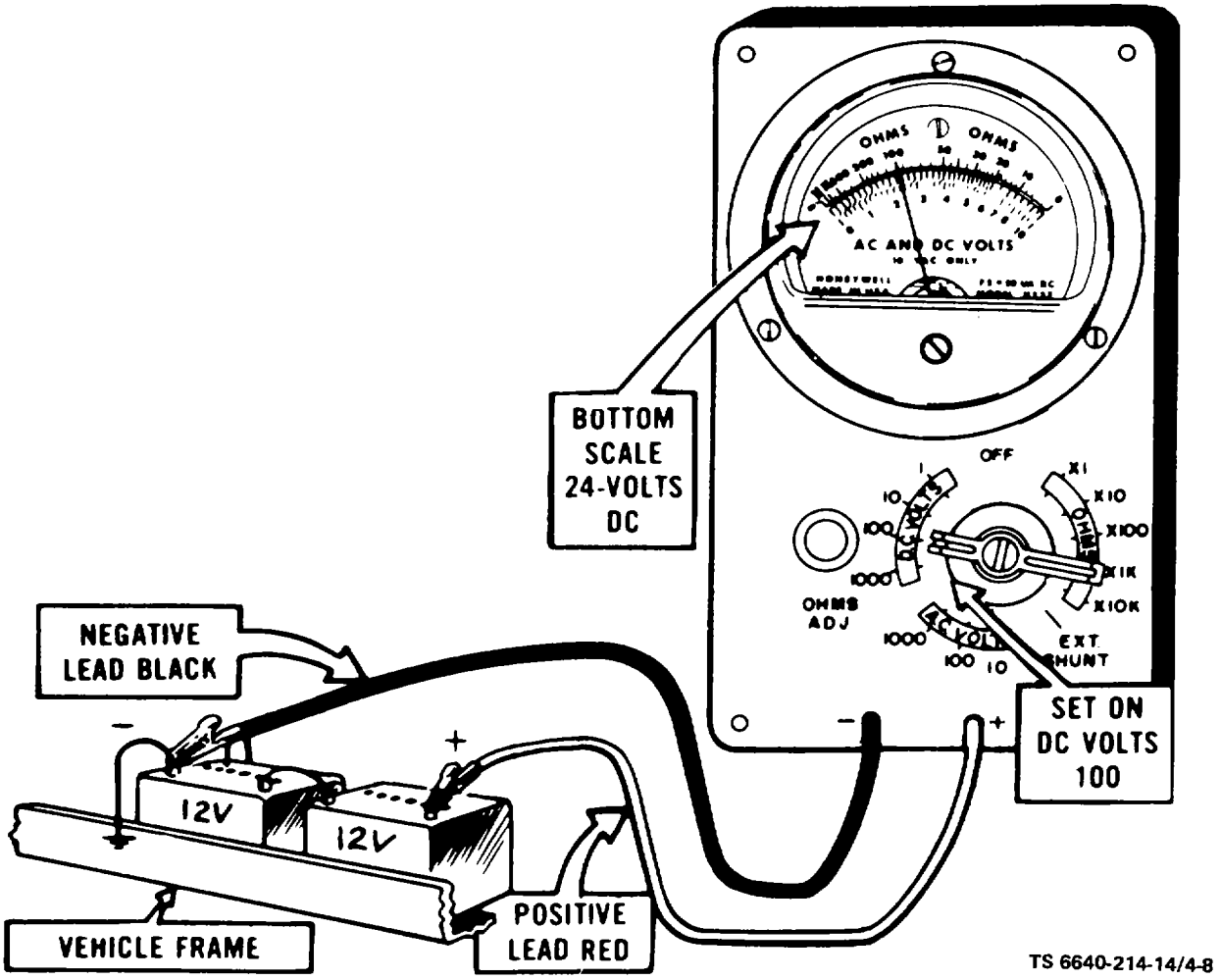


Figure 4-8. Measuring DC Voltage.

1. Simpson 160. Read the "dc" volts scale for the range the selector switch is set at.

Switch Setting	Scale
V/DC 50	0-50
V/DC 10	0-10
V/DC 2.5	0.25 (and divide by 10)

Thus the meter (fig. 4-9) is showing the following readings.

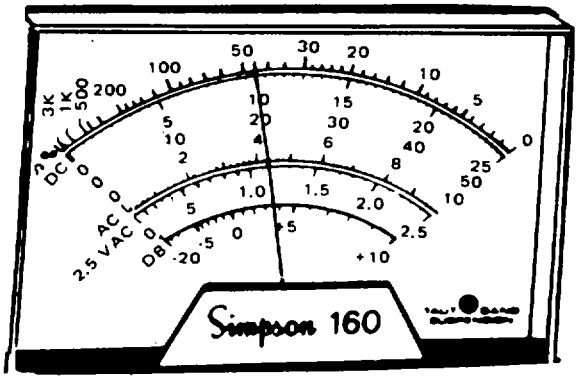


Figure 4-9. Reading DC Voltage (Simpson 160).

2. TS-352B/U. Read the "dc" volts scale for the range the red lead is plugged in at.

3. AN/URM-105. Read the upper, black, straight-lined portion of the "ac and dc volts" scale for the range the selector switch is set at.

Range	Scale
50V	0-5 (and multiply by 10)
10V	0-10
2.5V	0-2.5

Thus the meter (fig. 4-10) is showing the following reading:

Switch Setting	Scale
1000 DC Volts	0-10 (and multiply by 100)
100 DC Volts	0-10 (and multiply by 1-10)
10 DC Volts	0-10
1 DC Volt	0-10 (and divide by 10)

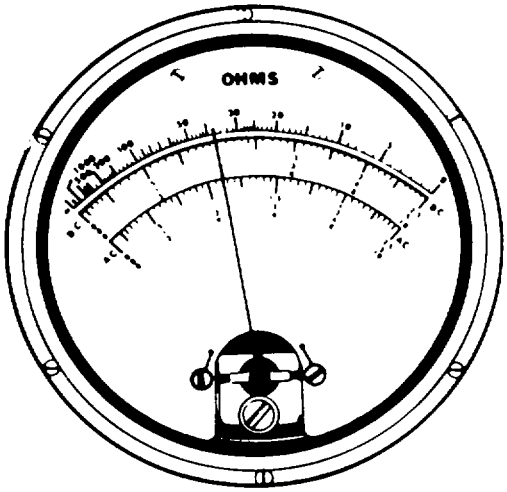


Figure 4-10. Reading DC Voltage (TS-352B/U).

Thus the meter (fig. 4-11) is showing the following readings:

Switch Setting	Reading
100 DC VOLTS	20 VOLTS DC
10 DC VOLTS	2 VOLTS DC
1 DC VOLT	.2 VOLTS DC

d. Using the AC Volts Scale. The ac volts scale is used to measure the 115 ac voltage found in the control panel.

(1) Before using the multimeter to measure 115 ac or 220 ac voltage, do the following steps that match the multimeter you have.

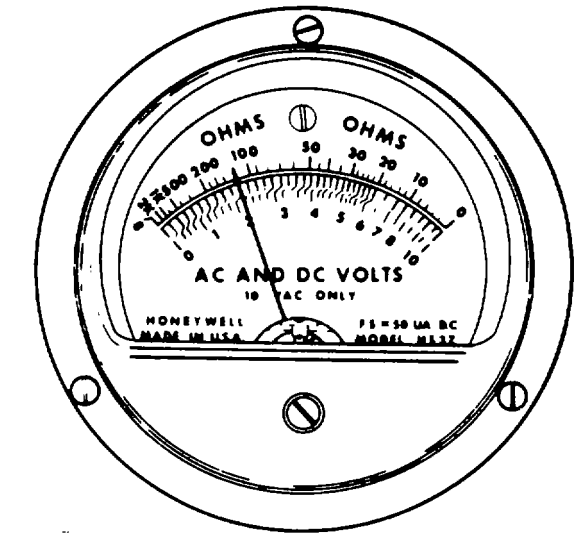
(a) AN/URM-105. Set meter switch to "1000 AC Volts" (fig. 4-12).

(b) TS-352B/U.

1. Set "FUNCTION" switch to "AC Volts" ("Range" switch can be at any setting) (A, fig. 4-13).

2. Put black lead in "-DC/+AC/OHMS" jack (B, fig. 4-12).

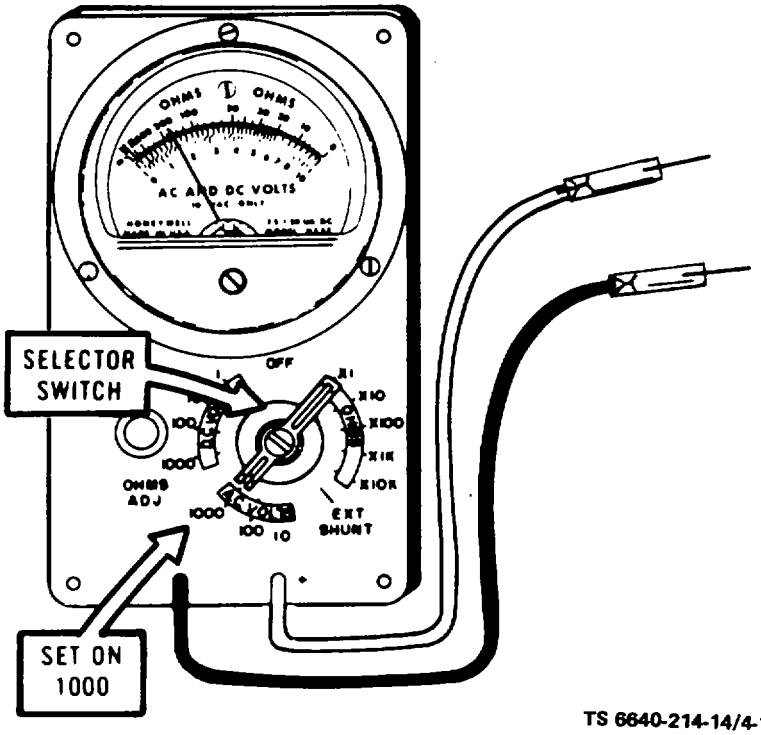
3. Put red lead in "250V" jack on right side of meter.



SWITCH SETTING	READING
100 DC VOLTS	20 VOLTS DC
10 DC VOLTS	2 VOLTS DC
1 DC VOLT	.2 VOLTS DC

TS 6640-214-14/4-11

Figure 4-11. AC Volt Scale (AN/URM-105).



TS 6640-214-14/4-12

Figure 4-12. AC Volt Scale (TS-352B/U).

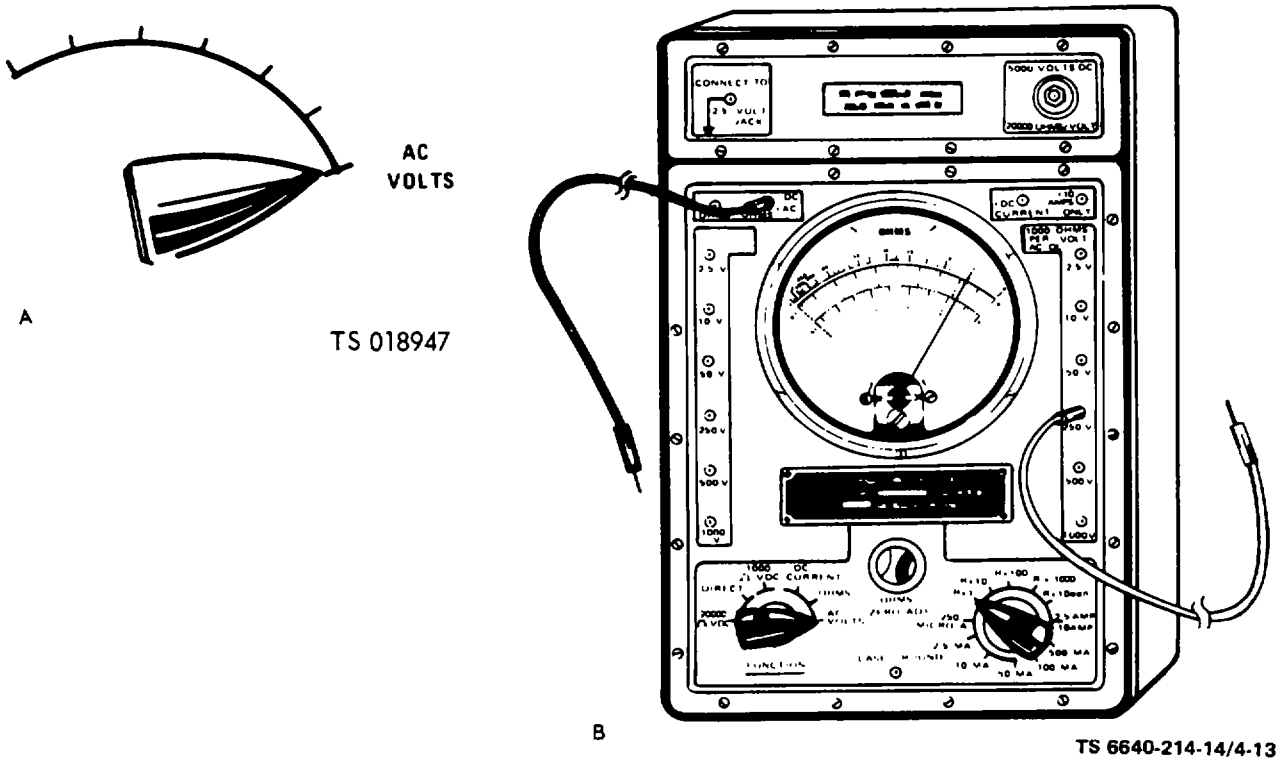


Figure 4-13. AC Volt Scale (TS-352B/U)

(c) Simpson 160 (fig. 4-14).

1. Put black lead in "COM-" jack.

2. Put red lead in "+" jack.

3. Set selector switch to "V/AC 250" position.

(2) To measure 115 ac voltage, do the following steps:

(a) Set up multimeter (fig. 4-15).

(b) With all three multimeters, connect one probe to one side of the circuit and the other probe to the other side. The example (fig. 4-15) shows 115 volts ac being measured across an ac light circuit.

(c) Read meter on the "ac" scale. Figure 4-16 shows a reading of 115 volts on all meters.

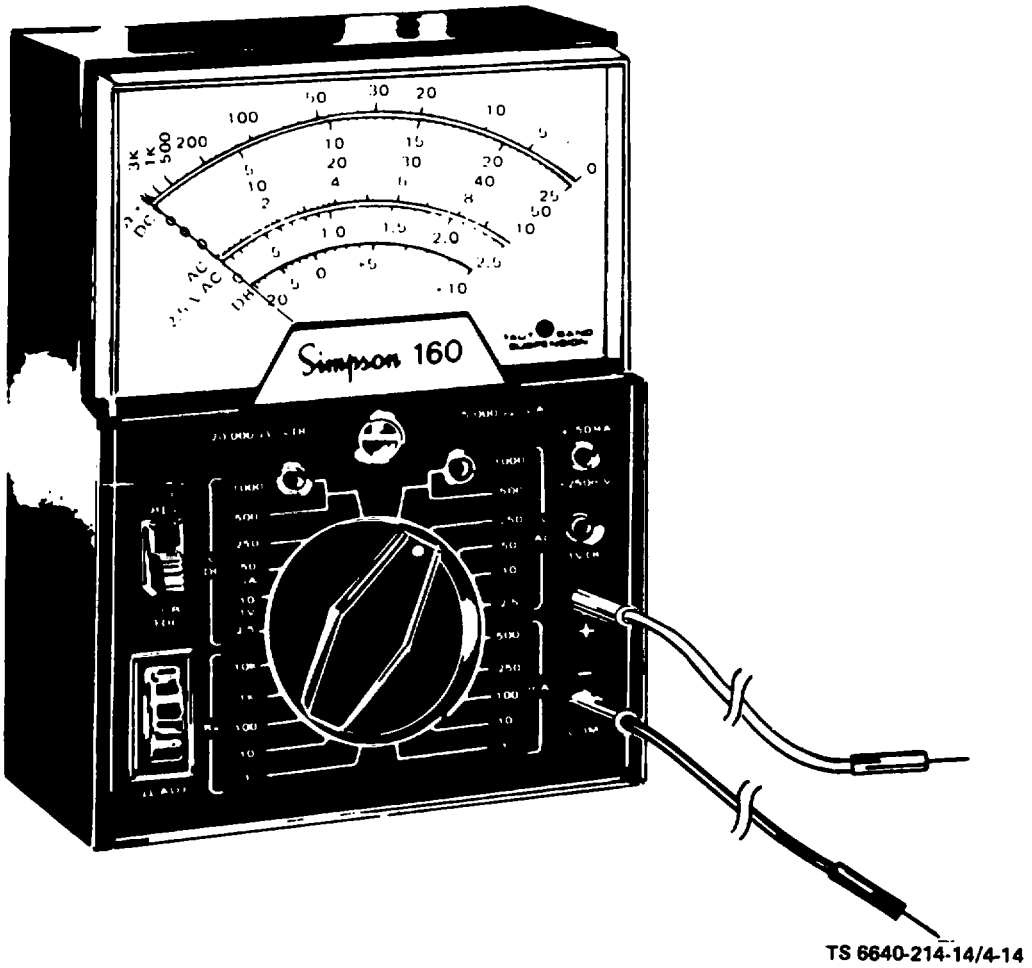


Figure 4-14. AC Volt Scale (Simpson 160)

4-3. OVEN.

a. Cleaning. Use a clean cloth and a mild soap and water solution to clean the interior and exterior when the oven has cooled.

b. Troubleshooting. The operator should be guided by the Oven Troubleshooting Chart (table 4-1) in diagnosing and correcting operating difficulties.

c. Replacement Procedures. Procedures for replacing the thermostat, heater bank, and pilot light and switch in the oven are as follows:

(1) Thermostat.

(a) Remove the screws and saddle clamps which hold the sensing bulb of the thermostat in place on the bottom of the working chamber.

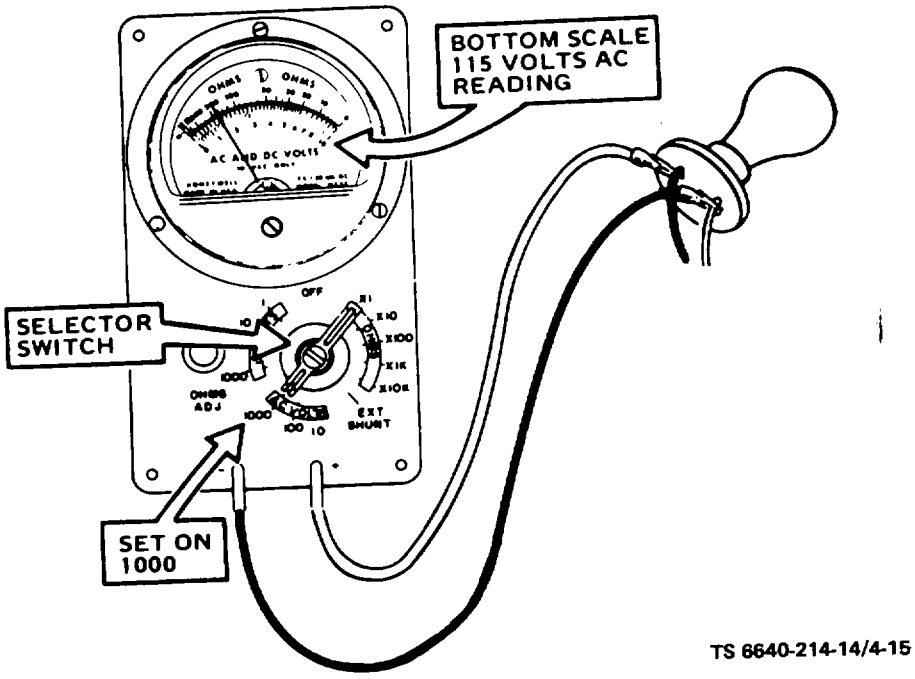


Figure 4-15. Measuring AC Voltage.

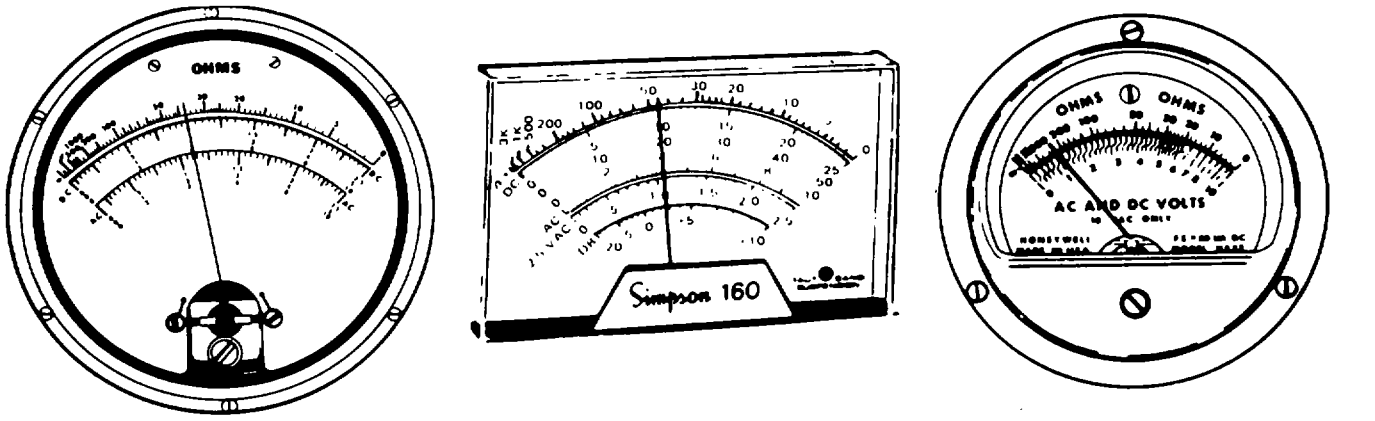


Figure 4-16. Reading AC Voltage.

Table 4-1. Oven Troubleshooting Chart

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
1. HEAT LOSS
Step 1. Check for a faulty door gasket. If defective, replace gasket.
Step 2. Check for improperly positioned door strike. Adjust door strike for tighter closure.
2. TEMPERATURE VARIES (VENT CLOSED)
Step 1. Check for an improperly loaded oven. Test oven empty.
Step 2. Check to see if hot oven is stabilized. Allow 1 to 2 hours for oven to stabilize.
Step 3. Inspect for faulty electrical connection. Check all electrical lines and connections.
Step 4. Check for partial failure of components. Replace faulty switch, thermostat, heaters, or wiring as required.
3. NO HEAT
Step 1. Check for loss of power. Check line voltage and connections. Check heaters and thermostat.
4. LOSS OF HEAT (CONTROL)
Step 1. Check if thermostat contacts are sticking. Replace thermostat.
Step 2. Check heater for short. Correct short or replace heater.

(b) Carefully erect the sending bulb to a position perpendicular to the diffuser panel. Pull off the reference dial.

(c) Lay the cabinet on its side.

(d) Remove the screws securing the thermostat to the rear of the oven control panel and disconnect the electrical connections to the thermostat.

(e) Withdraw the thermostat capillary out through the bottom of the working chamber.

(f) Install the replacement thermostat in the reverse order of the above steps.

CAUTION

Do not crimp or sharply bend the capillary tubing.

(2) Heater bank.

(a) Remove the screws and saddle clamps which hold the sensing bulb of the thermostat in place on the diffuser panel on the bottom of the working chamber.

(b) Carefully erect the sensing bulb to a position perpendicular to the diffuser panel.

(c) Lay the cabinet on its back and withdraw the capillary from the inside of the working chamber out through the bottom of the working chamber.

CAUTION

Do not crimp or sharply bend the capillary tubing.

(d) Stand the oven in an upright position and lift out the diffuser panel. Disconnect the electrical connections from the three bus bars of the heater bank.

(e) Remove the four screws securing the heater to the bottom of the oven, and lift out the heater assembly.

(f) Install the replacement heater in the reverse order of the above steps.

(3) Pilot light and switch. If it becomes necessary to replace the pilot light or switch, lay the oven on its side. Compress the spring clips at each side of the switch and push out through the front of the oven. Disconnect wires from the defective part. Make

the electrical connections, and insert the replacement. If further service is required on the oven, contact the local laboratory supply distributor, local representative of the manufacturer, or the technical service department of the manufacturer for further assistance. DO NOT return the oven for repair or service without first contacting the proper parties for shipping instructions. Service and repair parts are available through the distributor of the manufacturer's products. Mention the serial number and the catalog number of the oven on all correspondence.

4-4. MANOMETER.

WARNING

Mercury is a poisonous material which may enter the body by ingestion, inhalation, or skin absorption. Mercury has such density, high surface tension, and low viscosity that pouring without splashing and spilling is almost impossible. When mercury is poured, always use a funnel and make the transfer over spill trays. If a mercury spill occurs, do not vacuum or sweep the area. This will disperse mercury throughout the laboratory. Spills may be cleaned up by using a glass tube of about 1 mm and connected by rubber tubing to a filter flask connected with a vacuum pump or aspirator, the flask acting as a trap. Control of mercury vapor should not be attempted with Flowers of Sulfur as this is not effective. Spills must be reported to the Environmental Science Officer providing services to the unit.

WARNING

Most cleaning solvents are hazardous. Avoid prolonged skin contact and breathing of vapors. Check container label for warning.

a. Cleaning. The normal maintenance necessary with the manometer is an occasional cleaning of the glass tube, where deposits of oxidized mercury have collected on the interior surface. Drain the mercury and remove the top and bottom plugs on the tube. A suitable brush with either naphtha or acetone moved rapidly up and down in the tube will clean the tube efficiently.

NOTE

Refill the manometer reservoir with clean mercury. See paragraph 2-31 for instructions on filling reservoir.

b. Troubleshooting. The operator should be guided by the following chart (table 4-2) in diagnosing and correcting operating difficulties.

Table 4-2. Manometer Troubleshooting Chart

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
1. NO PRESSURE (READING) Step 1. Check if pressure is not being applied to either or both sides of the instrument. Check for plugged or leaking pressure lines. Make applicable correction. Step 2. Inspect atmospheric pressure connection for proper venting to atmosphere. Make applicable correction to ensure proper venting. Step 3. Check for foreign particles in internal passages of the meter which are blocking the flow. Remove mercury from meter and check internal passages for foreign particles. Clean instrument as required.
2. HIGH OR LOW PRESSURE READING Step 1. Check for leaks or obstructions. Locate leaks or obstructions, make applicable connections. Step 2. Check tubing and/or mercury for foreign matter. Disassemble and clean instrument, replace mercury. Step 3. Check for improper zero setting. Check zero setting. Make proper adjustment.

4-5. VACUUM PUMP.

a. Lubrication.

(1) Motor. Lubricate monthly with engine crankcase lubricating oil.

(2) Vacuum pump. Remove the top plate and fill with vacuum oil supplied with the pump until it is slightly above oil level (approximately 3 quarts) as indicated in window on the side of the pump. In operation, the oil should be even with or slightly above the oil level as indicated in the window. If sufficient oil is not used, a good seal around the vanes may not be maintained. If too much oil is used, oil may back through the pump trap into the vacuum' line. The oil supplied with the pump is specially prepared for high vacuum work. For maximum pumping speeds at low pressure, no other oil should be used. After the oil is changed, the pump must run for some time on a closed system before lowest pressure is obtained.

b. Before Operation Service.

(1) Make sure that the vacuum pump motor is lubricated and the vacuum pump is properly filled with oil.

(2) Make certain all vacuum pump fittings are perfectly sealed.

(3) Check the condition of vacuum pump drivebelt; make sure the belt is not too tight or too loose; check belt pulleys. See paragraph d. (3) below.

(4) Check all vacuum pipe connections for tightness.

c. During Operation Service.

(1) Check the oil level of vacuum pump after pump has been running for at least 15 minutes. The oil level should be maintained between the oil level marks when the pump is in operation.

(2) Check the vacuum pump motor for overheating.

(3) Check the vacuum pipe connections and fittings for vacuum leaks.

(4) Check the vacuum pressure gage on the control panel.

d. After Operation Service.

(1) If the oil level of the vacuum pump is low, fill to the proper level .

(2) Correct any vacuum leaks found during operation.

(3) Periodically, the V-belt should be adjusted so that a firm downward pressure at the middle of the span will cause a deflection of one-half to three-fourths inch (1.27 cm to 1.91 cm).

e. Air Removal and Cleaning.

(1) Turn off the pump.

(2) Remove the intake cover and lift out the air filter.

(3) Tap the filter on a clean disposable surface to remove solid particles. If necessary, rinse thoroughly in clean acetone, followed by a rinse in clean alcohol and then a rinse in distilled water. Dry in a stream of hot, dry air.

(4) Replace the filter.

(5) Varnish both sides of the new intake cover gasket and mount in position when varnish is tacky.

(6) Replace the intake cover and tighten screws evenly.

f. Troubleshooting. The operator should be guided by the following chart (table 4-3) in diagnosing and correcting operating difficulties.

Table 4-3. Vacuum Pump Troubleshooting Chart

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
1. INSUFFICIENT VACUUM PRESSURE
Step 1. Check low oil level.
Fill pump to prescribed level.
Step 2. Check for leakage in line.
Locate leak and repair line.
Step 3. Check if motor is functioning properly.
Check wiring for shorts or loose connections.
Check drivebelt for tightness. Correct condition.

4-6. REPAIR PARTS, SPECIAL TOOLS AND EQUIPMENT.

Repair parts and equipment for the laboratory assembly will be requisitioned by standard nomenclature and stock number listed in the Department of the Army Supply Catalog.

CHAPTER 5

DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

Section I. REPAIR PARTS, SPECIAL TOOLS AND EQUIPMENT

WARNING
Assure gas supply is shut off at the source before disconnecting lines on cabinets.

5-1. SPECIAL TOOLS AND EQUIPMENT.

There are no special tools or equipment required for maintenance of the laboratory.

5-2. MAINTENANCE REPAIR PARTS.

Repair parts and equipment covering direct and general support maintenance of the laboratory are listed in Appendix C.

Section II. TROUBLESHOOTING

5-3. SCOPE.

a. This section contains repair, adjusting and troubleshooting information and tests for locating and correcting most troubles which may develop for items which require direct support and general support maintenance.

b. This manual cannot list all possible malfunctions that may occur, or all tests, inspections, and corrective actions. If a malfunction is not listed, or is not corrected by listed corrective actions you should notify higher level maintenance.

5-4. AIR COMPRESSOR.

Refer to table 5-1 for troubleshooting procedures for the air compressor.

5-5. MUFFLE FURNACE.

a. Cleaning. Clean the steel tray and the chamber interior, using a clean cloth and mild soap and water solution.

b. Removal and Replacement Procedures. Procedures for removing and replacing the muffle unit in the muffle furnace are as follows:

Table 5-1. Air Compressor Troubleshooting Chart

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
1. COMPRESSOR PUMPING OIL
Step 1. Check for clogged intake filter. Change filter element.
2. KNOCKS OR RATTLES
Step 1. Check for loose, damaged belts or pulleys. Tighten or replace belt or pulley.
Step 2. Check for leaking valves or restricted air passages. Fix leaks, or clean blocked air passages.
3. AIR DELIVERY DROPPING
Step 1. Check for clogged intake filter. Change filter element.
4. EXCESSIVE STARTING AND STOPPING OF AIR COMPRESSOR
Step 1. Check for water in receiver tube. Remove power from air compressor, and drain the air receiver tank, when the air has escaped leave draincock open for a few minutes to allow condensation to escape. Close draincock, apply power and recheck operation.
Step 2. Check if air leaks in the piping. Make a solution of soapy water and apply to fittings. If a leak is present it will be indicated by the soapy water bubbling. If leak is found, try tightening fitting. If leak is not corrected, refer to higher maintenance.

Table 5-1. Air Compressor Troubleshooting Chart - Cont

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

5. COMPRESSOR RUNNING HOT

Step 1. Check for blockage of air to fan wheel.
Remove any object that is blocking the air passage.
Clean up and remove any accumulated dust or dirt.

6. COMPRESSOR RUNNING SLOW

Step 1. Check for Low line voltage, or a defective motor starter heater.
Correct line voltage if low, or tighten loose connections.

Step 2. Check for a leaking release valve.
Replace a leaking release valve.

(1) Removal of burned out muffle.

(a) Remove three screws (1, fig. 5-1) from sides of the case and remove the backplate (2).

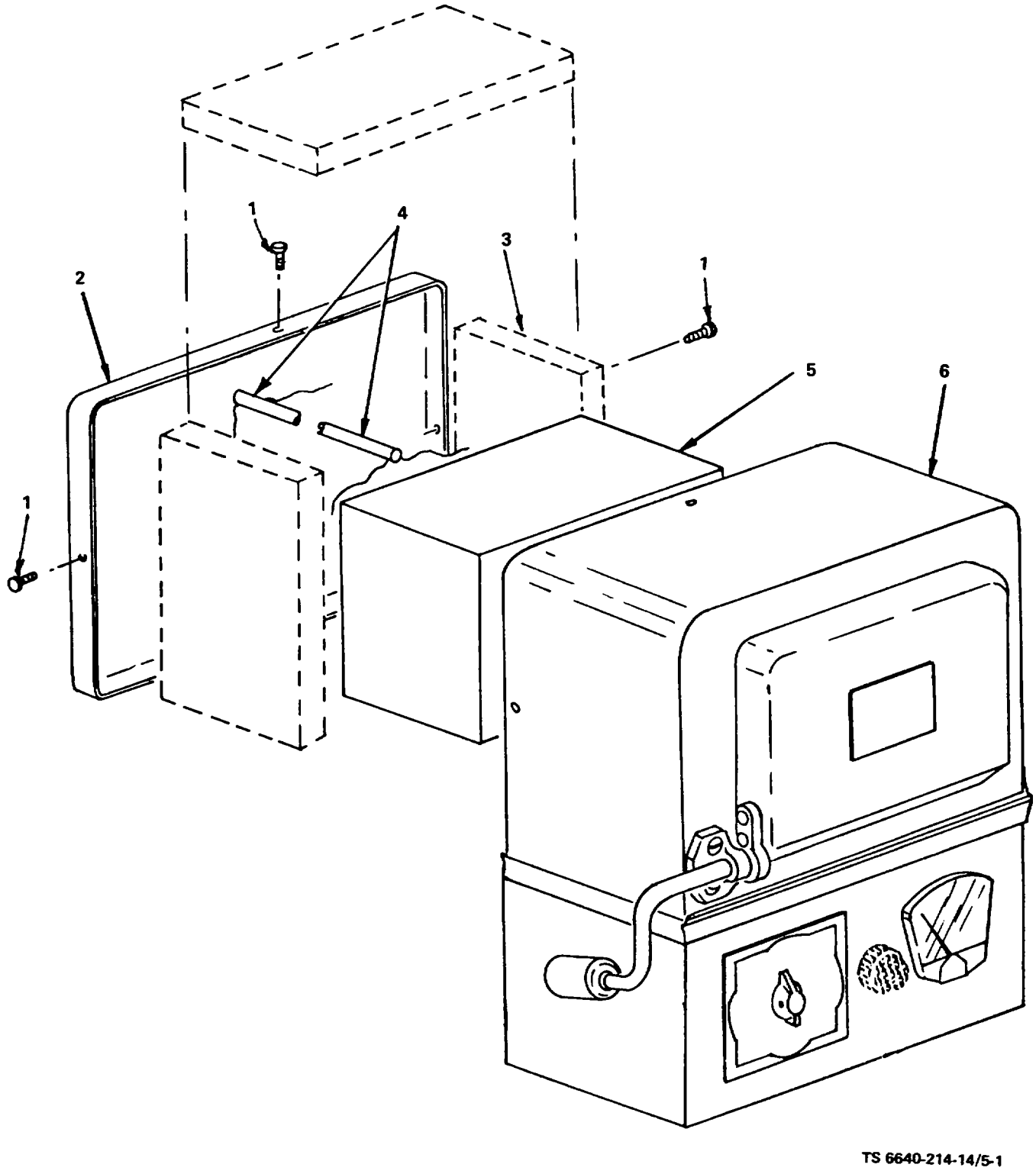
(b) Remove loose insulation blocks (3).

(c) Lay the furnace (6) on its face. Remove the thermocouple (4) from the instrument, marking each wire to which terminal wire goes. Withdraw the thermocouple (4) from the hole. Remove the metal air vent from the hole.

(d) Remove the nuts and the wires from the muffle terminals.

(e) Remove the terminal plate.

(f) Remove the insulating blocks at the back of the muffle carefully, laying out both layers so that they may be installed in the same order that they were taken out. Grasp lead wires. Gently work the muffle (5) unit out. Remove the insulating sleeves from the muffle lead wire.



1. Screw
2. Backplate
3. Insulation blocks
4. Thermocouple
5. Muffle
6. Furnace

Figure 5-1. Muffle Furnace Disassembly.

(2) Replacement of Muffle.

(a) Replace the insulating sleeves over the wire. Insert the muffle (5) with the hole for the thermocouple toward the top of the furnace. Replace the insulating blocks (3) over the rear of the muffle.

(b) Replace the terminal plate, drawing lead wires through holes.

(c) Attach leads to the terminals.

(d) Attach the thermocouple (4) to the instrument in the base, making sure that each wire goes to the terminal from which it has been removed. Replace metal air vent with spring in hole. Stand the furnace up. Open the hole from inside of the muffle and insert the thermocouple.

(e) Replace the loose insulation blocks (3).

(f) Replace the backplate (2) and tighten three screws (1).

5-6. REID VAPOR PRESSURE BOMB BATH.

a. Lubricating. Oil the stirrer motor approximately every 4 months using a good grade of light machine oil (PL-S).

b. Cleaning. Wipe all components with a clean, damp cloth.

c. Checking Thermoregulator. Inspect the thermoregulator closely for presence of gas bubbles in the mercury column. If bubbles or separation of mercury in column exist, heat the bulb gently until bubbles are driven up into the expansion chamber. Cool slowly in a vertical position, allowing the mercury to recede slowly to form a solid column without bubbles or separation.

d. Calibrating Thermoregulator. Immerse thermoregulator in the bath at a temperature lower than that at which the bath is to be regulated. Place a calibrated ASTM No. 18F thermometer in the bath. Bring the bath temperature up to 96 degrees F to 98 degrees F (35.5 degrees C to 36.4 degrees C). Rotate the microset magnetic coupler until the indicator light on the control box is extinguished. Rotate the magnetic coupler until the indicator light is on. Continue making minor adjustments until the bath temperature is maintained at the desired temperature (100 degrees F +0.2 or -0.2 degrees F) (37.7 degrees C +17.6 degrees C or -17.6 degrees C).

e. Troubleshooting. The operator should be guided by the following chart (table 5-2) in diagnosing and correcting operating difficulties.

Table 5-2. Reid Vapor Pressure Bomb Bath Troubleshooting Chart

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

1. LOSS OF TEMPERATURE (CONTROL OF BATH WATER)

   Step 1. Check if stirrer motor is malfunctioning.
   a. Check electrical connections to stirrer motor.
   b. Check stirrer rod (may be bent), and propeller (may be missing).
   c. Ensure proper water circulation. Connect applicable defect.

   Step 2. Inspect heater element for malfunction.
   a. Check electrical connections and ensure proper power supply to elements.
   b. Using electrical circuit tester, ensure proper function of elements. Correct applicable defect.

   Step 3. Check if thermoregulator is malfunctioning.
   a. Check thermoregulator. Reset and calibrate as required.
   b. Check location of thermoregulator, restore to proper location as required.
   c. Check condition of thermoregulator, replace if cracked or broken. Reset if bubbles are noted in mercury columns.

   Step 4. Check for improper water level.
   Add water as required up to overflow tube level.

2. BATH DRAIN HAS BEEN OPENED BUT WATER DOES NOT RUN OUT

   Step 1. Check for plugged drain or bent tube under trailer.
   Check drain and tube. Make applicable corrections.

5-7. REFRIGERATOR.

a. Lubrication. No lubrication is required.

CAUTION
Never use an abrasive or an alkaline solution.

(1) Interior. It is important that the interior of the refrigerator be cleaned periodically beginning with the initial installation. Spillage will tend to cause objectionable odors. When this condition occurs, clean the entire interior with a solution of baking soda and warm water. Wipe thoroughly dry after cleaning.

(2) Condenser. Use a brush with stiff bristles to remove any stubborn foreign matter that may cling to the condenser; then clean thoroughly with a vacuum cleaner.

b. Refrigerator Maintenance.

(1) Door seal adjustment.

(a) Each hinge is provided with slotted mounting holes in the wing that is fastened to the door.

(b) Adjust gasket pressure on the lock side of the door by adjusting the strike hook.

(c) If it becomes necessary to remove the complete door assembly, remove the screws that secure the hinge to the cabinet exterior; the door gasket pressure will not be disturbed.

(2) Thermostat.

(a) To adjust the thermostat for a warmer or colder setting, an indicator knob is provided. Turn the knob clockwise for a warmer temperature.

(b) Changing the thermostat indicator setting to a warmer or colder position changes the cutout temperature only. The thermostat indicator should not be changed more than once each 24 hours, and then by only one or two numbers. Usually, 24 hours are required for the temperature to stabilize.

(3) Electrical Trouble Check.

(a) When checking for electrical trouble, always be sure there is a live electrical circuit to the refrigerator and that the temperature selector dial is in the OFF position.

(b) When the sealed unit will not start and the refrigerator temperature is warm, the trouble may be in the relay, in the thermostat, in the wiring, or in the compressor motor itself.

(c) If the compressor will not run, make a test lamp check across the relay terminals. The test lamp should light to show a live circuit if the thermostat is in the normal operating position, and not in the OFF position. If this check does not show a live circuit, the thermostat and wiring should be checked for an open circuit. Pay particular attention to all terminal connections.

(d) A thermostat check can be made using a piece of wire as a temporary bridge across the two thermostat terminals. If the compressor starts and runs with the bridge, the thermostat is at fault and should be changed.

(e) If the test lamp check shows power supply at the relay terminals, check the compressor by means of a manual test set.

c. Troubleshooting. The operator should be guided by the following chart (table 5-3) in diagnosing and correcting operating difficulties.

Table 5-3. Refrigerator Troubleshooting Chart

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

1. UNIT WILL NOT RUN

   Step 1. Check for blown fuse.
   Replace fuse and check for cause of blown fuse.

   Step 2. Check for defective thermostat.
   Check, if defective replace.

   Step 3. Check for defective relay.
   Check, if defective replace.

2. COMPRESSOR CYCLES (INTERMITTENTLY)

   Step 1. Check for low voltage
   Check line voltage, eliminate cause of circuit overload.

   Step 2. Inspect for dirty condenser.
   Clean condenser.

   Step 3. Check for defective relay overload protector.
   Check with wattmeter.

   Step 4. Check for loose electrical connection.
   Check wiring.

3. UNIT RUNS BUT DOES NOT COOL OR FREEZE TO PROPER TEMPERATURE.

   Step 1. Check for defective control.
   Check and repair as required.

   Step 2. Check for dirty condenser.
   Clean condenser.

Table 5-3. Refrigerator Troubleshooting Chart - Cont

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

Step 3. Check if unit is too close to wall, or to a heat emitting appliance.
Move out from wall, or to a cooler spot.

4. REFRIGERATOR EVAPORATOR OR COILS WITH EXCESSIVE FROST BUILDUP

Step 1. Check for dirty condenser.
Clean condenser.

Step 2. Check for faulty control.
Check, if defective replace control.

Step 3. Check if control is too far from coil.
Check, if defective replace.

Step 4. Check if controls are set too high.
Set to lower number.

5. COMPRESSOR RUNS CONTINUOUSLY

Step 1. Check if excessive heat in room, or too close to heat generating equipment.
Reduce heat or relocate.

Step 2. Check for faulty control.
Check and replace if defective.

Step 3. Check for improper ventilation.
Allow more air space or install cooling fan.

APPENDIX A
REFERENCES

A-1	Fire Protection TB 5-4200-200-10	Hand Portable Fire Extinguishers for Army Users.
A-2	Lubrication C91001L	Fuels, Lubrication, Oil and Waxes.
A-3	Painting TM 9-213	Painting Instructions for Field Use
A-4	Cleaning C68001L	Cleaning and Chemical Products
A-5	Maintenance TM 9-2330-271-14	Operators, Organizational, Direct Support and General Support Maintenance Manual (Including Repair Parts and Special Tools List): Semitrailers, Van-Electronic, 10 ton, 4 Wheel.
	TB 50-236	Calibration Requirements for the Maintenance of Army Material.
A-6	Testing TM 5-6630-216-12	Testing Kit, Petroleum, Fuel Contamination, Portable.
	TM 10-70	Inspecting and Testing Petroleum Products.
A-7	Shipment and Storage TM 38-230-1	Preservation and Packing of Military Equipment.
	TM 38-250	Packaging and handling of dangerous Materials for transportation by military aircraft.
	TM 740-90-1	Administrative Storage of Equipment.

APPENDIX A
REFERENCES
(Continued)

	TM 740-93-2	Preservation of USAMED Mechanical Equipment for Shipment and Storage.
A-8	Demolition	
	TM 750-244-3	Destruction of Material to Prevent Enemy Use.
A-9	Operation	
	MIL-HDBK-200F	Military Standardization Handbook, Quality Surveillance Handbook for Fuels; Lubricants and Related Products.
	TB 9-6685-319-50	Calibration Procedure for Dial Indicating Pressure Gages. (General).
	TM 5-6640-212-14	Laboratory, Mobile, Petroleum Trailer Mounted.
	TM 5-6640-213-14	Laboratory, Airmobile, Aviation Fuel.
	FM10-69	Petroleum Supply Point. Equipment and Operation.
	TM 10-1163	ASTM Manual for Rating Motor,- Diesel and Aviation Fuels.
	TM 10-1165	Significance of ASTM tests for Petroleum Products.
	TM 10-1166	1972 Book of ASTM Standards: Part 17; Petroleum Products, Fuels and Solvents: Engine Tests, Burner Fuel Oils, Lubricating Greases and Hydraulic Fluids.

APPENDIX A
REFERENCES
(Continued)

TM 10-1167	ASTM Standards, Part 18: Petroleum Products,. Measurement and Sampling Liquefied Petroleum Gases, Light Hydrocarbons, Plant Spray Oils, Aerospace Materials Sulfates, Crude Petroleum Wax and Graphite.

APPENDIX B

MAINTENANCE ALLOCATION CHART

Section I. INTRODUCTION

B-1. GENERAL.

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

b. The Maintenance Allocation Chart (MAC) in Section II designates overall responsibility for the performance of maintenance functions on the identified end item or component. The implementation of the maintenance functions upon the end item or component will be consistent with the assigned maintenance functions.

c. Section III lists the special tools and test equipment required for each maintenance function as referenced from Section II.

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

B-2. MAINTENANCE FUNCTIONS.

a. Inspect. To determine the serviceability of an item by comparing its physical, mechanical and/or electrical characteristics with established standards through examination.

b. Test. To verify serviceability and detect incipient failure by measuring the mechanical 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, i.e., to clean (decontaminate), to preserve, to drain, to paint, or to replenish fuel, lubricants, hydraulic fluids, or compressed air supplies.

d. Adjust. To maintain, within prescribed limits, by bringing into proper or exact position, or by setting the operating 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 equipments 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. Install. The act of emplacing, seating, or fixing into position an item, part, or module (component or assembly) in a manner to allow the proper functioning of an equipment or system.

h. Replace. The act of substituting a serviceable like type part, subassembly or module (component or assembly) for an unserviceable counterpart.

i. Repair. The application of maintenance services (inspect, test, service, adjust, align, calibrate, or replace) or other maintenance actions (welding, grinding, riveting, straightening, facing, remachining, or resurfacing) to 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 (services/actions) necessary to restore an item to a completely serviceable/operational condition as prescribed by maintenance standards (i.e.-, DMWR) in appropriate technical publications. 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 applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours/miles, etc.) considered in classifying Army equipments components.

B-3. COLUMN ENTRIES USED IN THE MAC.

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

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

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

d. Column 4, Maintenance Level. Column 4 specifies, by the listing of a work time figure in the appropriate subcolumn(s), the lowest level of maintenance authorized to perform the function listed in column 3. This figure represents the active time required to perform the maintenance function at the indicated level of maintenance. If the number or complexity of the tasks within the listed maintenance functions vary at different maintenance levels, appropriate work time figures will be shown for each level. The number of man-hours specified by the work time figure represents the average time required

to restore an item (assembly, subassembly, component, module, end item, or system) to a serviceable condition under typical field operating conditions. This time includes preparation time, troubleshooting time, and quality assurance/quality control 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
O	Organizational maintenance
F	Direct support maintenance
H	General support maintenance
D	Depot maintenance

e. Column 5, Tools and Equipment. Column 5 specifies, by code, those common tool sets (not individual tools) and special tools, test, and support equipment required to perform the designated function.

f. Column 6, Remarks. This column shall contain a letter code in alphabetical order which shall be keyed to the remarks contained in Section IV.

B-4. COLUMN ENTRIES USED IN TOOL AND TEST EQUIPMENT REQUIREMENTS.

a. Column 1, Tool or Test Equipment Reference Code. The tool and test equipment reference code correlates with a maintenance function on the identified end item or component.

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/NATO Stock Number. The National or NATO stock number of the tool or test equipment.

e. Column 5, Tool Number. The manufacturer's part number.

B-5. EXPLANATION OF COLUMNS IN SECTION IV.

a. Reference Code. The code scheme recorded in column 6, Section II.

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

Section II. MAINTENANCE ALLOCATION CHART

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Level C	O	F	H	D	(5) Tools and Equipment	(6) Remarks
01	Analine Point Apparatus	Inspect	0.2					01	
		Replace	0.2						
		Repair	0.5						
02	Centrifuge, EMD, 4 Place	Inspect	0.2						
		Replace		1.0				01	
		Repair			3.0			02	
03	Cloud and Pour Point Apparatus	Inspect	0.2					01	
		Replace	0.2					02	
		Repair		1.0				03	
04	Distillation Apparatus	Inspect	0.3					01	
		Replace		0.5				02	
		Repair			4.0			03	
05	Grease Dropping Point Apparatus	Inspect	0.2					01	
		Replace	0.2					02	
		Repair		2.0				03	
06	Tester, Flash Point Cleveland Open Cup	Inspect	0.2					01	
		Replace	0.5					02	
		Repair		1.5				03	
07	Tester, Flash Point Pensky-Martens	Inspect	0.2					01	
		Replace	0.5					02	
		Repair		3.0				03	
08	Tester, Flaph Point, Closed Cup	Inspect	0.2					01	
		Replace	0.5					02	
		Repair		2.0				03	
09	Tester, Gasoline Gum Content	Inspect	0.3					01	
		Replace		2.0				02	
		Repair			8.0			03	
10	Bath, Gum Stability Apparatus	Inspect	0.2					01	
		Replace		2.0				02	
		Repair			4.0			03	
11	Sulfur Test Apparatus	Inspect	0.2					01	
		Replace		2.0				02	
		Repair			4.0			03	
12	Penetrometer	Inspect	0.2					02	
		Replace	0.5						
		Repair		1.0					

SUBCOLUMNS ARE AS FOLLOWS:

C - OPERATOR/CREW
O - ORGANIZATIONAL
F - DIRECT SUPPORT;
H - GENERAL SUPPORT;
INDICATES WT/MH REQUIRED
D - DEPOT

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Level C	O	F	H	D	(5) Tools and Equipment	(6) Remarks
13	Tetraethyl Lead Apparatus	Inspect	0.2					01	
		Replace	0.5					02	
		Repair		1.0				03	
14	Bath, Reid Vapor Pressure	Inspect	0.3					01	
		Replace		1.5				02	
		Repair			8.0			03	A
		Calibrate	1.0						
15	Bath, Kinematic Viscosity	Inspect	0.2					01	
		Replace		0.5				02	
		Repair			1.5			03	
16	Balance, Analytical	Inspect	0.2					02	
		Replace	0.5						
		Repair	1.0						B
17	Balance, Torsion	Inspect	0.2					02	
		Replace	0.5						
		Repair	1.0						B
18	Barometer, Aneroid	Inspect	0.2					02	
		Replace	0.5						
		Repair					2.0		C
19	Bath, Water, Utility	Inspect	0.2					01	
		Replace	0.2					02	
		Repair		2.0				03	
20	Furnace, Muffle	Inspect	0.2					01	
		Replace		0.5				02	
		Repair			2.0			03	
21	Heater, Ful-Kontrol	Inspect	0.2					01	
		Replace	0.2					02	
		Repair			6.0			03	
22	Manometer	Inspect	0.2						
		Replace		0.5				03	
		Repair		1.0					
23	Oven, Utility	Inspect	0.2					01	
		Replace	0.5					02	
		Repair		2.0				03	
24	Pump, Vacuum	Inspect	0.2					01	
		Replace	0.5					02	
		Repair		1.5					

SUBCOLUMNS ARE AS FOLLOWS:

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F - DIRECT SUPPORT; H - GENERAL SUPPORT; D - DEPOT
INDICATES WT/MH REQUIRED

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Level C	O	F	H	D	(5) Tools and Equipment	(6) Remarks
25	Thermometers	Inspect	.5						
		Replace	.5						
		Calibrate	2.0						D
26	Compressor	Inspect	.3					02	
		Replace		4.0					
		Repair			8.0				
27	Refrigerator	Inspect	0.5					01	
		Replace		3.0				02	
		Repair			12.0			03	
28	Foam Test Apparatus	Inspect	0.2					01	
		Replace	0.5					02	
		Repair		3.0				03	
29	Cabinets	Inspect	.3	1.5				01	
		Replace		2.0				02	
		Repair						03	

SUBCOLUMNS ARE AS FOLLOWS:

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H - GENERAL SUPPORT;
INDICATES WT/MH REQUIRED
D - DEPOT

Section III. TOOL AND TEST EQUIPMENT REQUIREMENTS

(1) Reference Code	(2) Maintenance Level	(3) Nomenclature	(4) National/NATO Stock Number	(5) Tool Number
01	C	Volt-Ohm-Millammeter, 0 to 1200v AC/DC (22527) 9-522-10 (1 EA.)	6625-00-375-1063	
02	C	Tool Kit, General Mechanics Automotive, SC5180-90-CL-N26 (1 EA)	5180-00-177-7033	
03	C	Soldering Gun, 115v, 60HZ, Single Phase, 3 Wire Plug, w/pistol grip and spotlight, w/o thermostat control, Fed Spec. W-S-569A, Type 1, Cord Ay B, Class 1, (22527) 15-231-12 (1 EA)	NNSN	

Section IV. REMARKS

(Not Applicable)

APPENDIX C

COMPONENTS OF END ITEMS LIST

Section I. INTRODUCTION

C-1. SCOPE.

This appendix lists Integral Components of any Basic Issue Items (BII) for the petroleum base laboratory assembly to help you inventory items required for safe and efficient operation.

C-2. GENERAL.

The components of end item list are divided into the following sections:

a. Section II, Integral Components of the End Item. These items, when assembled, comprise the petroleum base laboratory assembly and must accompany it whenever it is transferred or turned in. The illustrations will help you identify these items.

b. Section III, Basic Issue Items. These are minimum essential items required to place the petroleum base laboratory assembly in operation, to operate it and to perform emergency repairs. Although shipped separately packed, they must accompany the laboratory during operation and whenever it is transferred between accountable officers. The illustrations will assist you with hard to identify items. This manual is your authority to requisition replacement BII based on Table(s) of Organization and Equipment (TOE)/Modification Table of Organization and Equipment (MTOE) authorization of the end item.

C-3. EXPLANATION OF COLUMNS.

a. Illustration. This column is divided as follows:

(1) Figure Number. Indicates the figure number of the illustration on which the item is shown (if applicable).
(2) Item Number. The number used to identify the item called out in the illustration.

b. National Stock Number (NSN). Indicates the national stock number assigned to the end item which will be used for requisitioning.

c. Part Number (P/N). Indicates the primary number used by the manufacturer which controls the design and characteristics of the item by means of its engineering drawings, specifications, standards and inspection requirements to identify an item or range of items.

d. Description. Indicates the federal item name and, if required, a minimum description to identify the item.

e. Location. The physical location of each item listed is given in this column. The lists are designed to inventory all items in one area of the major item before moving on to an adjacent area.

f. Usable on Code. "USABLE ON" codes are included to help you identify which component items are used on the different models. Identification of the codes used in this list are:

CODE	USED ON

g. Quantity Required (Qty Reqd). This column lists the quantity of each item required for a complete major item.

h. Quantity. This column is left blank for use during inventory. Under the received column, list the quantity you actually receive on your major item. The date columns are for use when you inventory the major item at a later date, such as for shipment to another site.

(1) Illustration		(2)	(3)	(4)	(5)	(6)	(7)	(8) Quantity			
(a) Figure No.	(b) Item No.	National Stock Number	Part No. & FSCM	Description	Location	Usable	Qty Reqd	Rcv'd	Date	Date	Date
1-5	9	6640-00-359-9951	(22527) 13-422	Chrometer, Saybolt, Complete with the Following:	ASTMD-156	None	1				
		6630-00-359-2236	(22527) 13-423-5	Tube, Unqraduated, w/o Fittings		None	2				
			(22527) 13-423-15	Tube, Graduated w/o Fittings		None	2				
			(22527) 13-423-22	Washer, Rubber,12 Ea. Per Pkg.		None					
			(22527) 13-423-25	Disc, Glass		None					
			(22527) 13-423-35	Mirror, Frosted w/Bast Assembly		None	1				
			(22527) 13-425	Color Standard, Whole Disc		None	3				
		4210-01-001-7709	(31759) 40-0029	Extinguisher, Fire Mono-Bromo, 22 LB		None	4				
1-5	15	6630-01-028-2303	(02308) 654-S1	Cloud and Pour Point Apparatus, 5 Unit	ASTMD-97	None	1				
		6635-00-025-9152	(48619) 74530	Jar, Class, 4oz, Cloud and Pour Point		None	12				
		6685-00-247-3737	(48619) 72770	Thermometer - 36 to +120 DEGF, (ASTM No. 6F)		None	6				
		6685-00-245-9521	(48619) 72772F	Thermometer - 112 to +70 DEGF, (ASTM No. 6F)		None	12				
1-5	8	6630-00-359-221)3	(22527) 13-449	Colorimeter; Comparative Lube Oils, Complete w/:	ASTMD-1500	None	1				
			(22527) 13-450A	Jar, Referee		None	2				
			(22527) 3-086	Bottle, Sample		None	1				
			(22527) 13-449-15	Standards, NBS Color, Set of 16 Each		None	1				
		6630-00-251-2118	(48619) 76002	Distillation Unit, Front View, L.H.	ASTMD-86	None	1				
1-2	1		(48619) 74731	Distillation Apparatus 115V, ac, 50/6011Z, Complete with the following::	ASTMD-86		3				
			(48619) 76026	Board, Distillation, 11/4 in. Hole		None					
			(48619) 76028	Board Distillation, 2 in Dia. Hole		None	1				
		6640-00-359-9652	(21519)G17825L	Board, Distillation, Vermiculite, 4 in. Dia. Hole		None	2				
		6640-00-359-9650	(48619)) 76029	Board, Distillation, Vermiculite, 2 3/4 in. Dia. Hole		None	3				
		6640-00-359-9649	(22527) 13-464-20	Board, Distillation, Vermiculite, 11 Dia. Hole		None	4				
		6640-00-359-9648	(22527) 13-464-15	Board, Distillation, Vermiculite, 11/4 in. Dia. Hole		None	4				
			(14674) 3042-10	Cylinder, Graduated, Pyrex, 10ml		None	6				
			(14674) 3042-100	Cylinder, Graduated, Pyrex, 100ml		None	24				

(1) Illustration		(2)	(3)	(4)	(5)	(6)	(7)	(8) Quantity			
(a) Figure No.	(b) Item No.	National Stock Number	Part No. & FSCM	Description	Location	Usable	Qty Reqd	Rec'd	Date	Date	Date
		6685-00-247-3764	(33051) 39929F-61	Thermometer +127.5 to +132. 5 DEGF, (ASTM No. 30F)		None	12				
		6685-00-247-3763	(22527) 13-618J	Thermometer; +207.5 to +212. 5 DEGF, (ASTM No. 30F)		None	12				
		6630-00-397-9293	(22527)13-617B	Viscometer, Pyrex, Calibrated 0.8 to 4 Cont. (ASTM SIZE 50)	ASTMD-445	None	2				
		6630-00-359-9903	(22527) 13-617C	Viscometer, Pyrex, Calibrated 8 to 15 Cent., (ASTM SIZE 100)		None	2				
		6630-00-359-9904	(22527) 13-617E	Viscometer, Pyrex, Calibrated 20 to 100 Cent., (ASTM SIZE 200)		None	2				
		6630-00-359-9905	(22527) 13-617F	Viscometer, Pyrex, Calibrated 50 to 250 Cent., (ASTM SIZE: 300)		None	2				
			(22527) 13-617H	Viscometer, Pyrex, Calibrated 240 to 1200 Cent., (ASTM SIZE 400)		None	2				
			(22527) 13-617K	Viscometer, Pyrex, Calibrated 1600 to 8000 Cent., (ASTM SIZE 500)		None	2				
		6630-00-359-9893	(22527) 13-617L	Viscometer, Pyrex, Calibrated 4000 to 20,000 Cent., (ASTM SIZE: 600)		None	4				
		6685-00-245-7696	(22527) 15-173-14A	Thermometer - 30 to 120F (ASTM No. 58F)		None	6				
			(53629) T-3750-43F	Thermometer -61 to -29 DEGF, (ASTM No. 43F)		None	6				
			(53629) T-3750-74F	Thermometer -67.5 to -62.5 DEGF, (ASTM No. 74F)		None	6				
		6640-00-290-6687	(64484) S-40085-F	Rod, Pyrex, 6mm Dia., 4 Ft. Lg.		None	5				
		6640-00-290-6689	(64484) S-40085-H	Rod, Pyrex, 8mm Dia., 4 Ft. Lg.		None	5				
			(64484) S-40085-K	Rod, Pyrex, 9mm Dia., 4 Ft. Lg.		None	5				
		6640-00-290-6689	(64484) S-40085-K	Rod, Pyrex, 10mm Dia., 4 Ft. Lg.		None	5				
			(22527) 15-585C	Grid, Wire, Gauze, Iron 6X6 In		None	6				
			(22527) 15-590C	Grid, Wire, Gauze, Iron w/ Ceramic Center, 6x6 in.		None	6				
1-4	10		(53629) P-3530	Water Determination Appara-tus 550w, 115v, 60HZ	ASTMD-95	None	2				
			(14674) 2360-400	Condenser, Liebig, 400mm		None	4				
		6640-00-410-4462	(14674) 3611-25	Receiver, Distilling, 10ml		None	6				
		6640-00-290-6864	(14674) 4320-500	Flask, Boiling, Pyrex 500ml		None	6				
			(66486) S-67513	Receiver, Distilling, 10ml		None	6				
			(22527) A-190	Asbestos, Fiber Acid, 1 LB		None	1				
1-4	1		(89606) 6400	Balance, Analytical		None	1				
			(21519) G-1425	Weights, Analytical Balance		None	2				
			(22527) 1-916 Cap	Balance, Analytical 200 GM		None	1				
			(22527) 2-075-15 w/o Pans	Balance, Torsion, 2Kg Cap.,		None	1				

(1) Illustration		(2)	(3)	(4)	(5)	(6)	(7)	(8) Quantity			
(a) Figure No.	(b) Item No.	National Stock Number	Part No. & FSCM	Description	Location	Usable	Qty Reqd	Rec'd	Date	Date	Date
			(22527) 14-670D	Stand, Laboratory Apparatus 11 in. Base		None	6				
			(13629) R-6150-4-1-2	Ring, Laboratory Apparatus 4 ½ in. ID		None	3				
			(53629) R-6150-3-1-2	Ring, Laboratory Apparatus 3 ½ in. ID		None	3				
			(53629) R-6150-2-1-2	Ring, Laboratory Apparatus 3 3/8 in. ID		None	3				
			(29276) 1293S	Tape Caging, 50 Ft		None	3				
		8135-00-292-2345		Tag, Shipping, Cloth w/wire Fasteners		None	1000				
		6685-00-191-3213	(53629) T-3750-68F	Thermometer, +293 to +401 DEGF, (ASTM 68F)		None	1				
		6685-00-191-3214	(22527) 15-142C	Thermometer, +77 to +131 DEGF, (AS7M 64F)		None	1				
			(22527) 15-173-14B	Thermometer, +0 to +180 DEGF (ASTM No. 59F)		None	4				
		6685-00-247-3747	(64484) S-80020-C	Thermometer, -4 to +304 DEGF		None	6				
			(22527) 15-166A	Thermometer, -20 to +150 DEGF, (ASTM No. 1C)		None	6				
			(48619) 62530	Regulator, -35 to +700 DEGF		None	2				
			(48619) 62550	Thermo-Regulator Guard		None	1				
			(22527) 13-417-5	Thief, Drum,		None	6				
			(22527) 13-417	Thief, .Sampling		None	6				
			(22527) 15-195	Tongs, Crucible, 9 in. lg.		None	4				
		6640-00-360-0021	(22527) 15-202	Tongs, Utility, 7 In. lg.		None	2				
		6640-00-360-0018	(22527) 15-208	Tongs, Crucible, 20 in lg.		None	1				
		6640-00-360-0011	(22527) 2-620	Tongs, Beaker, 13 in. lg.		None	2				
		6640-00-359-9805	(22527) 10-275	Forceps, Gooseneck, 150 mm		None	2				
			(22527) 15-280A	Triangle, wire, w/Silica Sleeves, 1 ½ in.		None	6				
		6640-00-444-9000	(22527) 15-280B	Triangle, Wire, w/Silica Sleeves, 2 in.		None	6				
			(22527) 15-280C	Triangle, Wire, w/Silica Sleeves, 2 in.		None	6				
		6640-00-298-7258	(14674) 9860-18	Test Tube, Pyrex, Ignition Type, 150 mm lg.		None	12				
			(11273) 14095-606	Tubing, Round Borosilicate Glass, 48 in lg. 6m5 OD		None	10				
			(11273) 14095-608	Tubing, Round Borosilicate Glass, 48 in lg. 8m OD		None	10				
			(11273) 14095-610	Tubing, Round, Borosilicate Glass, 48 in lg., 10mm OD		None	10				
			(11273) 14095-615	Tubing, Round, Borosilicate Glass, 48 in lg., 13mn OD		None	10				
			(22527) 14-150-5A	Tube, Rubber, Black 4/8 in. ID		None	25				
		4720-00-961-3520	(22527) 14-150-5B	Tube, Rubber, Black, 3/16 in. ID		None	25				

(1) Illustration		(2)	(3)	(4)	(5)	(6)	(7)	(8) Quantity			
(a) Figure No.	(b) Item No.	National Stock Number	Part No. & FSCM	Description	Location	Usable	Qty Reqd	Rec'd	Date	Date	Date
			(53629) C1055	Sulfur Test Apparatus Oxygen Bomb, Complete w/Bomb, Bath Gage AY and Ignition Unit	ASTKD-129	None	1				
		6630-00-245-8378	(35051) D20616-00	Hydrometer. API, -1 to +11 DEGF (ASTM No. 51H)		None	2				
		6630-00-245-8379	(35051) D20616-02	Hydrometer, API, +9 to +21 DEGF (ASTM No. 52H)		None	3				
		6630-00-242-9257	(35051) D20616-03	Hydrometer, API, +19 to +31 DEGF (ASTM No. 53H)		None	4				
		6630-00-242-9258	(35051) D20616-04	Hydrometer, API, +29 to +41 DEGF (ASTM No. 54H)		None	4				
		6630-00-245-8376	(35051) D20616-05	Hydrometer, API, +39 to +51 DEGF (ASTM No. 55H)		None	4				
		6630-00-245-8377	(35051) D20616-06	Hydrometer, API, +49 to +61 DEGF (ASTM No. 56H)		None	8				
		6630-00-245-8374	(35051) D20616-07	Hydrometer, API, +59 to +71 DEGF (ASTM No. 57H)		None	4				
		6630-00-245-8375	(35051) D20616-08	Hydrometer, API, +69 to +81 DEGF (ASTM No. 58H)		None	2				
		6630-00-252-2264	(35051) D20616-09	Hydrometer, API, +79 to +91 DEGF (ASTM No. 59H)		None	2				
		6630-00-252-2262	(53629) 118101-5-11	Hydrometer, API, +5 to +11 DEGF (ASTM No. 22H)		None	2				
		6630-00-252-2263	(53629) H8101-10-16	Hydrometer, API, +10 to +16 DEGF (ASTM No. 23H)		None	2				
		6630-00-252-2260	(53629) H8101-15-21	Hydrometer, API, +15 to +21 DEGF (ASTM No. 24H)		None	4				
		6630-00-252-2261	(53629) H8101-20-26	Hydrometer, API, +20 to +26 DEGF (ASTM No. 25H)		None	4				
		6630-00-252-2258	(53629) H8101-25-31	Hydrometer, API., +25 to +31 DEGF (ASTM No. 26H)		None	4				
		6630-00-252-2259	(53629) H8103-30-36	Hydrometer, API, +30 to +36 DEGF (ASTM No. 27H)		None	4				
		6630-00-252-6389	(53629) H8101-35-41	Hydrometer, API, +35 to +41 DEGF (ASTM No. 28H)		None	4				
		6630-00-252-6390	(53629) H8101-40-46	Hydrometer, API, +40 to +46 DEGF (ASTM No. 29H)		None	4				
		6630-00-252-2256	(53629) 118101-45-51	Hydrometer, API, +45 to +51 DEGF (ASTM No. 30H)		None	4				
		6630-00-252-2257	(53629) H8101-50-56	Hydrometer, API, +50 to +56 DEGF (ASTM No. 31H)		None	4				
		6630-00-252-2254	(53629) 1H8101-55-61	Hydrometer, API, +55 to +61 DEGF (ASTM No. 32H)		None	8				
		6630-00-252-2255	(53629) H8101-60-66	Hydrometer, API, +60 to +66 DEGF (ASTM No. 44H)		None	4				
		6630-00-252-2252	(53629) H8101-65-71	Hydrometer, API, +65 to +71 DEGF (ASTM No. 34H)		None	2				
		6630-00-252-2253	(53629) H8101-70-76	Hydrometer, API, +70 to +76 DEGF (ASTM No. 35H)		None	2				
1-3	3	6635-00-359-2232	(48619) 73510	Penetrometer, Universal Complete w/50 and 100 Gm weight	ASTMD-217	None	1				
		6640-00-359-2218	(48619) 73526	Cone, Brass		None	4				
			(48619) 73520	Needle	ASTMD-5	None	2				

Section II. COMPONENTS OF END ITEMS

(1) Illustration		(2)	(3)	(4)	(5)	(6)	(7)	(8) Quantity			
(a) Figure No.	(b) Item No.	National Stock Number	Part No. & FSCM	Description	Location	Usable	Qty Reqd	Rec'd	Date	Date	Date
1-3	4		(48619) 73501	Grease Working Machine, EMD		None	1				
			(48619) 73508 (*)	Worker Assembly, Lower							
			(48619) 73506 (*)	Worker ,Assembly ASTM (51 Holes)							
1-5	4	6635-00-359-9947	(21519) 68-825	Sediment, Apparatus, Fuel Oil	ASTMD-473	None	2				
			(21519) 68-825-12	Condenser, Metal	ASTMD-25	None	2				
		6640-00-290-6874	(146174) 4980-1L	Flask, Erlenmeyer, 1000ml		None	6				
		6640-00-199-9985	(21519) 66-825-06	Support, Wire Basket		None	6				
		6640-00-360-0011	(22527) 09-661B	Thimble, Alundum		None	12				
1-2	8	6635-00-359-9956	(21519) 66-335	Smoke Point Apparatus Complete w/stand	ASTMD-1322	None	1				
		9390-00-360-0064	(21519) 66-335-07	Wick, Smoke Point Apparatus, 144 ca.		None	1				
1-2	2	6630-00-303-7734	(14674) 37723	Sulfur Determination Apparatus w/Base	ASTMD-90	None	2				
		6630-00-359-9619	(14674) 37723A0	Absorber, Pyrex		None	2				
			(14674) 377223B0	Burner, Pyrex		None	2				
			(14674) 37721C0	Chimney, Pyrex		None	2				
		6640-00-359-9799	(14674) 37723F0	Flask, Erlenmeyer, 25ml		None	2				
		6630-00-303-7736	(14674) 37723T0	Trap, Spray, Pyrex		None	2				
			(21519) 68-957	Wick, Lamp Ay, 12 ea.		None	2				
		6640-00-359-9994	(21519) G19322	Support, Stand		None	2				
1-2	3		(53629) P-4355-3	Tetraethyl lead Apparatus Pyrex, Complete	ASTMD-526	None	3				
			(22527) 15-348	Viscosimeter, Saybolt, Complete w/Thermometer		None	1				
		6640-00-359-9629	(48619) 74893	Bath, ReidVapor Pressure 3 Bomb Type, 115v, 50/60HZ	ASTMD-323	None	1				
			(48619) 74878	Bomb, Vapor Pressure		None	3				
			(48619) 74886	Gauge, RVP, 0 to 15PSI		None	4				
			(48619) 74888	Gauge, RVP, 0 to 14PSI		None	1				
		6685-00-242-2203	(22527) 13-575H	Thermometer, +94 to +108 DEGF, (ASTM No. 18F)		None	6				
		6685-00-245-7696	(22527) 15-173-14A	Thermometer, -30 to +120 DEGF, (ASTM No. 58F)		None	6				
		6630-00-162-6548	(48619) 74943	Bath, Kinematic Viscosity	ASTMD-445	None	2				
			(48619) 74947	Tube Cover and Support Clip, Zietfuch		None	1				
			(22527) 13-584	Pan, w/lip, Viscosimeter		None	I				
			(22527) 13-583	Strainer, Viscosimeter		None	2				
			(94481) S3	Oil, Standardization, Qt. Bottle, API Viscosity, Gamma 48		None	2				
			(94481) 5600	011, Standardization, Bottle, Viscosity Beta 48		None	4				
		6685-00-247-1765	(22527) 13-618D	Thermometer, +97.5 to +102.5 DEGF, (ASTM No. 28F)		None	12				

(1) Illustration		(2)	(3)	(4)	(5)	(6)	(7)	(8) Quantity			
(a) Figure No.	(b) Item No.	National Stock Number	Part No. & FSCM	Description	Location	Usable	Qty Reqd	Rec'd	Date	Date	Date
		6640-00-359-9870	(14674) 6920	Jar, Pyrex, w/o Cover		None	4				
		6685-00-242-2187	(22527) 13-480	Thermometer, +30 to +580 DEGF (ASTM No. 7F)	ASTMD-86	None	12				
			(22527) 13-482	Thermometer, -2° to 400°C (ASTM 8-C)		None	6				
		6685-00-915-5601	(22527) 13-485	Thermometer, +30 to +760 DEGF (ASTM No. 8F)	ASTMD-86	None	6				
		6640-00-359-9794	(96906) M536059-1	Flask, Distilling, Enqler Pyrex, w/side Arm, 100ml	ASTMD-86 ASTMD-26	None	24				
		6640-00-359-9798	(96906) MS36059-2	Flask, Distilling Saybolt, Pyrex, w/side Arm, 250ml	ASTMD-158 ASTMD-447	None	12				
1-3	4	6635-00-159-9827	(48619) 73455	Grease Dropping Point Apparatus, 115V	ASTMD-566	None	1				
		6640-00-403-9349	(48619) 73458	Grease Cup, Ay		None	3				
		6640-00-360-0046	(64484) S66673	Test Tube Pyrex		None	6				
		6685-00-247-3744	(22527) 15-167B	Thermometer, +20 to +580 DEGF (ASTM No. 2F)		None	6				
		6630-00-359-9787	(22527) 13-528	Tester, Flash Point Cleveland Open Cup	ASTMD-92	None	1				
		6685-00-242-2223	(22527) 13-535	Thermometer, +20 to +760 I)DEGF(ASTM No. 11F)		None	6				
1-3	5	6630-00-530-0987	(22527) 13-497-5	Tester, Flash Point Pensky Martens	ASTMD-93	None	1				
		6685-00-242-2183	(22527) 13-500	Thermometer, +20 to +230 DEGF (ASTM No. 9F)		None	6				
1-3	6	6630-00-244-9415	(48619) 74617	Tester, Flash Point Tag Closed Cup	ASTMD-56	None	1				
		6685-00-245-9519	(22527) 13-510-105	Thermometer, -4 to +122 DEGF (ASTM No. 57F)		None	12				
1-2	10	6630-00-895-1259	(48619) 74801	Tester, Gasoline Gum Content, 100W, ll5V	ASTMD-381	None	I				
		6640-00-290-6817	(14674) 1040-100	Beaker, Pyrex, w/o Spout, 100ml		None	24				
		6640-00-290-6693	(48619) 75042	Bath, Gum Stability Apparatus 2 Bomb Cap.	ASTMD-525 ASTMD-873	None	1				
			(21519) G18540	Table Socket, For Bomb		None	1				
			(14674) 7732	Liner, Bomb, Pyrex		None	24				
			(48619) 74744	Gage, Recording Pressure, w/100 Charts		None	1				
			(53477) 5495	Hose, Air, w/Check Valve, 6 Ft. Lg.		None	1				
		6685-00-242-2205	(22527) 13-575M	Thermometer, +204 to +218 DEGF (ASTM No. 22F)		None	6				
			(66484) S-66957	Gasket, Bomb, 12 ea Per Package		None	2				
		6640-00-262-0051	(48619) 74740	Bomb, Gum, Stability, Complete w/6 ea. Gaskets and Pyrex Liner		None	2				
		4720-00-360-0047	(48619) 74739	Tubing, Flexible Metal 5 Ft Lg. w/Couplings		None	4				
		6640-00-360-0067	(48619) 74741	Wrench, Bomb, 6 IN.		None	2				

(1) Illustration		(2)	(3)	(4)	(5)	(6)	(7)	(8) Quantity			
(a) Figure No.	(b) Item No.	National Stock Number	Part No. & FSCM	Description	Location	Usable	Qty Reqd	Rec'd	Date	Date	Date
		6685-00-194-1707	(53629) T-3790	Thermometer Testing Set, ASTM Certified, Fahrenheit, consisting of: 1 ea -36°F to +35°F 1 ea +18°F to +89°F 1 ea +77°F to +131°F 1 ea +122°F to +176°F 1 ea +167°F to +221°F 1 ea +203°F to +311°F 1 ea +293°F to +401°F 1 ea +383°F to +581°F 1 ea +563°F to +761°F 1 ea Channeled Carrying Case						

(1) Illustration		(2)	(3)	(4)	(5)	(6)	(7)	(8) Quantity			
(a) Figure No.	(b) Item No.	National Stock Number	Part No. & FSCM	Description	Location	Usable	Qty Reqd	Rec'd	Date	Date	Date
			(22527) P-217	Potassium Chloride , Crystal ACS 1 kg KCL		None	1				
			(22527) P-220	Potassium Chromate Granular ACS, 5 lb, $K_2Cr_2O_4$		None	1				
		6810-00-222-9675	(22527) P-188	Potassium, Dichromate Crystal, ACS, 1 lb $K_2Cr_2O_7$		None	10				
	(**)		(22527) P-236	Potassium, Ferrocynide Crystal, ACS, 1 lb, $K_4Fe\ (CN)_63H_20$		None	1				
		6810-00-281-9827	(22527) P-250	Potassium Hydroxide Pellets, ACS, 1 lb, KOH		None	5				
			(22527) P-410	Potassium Iodide, Granular, ACS, 1 lb, KL							
			(22527) P-263	Potassium Nitrate Crystal, ACS, 1 lb, KNO_3		None	1				
		6810-00-222-9665	(22527) P-279	Potassium Permanganate Crystal, ACS, 1 lb $KMNO_4$		None	1				
		6810-00-233-0126	(22527) S-181	Silver Nitrate Crystal ACS, 1/4 lb, A_gNO_3		None	1				
		6810-00-264-6593	(22527) S-263	Sodium Chloride Crystal 1 lb, NaCL		None	10				
		6810-00-234-8373	(22527) S-218	Sodium Hydroxide, Pellets, ACS, 5 lb, NaOH		None	2				
	(**)	6810-00-233-0118	(22527) S-343	Sodium Nitrate, Crystal ACS, 1 kg, $NaNO_3$		None	1				
			(22527) S-356	Sodium Oxalate Primary Standard, ACS, 1 lb, $Na_2C_2O_4$		None	1				
			(22527) 5-363	Sodium Peroxide. Granular, ACS, 1 lb, Na_2O_2		None	1				
		6810-00-234-8377	(22527) S-421	Sodium Sulfate Anhydrous Granular, ACS, 1 lb, Na_2SO_4		None	2				
		6810-00-234-8380	(22527) 5-445	Sodium Thiosulfate Crystal, ACS, 1 lb, $NaS_20_35H_2O$		None	1				
			(22527) 5-510	Starch Corn, Powder, Laboratory Grade 1 lb		None	2				
	(**)		(22527) S-457	Solvent, Stoddard 54 gal		None	1				
		6810-00-282-9710	(22527) S-591	Sulfur Sublimed (Sulfur Flowers) Powder, Laboratory Grade, 1 lb		None	1				
	(**)		(22527) A-300	Sulfuric Acid, Reagent ACS, 1 pt, (2 lb)		None	18				
			(22527) A-310	Tannic Acid, Powder, 1 lb. $C_{76}H_{52}O_{46}$		None	1				
			(35051) 87850-9Z	Tripoli Powder 1 lb.		None	5				
	(**)		(22527) Z-52	Zinc Oxide, Dry Process Powder, ACS, 1 lb, Z-NO		None	1				

(1) Illustration		(2)	(3)	(4)	(5)	(6)	(7)	(8) Quantity			
(a) Figure No.	(b) Item No.	National Stock Number	Part No. & FSCM	Description	Location	Usable	Qty Reqd	Rec'd	Date	Date	Date
		6685-00-242-2224	(22527) 11-604(*)	Thermometer, -5 to +215 DEGF (ASTM No. 12F)		None	1				
			(48619) 74856	Sampler, Oil, 1 qt	ASTMD-270	None	4				
			(22527) 13-420-25	Strip, Copper, 12 Per Pkg.	ASTMD-130	None	1				
			(81346) 12-401300-00	Standards Corrosion		None	1				
			(37163) 1293	Tape, 01 Caging 50 Ft		None	3				
			(37163) 590G	Bob, Plum, Brass 20 oz		None	3				
	(**)	6810-00-221-1415	(22527) A-38	Acetic Acid, Glacial ACS 1 lb Bottle, CH_3COOH	ASTMD-526 ASTMD-526	None None	2 2				
	(**)		(22527) A-19	Acetone, Spectranalyzed ACS 1 qt Bottle, CH_3COOH_3		None	5				
			(22527) A-979	Pocket Tester, Instant Ph Range of 2 thru 10		None	5				
		6810-00-234-7209	(22527) A-637	Ammonium Acetate, Crystal ACS, 1 lb Bottle, CH_3COOH_4		None					
		6810-00-222-9680	(22527) A-661	Ammonium Chloride, Crystal ACS, 2.2 lb Bottle NH_41		None	1				
			(22527) A-669	Ammonium Hydroxide, Reagent ACS, 1 lb Bottle, NH_4OH		None	8				
			(22527) A-937	Ammonium Iodide, Crystal ACS, 1/4 lb Bottle, NH_41		None	1				
			(22527) A-674	Ammonium Molybdate, Crystal ACS, 500)y Bottle $(NH_4)_2$ $MO_7O_{24}4H_2O$		None	1				
	(**)	6810-00-207-9050	(22527) A-676	Ammonium Nitrate, Crystal ACS, 1kg Bottle, NH_4NO_3		None	1				
			(22527) A-679	Ammonium Oxalate, Crystal ACS, 500g Bottle, (NH_4) C_2O_4-H_2O		None	1				
		6810-00-264-6546	(22527) A-702	Ammonium Sulfate Sulfate Granular, AC, 1 kg Bottle (NH_4) $_2SO_4$		None	1				
	(**)		(64484) SC12934	Isopropyl Alcohol, Reagent ACS, 1 gal. Bottle, $CH_3CHOHCH_3$		None	1				
	(**)		(22527) A-740	Aniline (Amino-Benzene) ACS 1 pt Bottle C_6H_5COOH		None	4				
	(**)	6640-00-202-1701	(22527) A-181	Asbestos, Long Fiber, Acid Washed, For Gooch Crucibles, 1 lb		None	1				
			(22527) B-31	Barium Chloride, Anhydrous, Purified, 1 lb		None	1				
			(22527) B-47	Barium, Hydroxide Anhydrous, Powder ,1 lb B_a $(OH)_z$		None	1				
			(64484) SC10998	Benzoic Acid, Primary Standard, Reagent Crystal ACS, ¼ lb, C_6H_5COOH		None	1				
	(**)		(64484) SC11134	Bromine, Reagent, ACS ¼ lb		None	1				
			(64484) SC16063	Calcium Chloride Reagent ACS, 8 Mesh, 5 lb $CaC1_2$		None	5				
	(**)		(64484) SC11288	Carbon Tetrachloride, Technical, 5 gal		None	1				

(1) Illustration		(2)	(3)	(4)	(5)	(6)	(7)	(8) Quantity			
(a) Figure No.	(b) Item No.	National Stock Number	Part No. & FSCM	Description	Location	Usable	Qty Reqd	Rec'd	Date	Date	Date
			(22527) C-211	Celite (Analytical Filter Aid) 300g		None	1				
	(**)		(22527) C-574	Chloroform, Spectranalyzed ACS, 1 qt, $CHC1_3$		None	1				
			(22527) C-371	Cobalt (ous) Chloride Crystal, ACS, ¼ lb, $COCL_2$-$6H_2O$		None	1				
			(22527) C-490	Cupric Sulfate Powder Technical, 5 lb		None	1				
			(64484) SC10449	Alcohol Reagent 1 gal		None	1				
			(64484) SC12125	Ethylene Glycol Technical 1 gal		None	5				
			(64484) SC12877	Ferris Chloride Reagent ACS Lump, 1 lb., $FeCL_3$-$6H2_0$		None	1				
			(64484) SC12377	Glycerol, Reagent ACS 1 pt		None	1				
			(22527) A-144	Hydrochloric Acid, Reagent ACS, 1 pt. HCL		None	30				
			(22527) A-147	Hydrochloric Acid, Reagent ACS, 1 lb, HF		None	1				
	(**)		(22527) H-327	Hydrogen Peroxide - Technical 1 pt. H_20_2		None	10				
			(22527) 0-261	8 Hydroxyquinoline (Ortho) ACS ¼ lb HOC_6H_3N-CH-CH-CH		None	1				
	(**)		(22527) I-37	Iodine, Resublimed Crystal ACS,1 lb, HF		None	1				
			(22527) I-150	Ferrous Sulfide Granular, 1 lb. Fes		None	1				
		6810-00-271-1405	(22527) L-33	Lead Acetate. Normal ACS 1 lb. Pb ($C_2H_30_2$) $23H_2O$		None	1				
			(22527) L-71	Load Oxide, Mono, Yellow Powder 1 lb PbO		None	1				
	(**)	6810-00-281-7453	(22527) M-141	Mercury, Metal Instrument Grade, ACS, 6 lb, Hg		None	1				
		6810-00-753-4783	(22527) A-412	Ethanol (Methyl Alcohol) ACS, CH_3OH a gal		None	5				
	(**)	6810-00-281-2785	(64484) SC 13555	Methyl Ethyl Ketone Technical, 1 gal		None	5				
		6810-00-227-1259	(22527) M-216	Methyl Orange (Indicator) ACS, ¼ Lb, 4-$NaOSO_2C_6$ H_4N-NC_6H_4		None	1				
			(22527) M-219	Methyl Red Hydro Chloride ACS 1 oz		None	2				
	(**)	6810-00-237-2954	(22527) A-200	Nitric Acid, Reagent ACS, 1 pt HN_3		None	3				
			(64484) SC15830	Xylene (Xylol) Technical 5 gal		None	1				
			(22527) X-4	Xylene, Purified, 1 gal $C_6H_4(CH_3)_2$	ASTMD-95	None	5				
			(64484) SC13846	Oleic Acid, Technical 1 pt.		None	1				
			(22527) N-105	P-Nitrophenol Reagent Flake, 100g NO_{26} H_4DH		None	1				
		6810-00-223-7612	(22527) P-79	Phenolphthalein, ACS, $C_6H_4COOC(C_6H_4$-4-$OH)_2$ 1oz		None	8				
		6810-00-753-4990	(225271 E-139	Petroleum Ether ACS I qt.		None	5				
			(22527) A-245	Phosphorus Pentoxide ACS 1 lb, 2%		None	1				
			(22527) P-205	Potassium Bromide, ACS 1 Lb KBr		None	1				

(1) Illustration		(2)	(3)	(4)	(5)	(6)	(7)	(8) Quantity			
(a) Figure No.	(b) Item No.	National Stock Number	Part No. & FSCM	Description	Location	Usable	Qty Reqd	Rec'd	Date	Date	Date
			(22527) 14-150-5C	Tube, Rubber, Black, ¼ in. ID		None	25				
		4720-00-235-5494	(22527) 14-175A	Tube, Rubber, 1/8 in. Wall Black, 1/8 in. ID		None	25				
			(22527) 14-175B	Tube, Rubber, 1/16 in. Wall Black, 1/16 in. ID		None	50				
		4720-00-684-6260	(22527) 14-150-5C	Tube, Rubber, 1/16 in. Wall Black, S in. ID		None	50				
		4720-00-260-6869	(22527) 14-150-5D	Tube, Rubber, 1/16 in. Wall Black, 5/16 in. ID							
			(22527)	14-173A Tubing, Pressure and Vacuum, 1/8 in. ID		None	25				
			(22527) 14-175B	Tubing, Pressure, and Vacuum, 3/16 in. ID		None	25				
			(225271 14-175C	Tubing, Pressure and Vacuum, ¼ in. ID		None	25				
			(11273) 73515-000	Watch, Stop, 60 Second		None	8				
			(22527) 2-610A	Watch, Glass, 50 mm Dia.		None	12				
		6640-00-290-6808	(22527) 2-610B	Watch, Glass, 65 mm Dia.		None	12				
		6640-00-290-6811	(22527) 2-610E	Watch, Glass,100 mm Dia.		None	12				
			(48619) 92230	Distilling Apparatus, 2600w ac, 115v, 50/60HZ		None	1				
			(48619) 92040	Heater, w/Gasket		None	1				
			(48619) 92217	Cut-Off, Automatic, For Distillation Apparatus		None	1				
			(22527) 13-634-5	water Indicating Paste 3 oz		None	12				
		5350-00-242-4404	(19206) 11577277	Wool, Steel, No. 1,1 lb Pkg		None	1				
		5350-00-242-4405	NPN	Wool, Steel, No. 0,1 lb Pkg		None	3				
		6640-00-264-5014	(22527) 11-388	Wool, Glass, Filtering 1 lb		None	2				
			(22527) 12-333	Microscope, Chamot, Bausch and Lomb, Type M		None	1				
			(22527) 11-403	Goggles, Gas Tight		None	1				
		6625-00-691-6605	(22527) 9-522-10	Volt-On Millimeter, ac/dc		None	1				
			(23299) 1151	Meter, Conductivity, Portable	ASTMD-2624	None	2				
			(23299) 1151-07	Kit, Cable Extension		None	1				
		4390-00-274-5713	(96906) M515762-1	Oiler, Hand, S Pt		None	1				
		5120-00-278-1282	(12436) 58	Screwdriver, 3 in. Blade, Standard		None	2				
		5120-00-278-1283	(94135) 41S1104-1025	Screwdriver, 6 in. Blade Standard		None	2				
		3439-00-188-6988		Solder, Resin Core, 1 lb		None	2				
		3439-00-812-1294		Solder, Acid Core, 1 lb		None	2				
			(97403) 5-14-322	Stool, Laboratory, 30 in Tall		None	4				
		5120-00-277-1483	(80244)GGGW651TY2 CLA 6 IN	Wrench, Pipe, Adj., 6 in.		None	2				

(1) Illustration		(2)	(3)	(4)	(5)	(6)	(7)	(8) Quantity			
(a) Figure No.	(b) Item No.	National Stock Number	Part No. & FSCM	Description	Location	Usable	Qty Reqd	Rec'd	Date	Date	Date
		5120-00-277-1484	(95683) 41W1661	Wrench, Pipe, Adj. 8 in.		None	2				
		5120-00-277-1485	(80244)GGGW651TY2 CLA 10 IN	Wrench, Pipe, Adj. 10 in		None	1				
		5120-00-277-1486	(19204) TKCX1H	Wrench, Pipe, Adj. 14 In		None	1				
		5120-00-277-1461	(19204) TKCX1C	Wrench, Pipe, Adj. 18 in		None	1				
		5120-00-264-3795	(47805) PROT0706	Wrench, Crescent, Adj. 6 in.		Non	2				
		5120-00-240-5328	(47805) PROT0708	Wrench, Crescent, Adj. 8 in.		None	2				
		5120-00-449-8083	(47805) PR3T0710	Wrench, Crescent, Adj. 10 in		None	2				
		5120-00-264-3796	(93389) 7125	Wrench, Crescent, Adj. 12 in		None	1				
		5120-00-423-6728	(19207) 6187328	Wrench, Crescent, Adj. 15 in		Non	1				
			(22527) 15-231-12	Gun, Soldering, Electric		None	1				
			(22527) 1-357	Apron, Rubber		None	6				
		4730-00-011-8539	(79470) 41x6	Unit Nut, Tube, 3/8 in. OD		None	6				
			[79470) 55x6	Elbow, Union, Tube, 3/8 in. OD		None	6				
		4730-00-639-9676	(79470) 49x6	E13, Male, Tube 3/8 in. OD		None	6				
		473D0--266-0538	(79470) 48x6	Connector, Male, Tube,. 3/8 OD		None	6				
			(79470) 44x6	Tee, Union 3/8 in. OD		None	6				
			(79470) 51x6	Tee, Male Run. 3/8 in. OD		None	6				
		4820-00-262-7020	(37239) 123-1-3-4	Valve, Globe, Brass 1/4, in.		None	6				
			(37239) 123-3-8	Valve, Globe, Brass, 3/8 in.		None	6				
		6640-00310-8558	(89352) SHE2C	Hood, Chemical, w/Blower		None	1				
			(97403) 5-14-333	Sink, Laboratory		None	1				
			(97403) 5-14-336	Viscosimeter, Kinematic Refrigerated		None	1				
			(88663) 232-1-3-4	Compressor, Air, 2 Stage 200 PSI, EMD, 110/220v		None	1				
			(88663) 1A214(*)	Valve Plate		None	2				
		4310-00-423-3576	(88663) 3W8874 (*)	Valve, Inlet, and Discharge		None	4				
			(88663) PP336 (S)	Spring, Pilot Valve		None	1				
			(88663) 2A252 (*)	Cleaner, Pad, Air Inlet		None	4				
			(50495) 232-C-1	S9,itch, Motor Protection		None	1				
			(97403) 5-14-337	Refrigerator, Electric 11 Cubic Feet		None	1				
		6640-00-377-9383	(21519) 67-985	Freezing Point Apparatus	ASTMD-615	None	2				
			(21519) 67-985-D3(*)	Tube, Inner		None	1				
			(21519) 67-985-75(*)	Flask, Dewar		None	1				
			(21519) 67-985-DB (*)	Top and Stirrer		None	1				
		6640-00-359-9628	(21519) 67-973	Foam Rest Apparatus	ASTMD-892	None	1				
			(21519) 67-973-01	Aerator		None	1				
		6640-00-403-9339	(21519) 67-973-32(*)	Cylinder, Pyrex		None	1				

(1) Illustration		(2)	(3)	(4)	(5)	(6)	(7)	(8) Quantity			
(a) Figure No.	(b) Item No.	National Stock Number	Part No. & FSCM	Description	Location	Usable	Qty Reqd	Rec'd	Date	Date	Date
			(48619) 240304 (*)	Switch Line, DIST		None	1				
			(22527) 9-485D	Paper, Filter, Double Acid Washed, Whatman No. 40, 100 each		None	2				
			(59728) 5218-240	Paper, Filer, Unwashed, Whatman No.12, 100 each		None	4				
			(35051) D13643-33	Paper, Filter, 33CM Dia., 100 ea.		None	2				
			(22527) 13-378	Scriber, Tungsten Carbide Point		None	2				
			(22527) 13-380C	Crayon, Marking, Red		None	12				
		6640-00-437-8000	(96906) MS35985-5	Pipette, Volumetric, 5 ml	FTMS 5327	None	6				
			(22527) 13-6505	Pipette, Volumetric, 50 ml		None	6				
			(22527) 13-6501	Pipette, Volumetric, 25 ml		None	6				
			(22527) 13-650L	Pipette, Volumetric, 10 ml		None	6				
			(11273) 18130 000	Scraper, Laboratory, Rubber		None	12				
			(11273) 91105-001	Pump, Vacuum, 2.5 CFPM, 110v, 60HZ		None	2				
			(11273) 91131-000	V Belt		None	1				
			(22527) 13-745	Plate, Spot Test. Porcelain Size No.1		None	2				
			(22527) 7-835B	Ring, Cork, 108mm dia.		None	6				
			(22527) 14-140	Stopper, Rubber, 2 hole Asstd. Sizes, 20 ea. Per Pd.		None	10				
		6640-00-232-6004	(22527) 14-130	Stopper, Rubber, Solid, Asstd. Sizes, 20 ea. Per Pd.		None	9				
		5110-00-223-6371	(22527) 14-275B	Shears, Trimmers, 8 in.		None	3				
			(22527) 14-290	Shears, Trimmers, 10 in.		None	2				
			(11273) 89085-020	Copper, Sheet, Plain		None	1				
			(22527) 14-323-10	Rule, Slide,. Versalog		None	2				
			(22527) 5-097	Indicator, Speed, 100 to 4000 RPM		None	1				
		6640-00-359-9958	(22527) 9-959	Splash. Eliminator, Filter Pump		None	1				
			(22527) 14-417	Sponge, Cellulose, 12 ea.		None	1				
			(22527) 14-37LB	Spatula, 4 in. Steel Blade		None	6				
		6640-00-592-8037	(22527) 14-365D	Spatula, 6 in. Steel Blade		None	6				
			(22527) 14-196	Stretcher, Rubber Tubing		None	6				
			(22527) 14-545	Stopcock, Brass, 3/8 in IPS		None,	24				
		6640-00-494-3774	(22527) 14-502	Stirrer, Electric, 115v 50/60HZ		None	2				
			(11273) 89205-000	Steel Strips		None	1				
		6640-00-494-3895	(11273) 15460-602	Stopcock, Pyrex, 2 way		None	6				
			(22527) 15-305B	Tripod laboratory Apparatus		None	4				
		6640-00-440-1200	(22527) 14-670C	Stand, laboratory Apparatus 9 in. Base		None	6				

(1) Illustration		(2)	(3)	(4)	(5)	(6)	(7)	(8) Quantity			
(a) Figure No.	(b) Item No.	National Stock Number	Part No. & FSCM	Description	Location	Usable	Qty Reqd	Rec'd	Date	Date	Date
		6640-00-438-2150	(22527) 7-880	Press, Cork, 5 to 32mm		None	1				
			(64484) S-23135	Cork Screw, Hand Pull Type		None	2				
			(22527) 1-455B	Pipe, Asbestos, 1LB Spool		None	2				
			(22527) 9-998A	Cots, Finger, Asbestos		None	4				
			(22527) 9-999B	Cots, Thumb, Asbestos		None	2				
			(22527) 7-955E	Crucible, Ignition, 30ml		None	12				
			(22527) 7-955F	Crucible, Ignition, 50ml		None	12				
			(22527) 7-955H	Crucible, Ignition, 150ml		None	6				
			(22527) 8-195D	Crucible, Filtering 25ml		None	12				
		6640-00-359-9753	(22527) 8-285	Holder, Filtering, Crucible		None	6				
			(22527) 7-96513	Crucible, Ignition, 30ml		None	12				
		5110-00-489-8135	(22527) 11-340	Cutter, Class Griffin Type		None	6				
		6640-00-290-6569	(35051) D-10176-40	Cylinder, Pyrex, Graduated 5ml		None	6				
		6640-00-290-6570	(22527) 8-552B	Cylinder, Pyrex, Graduated 10ml		None	6				
			(22527) 8-552C	Cylinder, Pyrex., Graduated 25ml		None	6				
		6640-00-420-000	(22527) 8-522E	Cylinder, Pyrex, Graduated 100ml		None	24				
		6640-00-290-6543	(22527) 8-552F	Cylinder, Pyrex, Graduated 250ml		None	12				
		6640-00-290-6544	(22527) 8-552-1E	Cylinder, Pyrex, Graduated 500ml		None	6				
		6640-00-290-6545	(22527) 8-552H	Cylinder, Pyrex, Graduated 1000ml		None	6				
		6640-01-419-9000	(22527) 8-552D	Cylinder, Pyrex, Graduated 50ml		None	6				
		6640-00-420-6000	(14674) 3002-100	Cylinder, Pyrex, Graduated w/ Stopper, 100ml		None	12				
			(22527) 8-566E	Cylinder, Pyrex, Graduated w/ Stopper, 250ml		None	6				
			(22527) 8-615B	Dessicator, Heavy Glass w/ Cover		None	6				
			(22527) 8-595-2E (*)	Cover, Dessicator		None	1				
			(22527) 8-690C	Dish, Evaporating, Porcelain, 80ml		None	6				
			(22527) 8-675	Pencil, Diamond Point		None	2				
			(22527) 14-666-5	Flexaframe, Laboratory		None	2				
			(225271 10-040C	Flask, Erlenmeyer, Pyrex w/o Stopper 50ml		None	12				
			(22527) 10-040D	Flask, Erlenmeyer,. Pyrex w/o Stopper, 125ml		None	12				
		6640-00-279-2634	(64484) S-33918-C	Flask, Distilling, 125ml	ASTMD-86	None	2				
			(21519) 35-690-200	Flask, Erlenmeyer, Pyrex w/o Stopper, 200ml		None	12				
			(14674) 4980-300	Flask, Erlenmeyer, Pyrex w/o Stopper, 300 ml		None	24				
			(22527) 10-0401	Flask, Erlenmeyer, Pyrex w/o Stopper, 500 ml		None	12				

(1) Illustration		(2)	(3)	(4)	(5)	(6)	(7)	(8) Quantity			
(a) Figure No.	(b) Item No.	National Stock Number	Part No. & FSCM	Description	Location	Usable	Qty Reqd	Rec'd	Date	Date	Date
			(22527) 10-040K	Flask, Erlenmeyer, Pyrex w/o Stopper, 1000 ml		None	6				
			(14674) 5400-250	Flask, Laboratory, Iodine, 250 ml		None	6				
		6640-00-290-6865	(22527) 10-065B	Flask, Boiling, Pyrex 500 ml		None	6				
			(22527) 10-204-5H	Flask, Volumetric, Pyrex 1000 ml		None	6				
		6640-00-424-9000	(22527) 10-180F	Flask, Filtering, Pyrex, w/side Tube 1000 ml		None	6				
		6640-00-290-6915	(22627) 10-412-2C	Funnel, Separatory., Pyrex 250 ml		None	6				
		6640-00-290-6900	(22527) 1-435-5D	Funnel, Separatory, Pyrex 500 ml		None	6				
			(22527) 10-381B	Funnel, Common, Glass 250 ml		None	6				
			(11273) 15056-607	Funnel, Common, Pyrex		None	6				
		6640-00-359-9814	(48619) 31000	Furnace, Muffle 115v		None	1				
			(48619) 511974 (*)	Muffle, Unit, 120v		None	1				
			(82971) 4723-A	System, Gas, Complete w/Gages and connections		None	1				
		8415-00-261-7015	(22527) 11-392	Gloves, Asbestos		None	2				
		8415-00-266-8679	(22527) 11-394-20C	Gloves, Rubber		None	6				
			(22527) C-602-1	Grease, Stopcock, 1 oz		None	6				
		6640-00-980-5002	(48619) 61600	Heater, Ful-Kontrol, 115v 750w		None	4				
		6640-00-359-9647	(48619) 61820 (*)	Refractory Top		None	1				
			(48619) 225087 (*)	Brush, Contact (For ohmite VT8)		None	1				
			(48619) 61856	Clay, Lower		None	1				
			(48619) 67576	Clamp. Dovetail		None	1				
			(22527) 13-580	Heater, Immersion Viscosimeter 115v, ac/dc 500w		None	3				
			(59728) 6171-8	Hot Plate, Circular, 3 Heat 110v, 300 to 1200w		None	3				
			(22527) 8-532C	Cylinder, Hydrometer, Jar Pyrex, 500 ml		None	6				
			(22527) 11-850C	Label, Gum Red Borders 720 Per Box		None	6				
		6685-00-255-8050	(22527) 11-286C	Manometer, U-Tube, 100PSI		None	1				
			(22527) 11-286-2C (*)	U-Tube, Manometer		None	1				
			(11273) 522-000	Mortar and Pestel, Porcelain		None	2				
		6640-00-359-9880	(48619) 31540	Oven, Utility, 35 to 180 DEGC, 115v, 300w		None	1				
			(48619) 223386 (*)	Motor, 120v		None	1				
			(48619) 234147 (*)	Lamp, Pilot Red and White		None	1				

(1) Illustration		(2)	(3)	(4)	(5)	(6)	(7)	(8) Quantity			
(a) Figure No.	(b) Item No.	National Stock Number	Part No. & FSCM	Description	Location	Usable	Qty Reqd	Rec'd	Date	Date	Date
			(11273) 10310-005	Bottle, Stopper, Round, w/ cork Green 5 Gal.		None	4				
			(64484) S-8335-B	Bottle, PennyHead Stopper, Pound, Crystal, 2 oz		None	12				
		6640-00-379-4605	(65143) 211754	Bottle, Dropping, TK, Glass, Amber, 60ml		None	36				
			(11273) 10425-616	Bottle, Stopper, Round Glass, Crystal, 16 oz		None	36				
			(22527) 3-571-5	Brush, Flask and Bottle		None	6				
			(22527) 3-540	Brush, Beaker, large		None	6				
			(22527) 3-565	Brush, Beaker, Small		None	3				
		7920-00-889-3381	(22527) 3-572-5	Brush, Test Tube, Large		None	6				
		7920-00-282-7784	(22527) 3-574	Brush, Test Tube, Small		None	6				
			(22527) 3-614	Brush, Burette, Small		None	6				
			(22527) 3-625	Brush, Pipette		None	6				
			(22527) 3-654	Brush, Balance		None	6				
			(22527) 3-682	Brush, Sink		None	2				
			(22527) 3-685	Brush, Brasswire		None	2				
			(22527) 3-621-A	Brush, Cylinder, Small		None	2				
			(22527) 3-621-B	Brush, Cylinder, Large		None	6				
		6640-00-494-3726	(22527) 14-087	Bulb, Circulating		None	12				
		6400-00-410-0000	(22527) 3-740B	Burette, Glass, w/Stopcock 55ml		None	12				
			(22527) 3-995B	Flare Spreader, Brass for Bunsen Burner		None	3				
			(22527) 3-900	Burner, Artificial Gas 150 to 600 BTU		None	6				
			(22527) 3-902P	Burner, LPG, 2400 to 3300 BTU		None	12				
			(22527) 3-962-P	Burner, Pittsburgh Type, LG 2400 to 3300 BTU		None	6				
		6640-00-017-6595	(22527) 4-236 (22527) 3-915	Burner, Alcohol, Lamp Burner, Gas, 600 BTU		None None	2 6				
			(35051) D03618-00	Jug, Screwcap, Polypropylene 1 Gal.		None	48				
			(22527) 4-667E	Can, Screw Cap, 5 Gal		None	6				
			(22527) 4-667C	Can, Friction Top, 2½ Pound Cap		None	12				
			(35051) D03506-18	Bottle, Screw Cap, Clear Glass, 32 oz		None	160				
			(22527) 4-750	Cement, Dekhottnsky, 1 oz		None	12				
		8040-00-290-8150	(22527) 4-752	Cement, Duco, 1 oz		None	6				
			(22527) 5-680B	Chamois, 18x14A In		None	3				
		6640-00-248-4492	(81346) 12-403-410-52	Chart, Kinematic, Viscosity 25 Sheets Per Pad		None	2				
			(11273) 12090-000	Clamp, Beaker		None	6				
			(22527) 5-779	Clap, Utility, Two Prong		None	4				

(1) Illustration		(2)	(3)	(4)	(5)	(6)	(7)	(8) Quantity			
(a) Figure No.	(b) Item No.	National Stock Number	Part No. & FSCM	Description	Location	Usable	Qty Reqd	Rec'd	Date	Date	Date
		6640-00-962-9820	(22527) 5-766	Clamp, Lab Support Rod		None	12				
			(22527) 5-734	Clamp, Utility, Two Prong Asbestos Covered		None	12				
		6640-00-526-7989	(22527) 5-742	Clamp, Versatile		None	6				
			(22527) 5-779	Clamp, Utility, Two Prong Rubber Sleeved		None	12				
		6640-00-290-6797	(22527) 05-849	Clamp, Rubber Tubing Shutoff		None	24				
		6640-00-418-0000	(22527) 5-850	Clamp, Rubber Tubing, Brass		None	12				
		8305-00-267-3015	(22527) 6-665-17	Cloth, Cheese		None	10				
			(22527) 06-661	Clock, Interval Timer		None	1				
			(48619) 87827	Cloth, Emery No. 00		None	2				
			(22527) 7-891	Cotton, Absorbent, 12 In.		None	3				
		6640-00-232-5986	(64484) S-23025-E	Stopper, Cork, xxx Quality, No. 2, 100 Per Bag		None	1				
			(64484) S-23025-F	Stopper, Cork, xxxx Quality, No. 3, 100 Per Bag		None	1				
		6640-00-232-5990	(64484) S-23025-G	Stopper, Cork, xxxx Quality, No. 4, 100 Per Bag		None	1				
			(64483) S-23025-H	Stopper, Cork, xxxx Quality, No. 5, 100 Per Bag		None	1				
			(64484) S-23025-J	Stopper, Cork, xxxx Quality, No. 8, 100 Per Bad		None	1				
			(64484) S-23025-K	Stopper, Cork, xxxx Quality, No. 7, 100 Per Bag.,		None	1				
			(64484) S-23025-L	Stopper, Cork, xxxx Quality, No. 8, 100 Per Bag		None	1				
			(64484) S-23025-M	Stopper, Cork, xxxx Quality, No. 9, 100 Per Bag		None	1				
			(64484) S-23025-N	Stopper, Cork, xxxx Quality,, No. 10, 100 Per Bag		None	1				
			(64484) S-23025-P	Stopper, Cork, xxxx Quality, No. 11, 100 Per Bag		None	1				
			(64484) S-23025-Q	Stopper, Cork, xxxx Quality, No. 12, 100 Per Bag		None	1				
		6640-00-239-5408	(64484) S-23025-S	Stopper, Cork, xxxx Quality, No. 14, 100 Per Bag		None	1				
			(64484) S-23025-T	Stopper, Cork, xxxx Quality, No. 15, 100 Per Bag		None	1				
			(64484) S-23025-AA	Stopper, Cork, xxxx Quality, No. 18, 100 Per Bag							
			(64484) S-23025-CC	Stopper, Cork, xxxx Quality, No. 20, 100 Per Bag		None	1				
			(64484) S-23025-DD	Stopper, Cork xxxx Quality, No. 22, 100 Per Bag		None	1				
			(64484) S-23025-EE	Stopper, Cork, xxxx Quality, No. 24, 100 Per Bag		None	1				
			(64484) S-23025-FF	Stopper, Cork, xxxx Quality, No. 26, 100 Per Bag		None	1				
			(22527) 7-865	Sharpener, Cork Borer		None	1				

(1) Illustration		(2)	(3)	(4)	(5)	(6)	(7)	(8) Quantity			
(a) Figure No.	(b) Item No.	National Stock Number	Part No. & FSCM	Description	Location	Usable	Qty Reqd	Rec'd	Date	Date	Date
			(22527) 2-075-40	Pans, Stainless Steel w/pan Holders (2 Per Set)		None	1				
			(22527) 2-301A	Weight Set, 1 to 500gm		None	1				
			(22527) 2-405	Barometer, Aneroid		None	1				
			(48619) 73410	Bath, Oxidation Stability	ASTMD-94Z	None	1				
			(48619) 73414	bomb, Norma-Hoffman		None	3				
			(48619) 74972	Oil, Bath, Technical White 1 Gal		None	10				
			(64484) S-80765-F	Thermometer, 204°F to 218°F (ASTM E1-22F)		None	6				
1-3	12		(48619) 66656	Water Bath, Utility 120v 1000w		None	1				
			(48619) 524364 (*)	Heater Assembly, 1000w		None	1				
			(48619) 240151 (*)	Switch, 4 Heat		None	1				
			(14674) 1000-20	Beaker, Pyrex, Griffin w/ Spout, 20ml		None	12				
			(14674) 1000-50	Beaker, Pyrex, Griffin w/ Spout, 50ml		None	12				
			(14674) 1000-100	Beaker, Pyrex, Griffin w/ Spout, 100ml		None	12				
			(14674) 1000-250	Beaker, Pyrex, Griffin w/ Spout, 250ml		None	12				
			(14674) 1000-400	Beaker, Pyrex, Griffin w/ Spout, 400ml		None	24				
			(14674) 1000-IL	Beaker, Pyrex, Griffin w/ Spout, 1000ml		None	12				
		6640-00-290-6822	(14674) 1000-30	Beaker, Pyrex, Griffin w/ Spout 30ml		None	12				
			(53629) B-3870-5	Beaker, Pyrex, Griffin w/ Spout, 5ml		None	12				
			(14674) 1000-800	Beaker, Pyrex, Griffin w/ Spout, 800ml		None	12				
			(66484) S23165C	Borer, Set, Cork		None	2				
			(22527) 3-325DD	Bottle, French Square, w/ Cap, 8 oz		None	24				
			(64484) 5-8275-H	Bottle, French Square w/ Cap Crystal, 32 oz		None	24				
			(64484) 5-8250-F	Bottle, Stopper, Round w/o Bulb, Crystal, 32 oz		None	48				
			(22527) 2-890-10G	Bottle, French Square w/Cap Amber 32 oz		None	48				
		6640-00-359-9663	(22527) 13-559	Bottle, Unsaturation, w/ Glass Stopper, 0%; to 100%.		None	6				
			(22527) 2-892CC	Bottle, Round, a/Cap, Crystal, 4 oz		None	48				
		6640-00-290-6835	(22527) 3-406A	Wash Bottle, Pyrex, w/2 hole Stopper and tubes 500ml		None	6				
		8125-00-263-8232	(64484) S-8240-B	Bottle, round, w/Cap Crystal 2 oz		None	12				
			(22527) 3-086	Bottle, Stopper, Round w/ stopper, Crystal 4 oz		None	24				

(1) Illustration		(2)	(3)	(4)	(5)	(6)	(7)	(8) Quantity			
(a) Figure No.	(b) Item No.	National Stock Number	Part No. & FSCM	Description	Location	Usable	Qty Reqd	Rec'd	Date	Date	Date
1-4	7	6630-00-359-9626	(48619) 73478	Aniline Point Apparatus U-Tube, 120v, 50/60HZ	ASTMD-611	None	1				
			(65586) CES-12-208-1PH	Boiler, Steam			1				
			(65586) 118524-008 (*)	Element, 208V			1				
			(65586) 118533-1 (*)	Gasket			1				
			(65586) GCH-2155-120	Heater, Circulation	ASTMD-323		1				
			(65586) TM0-215-120V-1500W (*)	Element, 120V, 1500W			1				
			(66586) AR5524 (*)	Thermostat, 120V			1				
			(66586) 010046-002 (*)	Gasket			1				
			(48619) 72752C	Thermometer, Aniline Point, 25°C to 105 °C		None	6				
		6640-00-359-9841	(48619) 73482	Heater, Electric, Aniline Point, 800W		None	1				
1-3	8		(48619) 75024	Carbon Residue, Ramsbottom, Natural Gas, Complete with the Following:	ASTMD-524						
			(48619) 75025	Pyrometer, 1200°F		None	1				
			(48619) 75026	Coking Bulb, Glass		None	24				
			(48619) 75031	Control Bulb, Steel		None	1				
			(48619) 247045 (*)	Heater		None					
			(48619) 536537 (*)	Insulator, Heater		None					
			(48619) 240003 (*)	Switch, Power		None					
			(66484) S-24155	Crucible, Outer, Iron		None	1				
			(66484) S-23665G	Crucible Ignition w/o Cover, Porcelain		None	12				
			(22527) 08-020B	Crucible, Skidmore, Nickel w/o Cover		None	1				
			(22527) 08-025B	Cover, Crucible		None	1				
		6640-00-444-9000	(96906) MS36027-1	Triangle, Chrome Wire		None	8				
			(48619) 66125	Burner, Natural Gas		None	1				
		6640-00-359-9640	(48619) 73577	Block, Asbestos, Molded Porcelain, Refractory		None	1				
			(22527) 11-312C	Beads, Glass, Solid, 5MM Dia. 2900 Per LB		None	1				
1-5	10	6640-00-062-4336	(48619) 67310	Centrifuge, Electric, 4 Place Head, 60 Cycle, 115V, Complete with the Following:		None	1				
			(48619) 67314	Ring, Trunnion		None	4				
			(48619) 67360	Shield, Tube		None	12				

(1) Illustration		(2)	(3)	(4)	(5)	(6)	(7)	(8) Quantity			
(a) Figure No.	(b) Item No.	National Stock Number	Part No. & FSCM	Description	Location	Usable	Qty Reqd	Rec'd	Date	Date	Date
2-10			(81337) 5-14-322	CABINET,OVEN AND WATER BATH		None	1				
2-11			(81337) 5-14-323	CABINET, HIGH TEMPERA-TURE: KINEMATIC VISCOSIMETER		None	1				
2-13			(81337) 5-14-124	CABINET, DISTILLATION (DOUBLE) APPARATUS		None	1				
2-14			(81337) 5-14-125	CABINET, DISTILLATION (SINGLE) APPARATUS		None	1				
2-15			(81337) 5-14-326	CABINET, MUFFLE FURNACE AND PENETROMETER		None	1				
2-16			(81337) 5-14-327	CABINET, ASTM GUM APPARATUS		None	1				
2-17			(81337) 5-14-328	CABINET, WATER STILL		None	1				
2-18			(81337) 5-14-329	CABINET, TETRAETHYL LEAD AND SULFUR APPARATUS		None	1				
2-18.1			(81337) 5-14-330	CABINET, GLASSWARE STORAGE		None	8				
2-18.2			(81337) 5-14-331	CABINET, CHEMICAL STORAGE		None	1				
2-19			(81337) 5-14-332	CABINET, BALANCE TABLE		None	1				
2-20			(81337) 5-14-333	CABINET, SINK, STORAGE		None	1				
2-21			(81337) 5-14-334	CABINET, OXIDIZATION STABILITY APPARATUS		None	1				
2-22			(81337) 5-14-335	HOOD, FUME		None	2				
2-23			(81337) 5-14-336	CABINET, LOW TEMPERA-TURE KINEMATIC VISCOSIMETER APPARATUS		None	1				
2-24			(81337) 5-14-337	CABINET, REFRIGERATOR		None	1				
2-25			(81337) 5-14-338	CABINET, CLOUD AND POUR POINT APPARATUS		None	1				
2-27			(81337) 5-14-340	CABINET, CENTRIFUGE AND CHANNEL POINT APPARATUS		None	1				
2-1			(81337) 5-14-341	CONTAINER, SHIPPING		None	27				

APPENDIX D

TEXTBOOK LISTING FOR PETROLEUM BASE LABORATORY

Item	Nomenclature	Unit	Quantity Desired
1	ASTM Manual for rating motor, diesel and aviation fuels (TM-10-1163)	EA	1
1	ASTM Standards on petroleum products and lubricants (TM-10-1166) part 17	EA	1
3	Federal test method standard No. 791A	EA	1
4	Federal test method standard No. 791B	EA	1
5	ASTM methods for measurement and sampling method D-1085	EA	1
6	Military/Federal specifications Volume I	EA	1
7	Military/Federal specifications Volume II	EA	1
8	Military/Federal specifications Volume III	EA	1
9	Index of specifications and standards (Part I)	EA	1
10	Index of specifications and standards (Part II)	EA	1
11	Reference list of specifications and standards	EA	1
12	Hand book Chemistry and Physics	EA	1
13	Hand book Chemical Engineers	EA	1
14	Booklet of national petroleum correction tables	EA	1
15	Technical methods of analysis	EA	1
16	Chemical technology of petroleum and its products, McGraw Hill	EA	1
17	ASTM standards, TM-10-1167 (part 18)	EA	1

Item	Nomenclature	Unit	Quantity Desired
18	ASTM standards index	EA	1
19	Inspecting and testing petroleum products TM-10-70	EA	1
20	Book, ASTM Viscosity index (U/O ASTM D-445-74)	EA	1
21	Catalog, Fisher Scientific Co.	EA	1
22	Catalog, Sargant Welch Scientific Co.	EA	1
23	Catalog. Precision Scientific Co.	EA	1
24	Catalog Greiner Scientific Co.	EA	1
25	Chemistry of petroleum by Ellis Volume I	EA	1
26	Chemistry of petroleum by Ellis Volume II	EA	1
27	Scotts Standard Methods of Chemical Analysis Volume I	EA	1
28	Scotts Standard Methods of Chemical Analysis Volume II	EA	1
29	Significance of ASTM Test for Petroleum Products(TM-11-1165)	EA	1

NOTE: All text books listed are authorized and will be furnished as required.

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INDEX - Continued

By Order of the Secretary of the Army:

E. C. MEYER
General, United States Army
Chief of Staff

Official:

ROBERT M. JOYCE
Brigadier General, United States Army
The Adjutant General

DISTRIBUTION:
To be distributed in accordance with DA Form 12-25A, Operator maintenance requirement for Equipments Miscellaneous, Petroleum Distribution.

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RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS

THEN...JOT DOWN THE DOPE ABOUT IT ON THIS FORM. CAREFULLY TEAR IT OUT, FOLD IT AND DROP IT IN THE MAIL.

SOMETHING WRONG WITH PUBLICATION

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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