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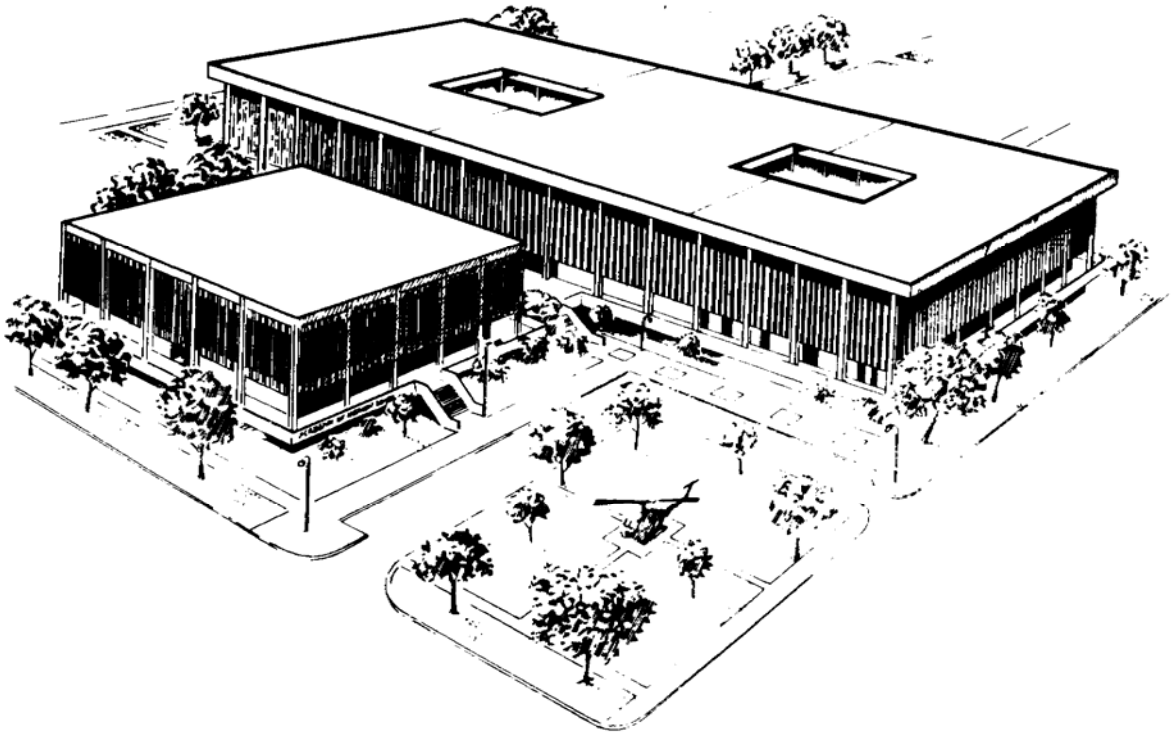

REFRIGERATOR AND FIELD SINK

SUBCOURSE MD0367 EDITION 100

DEVELOPMENT

This subcourse is approved for resident and correspondence course instruction. It reflects the current thought of the Academy of Health Sciences and conforms to printed Department of the Army doctrine as closely as currently possible. Development and progress render such doctrine continuously subject to change.

ADMINISTRATION

Students who desire credit hours for this correspondence subcourse must enroll in the subcourse. Application for enrollment should be made at the Internet website: http://www.atrrs.army.mil. You can access the course catalog in the upper right corner. Enter School Code 555 for medical correspondence courses. Copy down the course number and title. To apply for enrollment, return to the main ATRRS screen and scroll down the right side for ATRRS Channels. Click on SELF DEVELOPMENT to open the application; then follow the on-screen instructions.

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CLARIFICATION OF TERMINOLOGY

When used in this publication, words such as "he," "him," "his," and "men" 'are intended to include both the masculine and feminine genders, unless specifically stated otherwise or when obvious in context.

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CORRESPONDENCE COURSE OF
THE U.S. ARMY MEDICAL DEPARTMENT CENTER AND SCHOOL

SUBCOURSE MD0367

REFRIGERATOR AND FIELD SINK

INTRODUCTION

In this subcourse, you will learn how to maintain and repair a refrigerator and how to maintain a field sink.

If a refrigerator fails at home, food could spoil. If a refrigerator fails in the medical field, thousands of dollars in lost medicine could occur. This could cost someone his or her life.

When surgery is performed in the field, the chance of infection increases. To help prevent infections, field medical personnel use the field sink. It is vital that you know how to maintain and repair the refrigerator and field sink.

Subcourse Components:

This subcourse consists of two lessons and an appendix. They are:

- Lesson 1, Refrigerator Maintenance.
- Lesson 2, Field Sink Maintenance.
- Appendix, Troubleshooting Guide for the Refrigerator.

Credit Awarded:

Upon successful completion of the examination for this subcourse, you will be awarded 5 credit hours.

To receive credit hours, you must be officially enrolled and complete an examination furnished by the Nonresident Instruction Branch at Fort Sam Houston, Texas.

You can enroll by going to the web site http://atrrs.army.mil and enrolling under "Self Development" (School Code 555).

A listing of correspondence courses and subcourses available through the Nonresident Instruction Section is found in Chapter 4 of DA Pamphlet 350-59, Army Correspondence Course Program Catalog. The DA PAM is available at the following website: http://www.usapa.army.mil/pdffiles/p350-59.pdf.

LESSON ASSIGNMENT

LESSON 1	Refrigerator Maintenance.
TEXT ASSIGNMENT	Paragraphs 1-1 through 1-8.
TASKS TAUGHT	Perform Preventive Maintenance Checks and Services (PMCS) on the Refrigerator. Isolate Malfunctions to Component Level in the Refrigerator. Remove and Replace or Repair Defective Components of the Refrigerator.
LESSON OBJECTIVES	When you have completed this lesson, you should be able to: 1-1. Identify the purpose of the components. 1-2. Identify the location of components 1-3. Identify procedures to perform tests. 1-4. Identify how to use the troubleshooting guide to isolate malfunctions. 1-5. Identify procedures to remove and replace or repair defective components.
SUGGESTION	Work the lesson exercises at the end of this lesson before beginning the next lesson. These exercises will help you accomplish the lesson objectives.

LESSON 1

REFRIGERATOR MAINTENANCE

1-1. HEAT REMOVAL

The study of refrigeration is the study of removing heat. Heat can be changed from one form to another: for example, electricity to heat. Heat can be moved from one place to another. Heat travels from hot to cold. The larger the temperature difference, the faster heat travels. Cold, then, is the absence of heat. All materials contain heat down to -460º Fahrenheit, absolute zero. At absolute zero, there is nothing colder to absorb heat.

1-2. COMPONENTS OF A BASIC REFRIGERATION SYSTEM

Refer to figure 1-1. This figure illustrates the refrigeration system and the location of the major components. The following paragraphs provide the functions of the major components.

a. **Evaporator**. The evaporator boils or evaporates refrigerant. It changes the state of the refrigerant from a liquid to vapor and absorbs heat.

b. **Compressor**. The compressor increases the vapor pressure and moves the refrigerant. The types of compressors are hermetic, semihermetic, and open.

c. **Condenser**. The condenser condenses the refrigerant. It changes the state of refrigerant from vapor to liquid and gives up heat to the atmosphere.

d. **Flow Controls**. The flow controls create a pressure difference and regulate the quantity of refrigerant flow. Types of flow controls are as follows:

(1) Capillary tube. The inside diameter and length control the flow. This tube is used on balanced manufactured units and only with hermetic compressors. It is a simple and low cost method to control refrigerant flow. You must use an accumulator strainer dryer with the capillary tube.

(2) High side float. This control is used in high volume centrifugal systems and big chillers. It passes liquid but not vapor.

(3) Low side float. This control is generally used with ammonia systems.

(4) Automatic expansion valve. The valve applies constant pressure on the evaporator and is commonly used on water fountains.

(5) Thermostatic expansion valve. The sensing bulb refrigerant in the bulb is the same as the unit bulb on the evaporator.

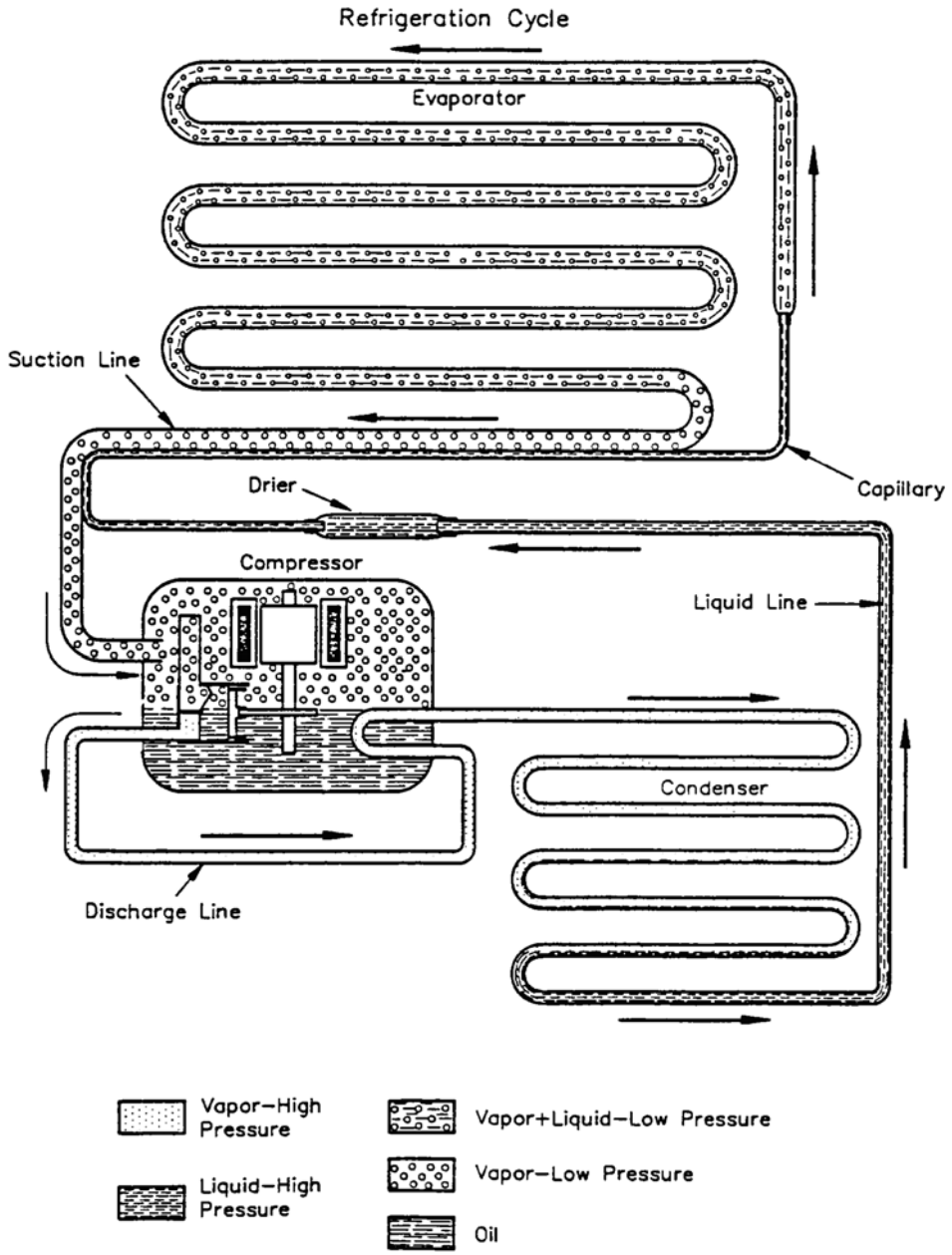

Figure 1-1. Basic refrigeration system.

1-3. PREVENTIVE MAINTENANCE CHECKS AND SERVICES PROCEDURES

You perform preventive maintenance checks and services (PMCS) to ensure that the refrigerator operates properly. All checks are performed before operation and semiannually.

a. **Operational Inspection/Test Procedures**. While inspecting and testing the refrigerator, you can discover malfunctions that require servicing. Follow these procedures to inspect and test the refrigerator.

CAUTION: Under no circumstances should the refrigerator be laid on its front or side. Flooring on which the refrigerator is to be situated must be free of vibration and reasonably level.

(1) Check all exposed refrigeration lines to be sure they are not dented or broken.

(2) Check the condenser fan for free rotation.

(3) Check the outer surface for dents, breaks or damage that could affect the operation. If a break extends through outer surfaces into the interior of the unit, request unit medical equipment maintenance support.

NOTE: The equipment is not ready or available if a break extends through the outer surfaces into the interior of the unit.

(4) Check the latches and hinges for tightness of attachment and smooth operation. Ensure that when the door is closed, it provides a tight seal.

(5) Check the door gasket for cracks, cuts, or breaks.

(6) Check the interior of the unit for cracks or breaks in surfaces.

(7) Check that the shelves are present and in good condition.

(8) Check controls and gauges for damage that would prohibit the unit from operating normally.

(9) Check the shock mount and foot assembly for damage and proper operation.

(10) Check the grille front and back to ensure they are clean and do not obstruct air flow.

(11) Check all exposed tubing connections of the refrigeration system for leaks. Request unit medical equipment maintenance support if tubing is leaking,

(12) Check the power cord and plug for cracks, cuts, and exposed bare wires. Check that the insulation has not been pulled away from plug or unit strain relief.

NOTE: The equipment is not ready or available if there are bare wires exposed or damaged prongs on the plug.

CAUTION: Make certain that the cabinet is located so that the front grille opening is unobstructed.

(13) Connect the power cord to the correct power supply as indicated on the unit identification plate.

NOTE: The equipment is not ready or available if the unit fails to operate after checking the fuse, or the unit starts and you notice unusual smells or noises.

NOTE: Allow the unit to operate for several hours before checking that it is operating within the proper temperature range set by the manufacturer.

(14) Check that the unit is operating within the temperature range set on the refrigerator control.

(a) Hang an accurate thermometer next to the temperature sensing bulb in the refrigerator.

(b) Ensure that the temperature reading on the temperature gauge corresponds to the reading of the accurate thermometer inside the refrigerator.

NOTE: The equipment is not ready or available if the unit fails to operate within the manufacturer's specified temperature range.

(15) Put the unit into operation if no EQUIPMENT IS NOT READY/AVAILABLE condition exists.

b. **Manifold Gas and Pressure Test**. To perform the manifold gas and pressure test, follow these procedures.

(1) Connect the blue hose from the low side gauge to the suction access (vacuum on gauge).

(2) Connect the red hose from the high side gauge to the high side access.

(3) Connect the yellow hose from the center on the manifold to the Freon tank.

(4) Open the Freon valve.

(5) Loosen the red and blue hoses at the access valves. Crack open the valves at the manifold to purge air from the hoses.

(6) Tighten the hoses and open the valves on the refrigerator and at the manifold until the pressure on both gauges equalize.

(7) Test for leaks.

(a) Spray a soap solution on the joints.

(b) Add dye to the system to detect very small and hard to detect leaks.

(c) Use a halide torch to locate leaks.

1 Use the torch to heat the copper element until it is cherry red.

2 Move the hose over the system. A change of color indicates a leak.

a Pale blue--no leaks.

b Yellow-green--small leak.

c Purplish-blue--large leak.

(d) Use an electronic leak detector. Follow the manufacturer's instructions.

c. **System Evaporation**.

(1) Connect the manifold gauges.

(a) Connect the blue hose from the compound gauge to the suction access valve.

(b) Connect the red hose from the high side gauge to the high side access valve.

(c) Connect the yellow hose from the center on the manifold to the vacuum pump.

(2) Check the oil in the vacuum pump.

(3) Open both valves on the manifold.

(4) Read the instructions for the pump you are using.

(5) Start the vacuum pump.

(6) Run the vacuum pump until the gauge reads 25 inches to 27 inches vacuum (the time depends on the size of the system).

(7) Close both valves on the manifold.

(8) Turn off the vacuum pump per the instructions on the pump.

(a) Leave everything hooked up and see if the compound gauge rises.

1 Retighten all hose fittings if the gauge rises.

2 Repeat the leak check if the gauge continues to rise.

(b) Determine the system is good to charge if the pressure holds for 15 minutes.

d. **System Vapor Charge**.

(1) Connect the manifold gauges.

(a) Connect the blue hose from the compound gauge to the suction access valve.

(b) Connect the red hose from the high side gauge to the high side access valve.

(c) Connect the yellow hose from the center on the manifold gauge to the tank of Freon.

(2) Open the valve on the tank (make sure the tank is upright).

(3) Open both valves at the manifold (this allows vapor to enter both high and low sides).

(4) Release the pressure to equalize at the gauges.

(5) Close both valves on the manifold.

(6) Start the compressor by plugging in the refrigerator.

(7) Let the system stabilize to check the desired pressure (open the low side valve on the manifold to add Freon).

(8) Continue to add Freon in this manner until you reach the desired pressures.

(a) High side 110 to 140 pounds per square inch (psi).

(b) Low side 5 to -5 psi.

CAUTION: Never add liquid refrigerant to a system as you will flood the system and damage the compressor and other components.

1-4. TROUBLESHOOTING PROCEDURES

General troubleshooting information for locating and correcting many of the operating malfunctions which may develop in the refrigerator are listed in the troubleshooting guide in the appendix. Because local units do not have Freon recovery systems, they do not remove and replace components once they isolate a malfunction. Also, you cannot cut lines carrying Freon because it may cause a Freon leak. Only in a combat situation are you permitted to make repairs which allow Freon leaks.

1-5. COPPER TUBING REPAIR

a. **Flare the Tubing.**

(1) Cut off 1 or 2 inches of copper tubing from stock copper tubing.

(2) Remove any burrs from the copper tubing by using the reamer or cutter.

(3) Place the copper tubing piece in the flaring tool block with about 1/16 inch of the tubing (about the thickness of a nickel) above the flaring tool block.

(4) Lubricate the flaring tool threads with oil to obtain better performance of the tool.

(5) Position the flaring tool over the copper tubing on the flaring tool block.

(6) Compress the copper tube solidly against the counter-sunk recess of the flaring tool block by turning the flaring tool handle clockwise (CW).

NOTE: Too much pressure may split the flare, and too little pressure will not make the flare wide enough. A lopsided flare results from flaring out-of-round tubing.

(7) Remove the flaring tool from the copper tubing.

(8) Remove the copper tubing from the flaring tool block and check the flare for defects.

(a) The flare wall thickness should be equal all around.

(b) The flare should drag easily through the flare nut.

b. **Swage the Tubing.**

(1) Cut off 1 or 2 inches of copper tubing from stock copper tubing.

(2) Remove any burrs from the copper tubing by using the reamer on cutter.

(3) Place the copper tubing piece in the flaring tool block with the tubing extending out from the block at least equal to the outside diameter of the tubing plus 1/4 inch.

(4) Place the flaring tool with the right size adaptor into position over the tubing and flaring tool block.

(5) Turn the flaring tool handle CW until the adaptor is into the tubing all the way (equal to the diameter of the tubing).

NOTE: Do not screw the flaring tool too far down or you will smash the tubing.

(6) Remove the flaring tool from the copper tubing.

(7) Remove the copper tubing from the tool block and check the for defects.

(8) Check to see if the copper tubing will fit into the swage area.

c. **Solder the Tubing.**

(1) Ignite the solder torch.

(a) Open the valve on the tank 1/2 turn counter-clockwise (CCW) (right-handed threads) using a refrigeration wrench. Leave the wrench on the tank.

NOTE: You use a refrigeration wrench because it has the right size hole for the tank, and it will not strip the valve on the tank.

(b) Turn the handle on the regulator 1 to 2 turns CW (left-handed threads).

(c) Use a soap solution to check for leaks around the regulator.

(d) Turn the on/off knob on the torch head CCW to allow gas flow.

(e) Light the torch by holding the torch igniter 1 to 2 inches away from the tip and strike the igniter until the torch is lit. Keep the lighted torch tip pointing away from gas tanks, personnel, and yourself.

(f) Adjust the torch flame by turning the regulator knob. The flame should be about 1 inch in length at the tip of the blue flame.

(2) Extinguish the torch.

(a) Turn the on/off knob on the torch head CW to stop gas flow.

(b) Turn the regulator knob on the tank CCW (all the way out).

(c) Turn off the tank by turning the valve CW.

(3) Solder a swage joint with 25 percent to 45 percent silver solder.

(a) Obtain copper tubing pieces prepared for swaging and clean the inside of the swage tubing and the outside portion of the other piece using crocus cloth.

NOTE: After you clean them, do not touch the clean surfaces with your fingers because the oil from your fingers will get on the tubing, and the solder will not adhere to it.

(b) Position the two pieces of tubing together and secure them in a vise.

(c) Apply the 25 percent silver solder flux all around the joint using a flux brush.

(d) Bend a piece of 25 percent silver solder about 1/2 inch from the end using pliers. (This is all you need to solder the joint.)

(e) Ignite the torch.

(f) Point the flame at the center of overlapping joint. The blue tip of the flame should be about 1/8 inch from the joint. This will heat both pieces of tubing equally.

(g) Move the flame around the joint. When the tubing becomes red hot, touch the solder to the opposite side of the flame. The solder will melt and flow around the joint when joint is hot enough.

(h) Extinguish torch.

(i) Obtain a professional appearance on the soldered joint by wiping the joint with a wet rag to cool the joint and remove the flux.

(4) Solder a swage joint with 15 percent silver solder or silver braze.

(a) Obtain copper tubing pieces prepared for swaging.

(b) Position the two pieces of tubing together and secure them in a vise.

(c) Position a piece of 15 percent silver solder (flat stick) for soldering.

(d) Ignite the torch.

(e) Point the flame at the center of the overlapping joint. The blue tip of flame should be about 1/8 inch from the joint. This will heat both pieces of tubing equally.

(f) Move the flame around the joint and touch the solder to opposite side of the flame. The solder will melt and flow around the joint when the joint is hot enough.

(g) Extinguish torch.

(h) Obtain a professional appearance on the soldered joint by wiping the joint with a wet rag to cool the joint and remove the flux.

1-6. THERMOSTAT REMOVAL AND REPLACEMENT

a. Unplug the unit.

b. Open the door.

c. Locate the thermostat.

d. Remove the knob.

e. Remove the faulty thermostat.

f. Replace the faulty thermostat with a thermostat that functions.

g. Replace the knob.

h. Close the door.

i. Plug in the unit.

1-7. THERMAL OVERLOAD DEVICE REMOVAL AND REPLACEMENT

a. Unplug the unit.

b. Locate the thermal overload detector.

c. Remove electrical connections.

d. Remove the malfunctioning thermal overload detector.

e. Replace the malfunctioning thermal overload detector with one that operates properly.

f. Replace the electrical connections.

g. Plug in the unit.

1-8. COMPRESSOR REMOVAL AND REPLACEMENT

a. Unplug the unit.

b. Evacuate Freon from the system using a recovery system.

c. Disconnect the electrical connections from the compressor.

d. Cut the refrigeration tubing on the high and low side. It may be possible to unsolder swage joints or disconnect flare fittings before cutting tubes.

e. Unbolt the compressor from the shock mounts.

f. Remove the compressor.

g. Connect the new compressor. It will be necessary to re-flare or swage new fittings.

h. Silver solder the refrigeration connections.

i. Evacuate the system with a vacuum pump.

j. Charge the system with Freon.

Continue with Exercises

EXERCISES, LESSON 1

INSTRUCTIONS: Answer the following exercises by marking the lettered response that best answers the question or best completes the sentence.

After you have answered all of the exercises, turn to "Solutions to Exercises" at the end of the lesson and check your answers. For each exercise answered incorrectly, reread the lesson material referenced with the solution.

1. Which of the following components gives up heat to the atmosphere?

   a. Condenser.

   b. Evaporator.

   c. Compressor.

   d. Low side float.

2. Which of the following flow controls is commonly used on water fountains?

   a. Low side float.

   b. High side float.

   c. Automatic expansion valve.

   d. Thermostatic expansion valve.

3. When performing the manifold gas and pressure test, before you loosen the hoses at the access valves to purge air from the hoses, you must:

   a. Test for leaks.

   b. Open the Freon valve.

   c. Connect the manifold gauges.

   d. Open the valves at the manifold.

4. You are testing for leaks using the halide torch and observing changes of color. Which color indicates a small leak?

   a. Pale blue.

   b. Yellow-blue.

   c. Yellow-green.

   d. Purplish-blue.

5. When you vapor charge the system, you must connect the manifold gauges. You connect the red hose from the high side gauge to the:

   a. Vacuum pump.

   b. Tank of Freon.

   c. Suction access valve.

   d. High side access valve.

Check Your Answers on Next Page

SOLUTIONS TO EXERCISES, LESSON 1

1. a (para 1-2c)
2. c (para 1-2d(4))
3. b (para 1-3b(4))
4. c (para 1-3b(7)(c)2)
5. d (para 1-3d(1)(b))

End of Lesson 1

LESSON ASSIGNMENT

LESSON 2	Field Sink Maintenance.
TEXT ASSIGNMENT	Paragraphs 2-1 through 2-6.
TASKS TAUGHT	Perform Preventive Maintenance Checks and Services on the Field Sink.
LESSON OBJECTIVES	When you have completed this lesson, you should be able to: 2-1. Identify the location of the components. 2-2. Identify PMCS procedures.
SUGGESTION	Work the lesson exercises at the end of this lesson before beginning the next lesson. These exercises will help you accomplish the lesson objectives.

LESSON 2

FIELD SINK MAINTENANCE

2-1. GENERAL

The field sink unit consists of a collapsible, portable scrub sink that is capable of delivering either electrically heated or unheated water. This sink unit is for medical personnel to use in the field during pre-operative and post-operative scrub and for cleaning instruments.

2-2. SPECIFICATIONS

You must know the operating specifications for the field sink to ensure that the sink is operating properly. Refer to figure 2-1 for a listing of the general specifications. Figure 2-2 provides performance specifications.

Line Voltage (ac)	115 volts (v), 60 Hertz (Hz)
Flow and Start Delay	Continuous flow within 30 seconds of activating the pump.
Spare Fuses	Two
Spare Washers	Six

Figure 2-1. General specifications.

Heater Performance (Pump)	**Flow Rate (Qt/Min)**	**Temperature (F)**
Knee Lever Left (Activate)	1.8 ± 0.1	95º +5º -2º
Knee Lever Middle	1.2 ± 0.1	105º ± 3º
Knee Lever Right	0.8 ± 0.1	120º +2º -5º
Ambient Water		70º +0º -2º
Heater Performance (Gravity)	**Flow Rate (Qt/Min)**	**Temperature (F)**
	1.5 ± 0.1	98º ± -3º
	2.2 ± 0.1	89º ± -3º

Figure 2-2. Heater performance specifications.

2-3. SINK COMPONENTS

The sink consists of three major components. The following paragraphs describe the components. Refer to figure 2-3.

a. **Base Section.** The parts in the base section serve a dual purpose. The pieces provide a carrying case for all the other components when the unit is transported or stored. When the sink is assembled for use, these parts provide a base and reservoir for the unit. A grounding strap and clamp, the knee controlled valve, and related hoses and fittings are located in the base section. See item 13 in figure 2-3.

b. **Sink Section.** The parts in the sink section in figure 2-3 are the sink (item 14), a detergent dispenser (item 8), a faucet (item 6), and the necessary hoses and fittings.

c. **Power Unit.** The power unit is connected through wiring and hoses to the sink and base sections. It is supported by extension rods. Located externally on the power unit is an indicator light, the heat and pump controls, a fuse holder, a selector valve handle, a demountable fan, and fittings for various connecting lines. Located within the power unit is a water mode selector valve, a terminal block, a water heater, water, and the necessary interconnecting plumbing fittings.

2-4. ASSEMBLY PROCEDURES

The sink is packed in a disassembled form within a field chest (item 13 in figure 2-3). The field chest provides a sturdy, reinforced carrying, shipping, and storage case. If the case is in good condition, it is a water tight case. To assemble the sink, perform the procedures in the following paragraphs.

a. **Mechanical Assembly.**

(1) Place the field chest upside down (lid secured).

(2) Release the chest latches and lift the chest bottom from the lid. (The scrub sink components remain with the lid.)

(3) Release the restraining strap from the power unit. Release the catches and remove the power unit from the lid.

(4) Release the restraining strap from the sink assembly. Remove the sink from the lid, exposing the remaining components.

(5) Release the straps retaining the sink components. Note the location of these items for repacking purposes.

(6) Remove all components from the lid. Lay them on a clean surface.

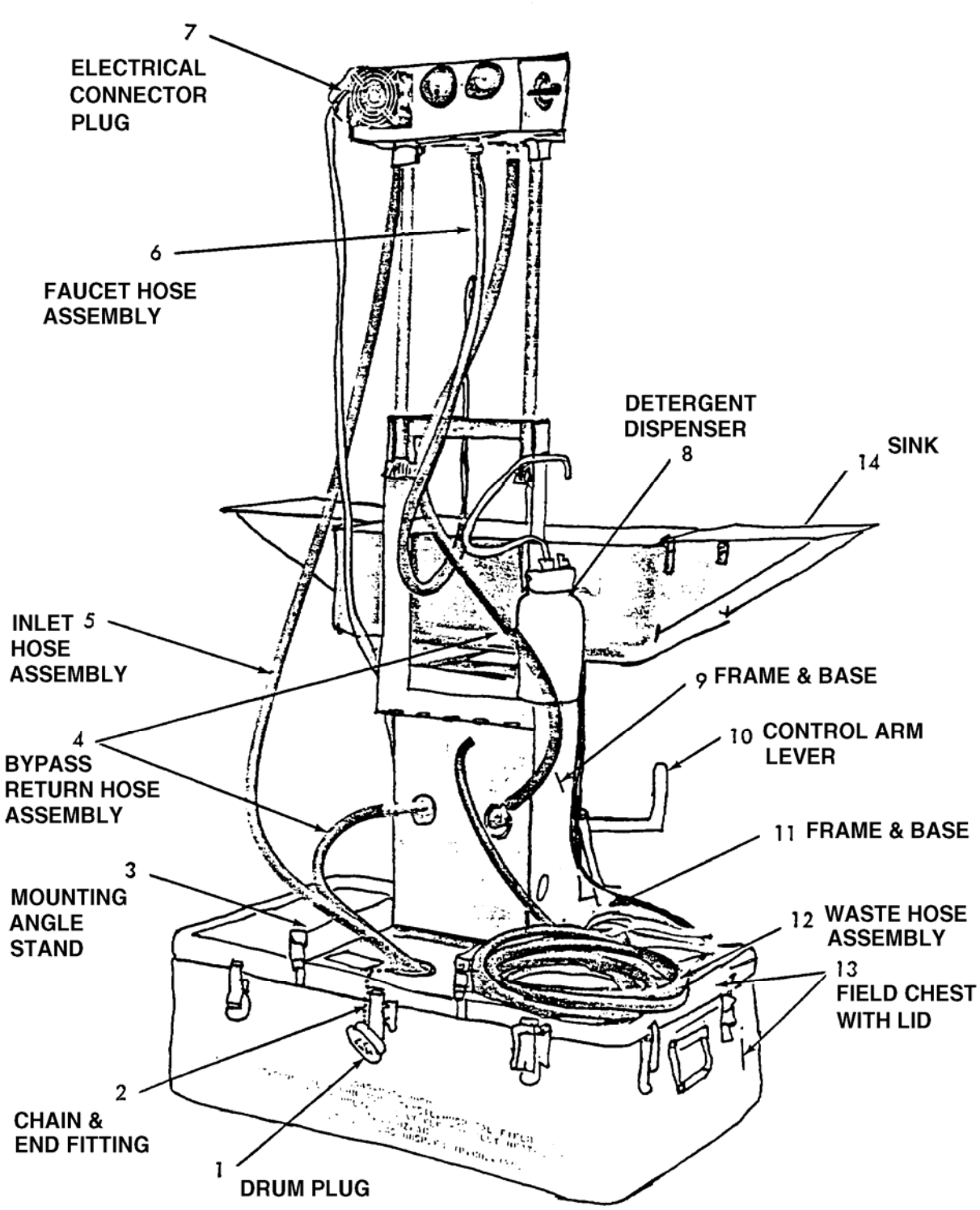

Figure 2-3. Sink unit (rear view).

(7) Secure all restraining straps within the lid.

(8) Replace the lid on the chest and latch it securely.

(9) Swing the stand mounting angles into position. Secure the braces with wing nuts and attach them to the field chest lid.

(10) Position the stand assembly.

(11) Attach the sink assembly using the latches.

(12) Snap the tray assemblies and tray leg brackets into place on either side of the sink assembly.

(13) Position the extension rods on the extension of the stand assembly.

(14) Position the faucet through the bracket on the rear of the sink. Lock it in place with a thumbscrew.

(15) Attach the detergent dispenser. Clip its dispensing spout to a bracket on the stand. Attach the clear hose on the rubber base to the underside of the soap dispenser and lay the rubber base (foot pump) in front of the sink assembly.

(16) Position the power unit on the extension rods.

(17) Connect the hoses.

(18) Fill the reservoir.

NOTE: Disassemble in the reverse sequence.

b. **Electrical Installation.** The electrical installation involves making the ground and electrical connections as described in the following paragraphs

(1) Make the ground connection.

(a) Remove the binding around the wire braid and stretch it out.

(b) Locate a proper ground, such as a water pipe. Tighten the clamp to the pipe.

(c) Check the ground connection between the sink assembly frame and the grounding object.

CAUTION: Put all switches in the OFF position before connecting the sink unit to a power source.

(2) Make the electrical connection.

(a) Use an electrical receptacle supplying the required voltage.

(b) Ensure that the receptacle is located at least five feet above the ground or floor. Make sure the receptacle is properly grounded and designed to accept a three-prong plug from the sink.

CAUTION: Fill the chest reservoir or connect to a suitable water supply before making any pump or heater operational checks.

2-5. OPERATIONAL CHECKOUTS

Refer to figures 2-4 and 2-5 for illustrations of pump operation flow and gravity feed control. After the sink is assembled, you perform an operational checkout. This includes checking the pump and heater. Perform the procedures in the following paragraphs.

a. **Operational Checkout of the Pump.**

(1) Put the plug valve handle in the PUMP position.

(2) Move the toggle switch labeled pump to the ON position.

(3) Move the knee lever to the right (activated) position. The water should begin to flow within 30 seconds.

b. **Operational Checkout of the Heater.**

(1) Move the toggle switch labeled heater to the ON position.

(2) Move the knee operated lever to the activated position (right).

(3) Ensure that the heater is on and the indicator light lights.

(4) Inspect the unit for cleanliness and corrosion. Clean the unit if necessary.

(5) Inspect all hoses and clamps. Replace cracked or deteriorated hoses.

(6) Inspect the electrical components. Clean any components that are corroded.

(7) Inspect wires for brittle or cracked insulation.

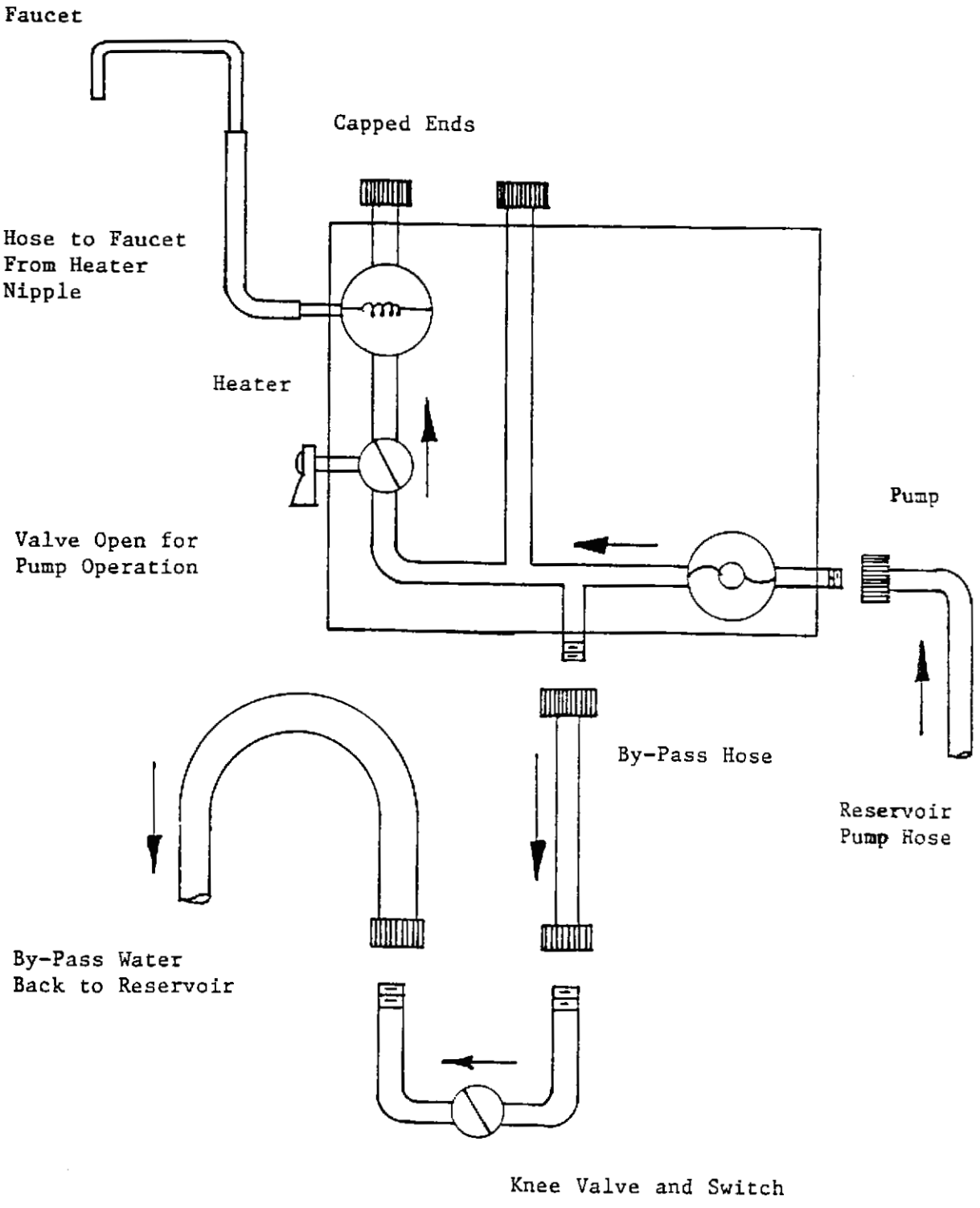

Figure 2-4. Pump operation flow.

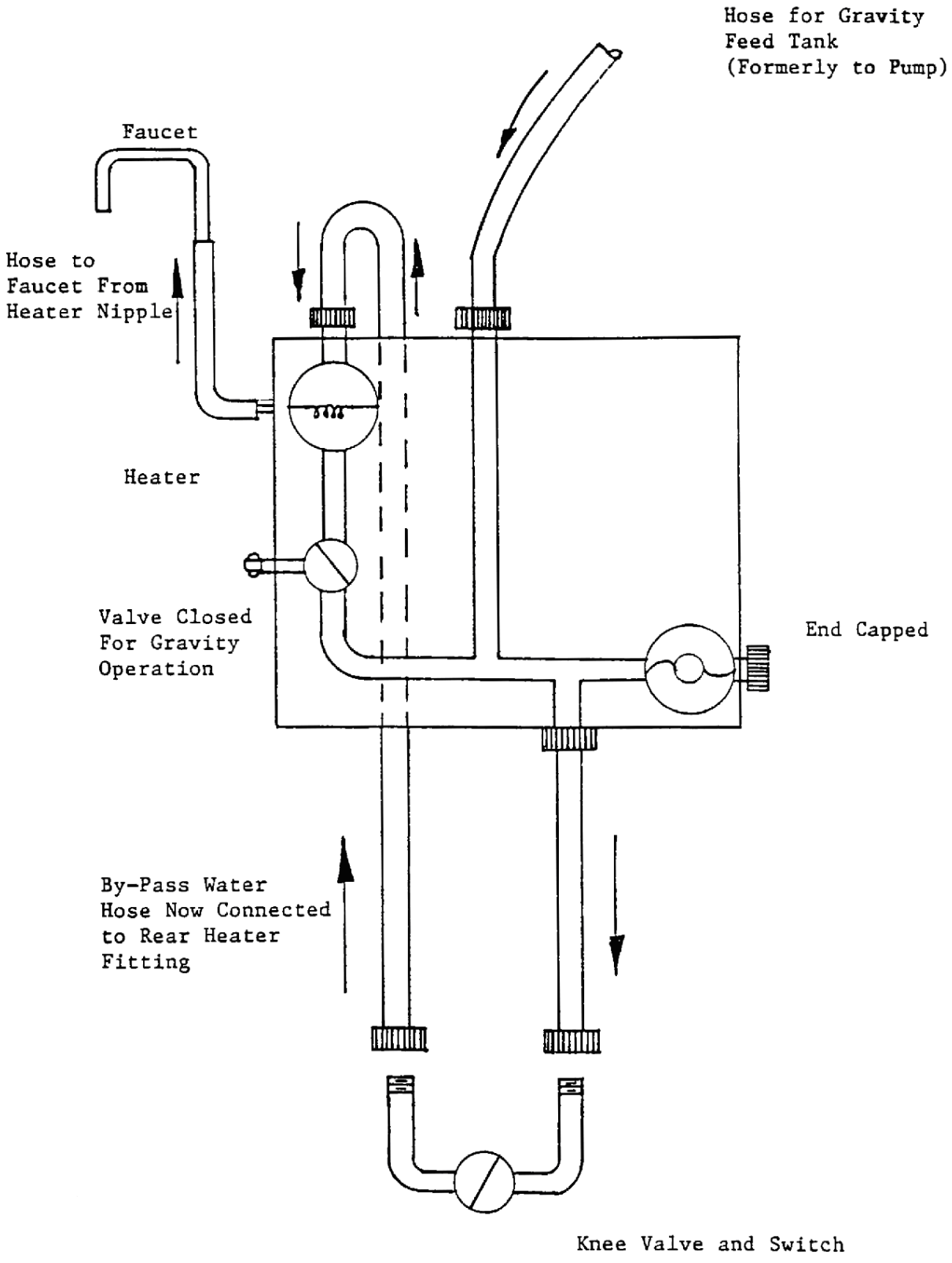

Figure 2-5. Gravity feed flow.

2-6. PREVENTIVE MAINTENANCE CHECKS AND SERVICES

You perform PMCS to ensure the sink operates properly when needed. The following paragraphs describe the procedures.

a. **Inspect the Power Unit Assembly.**

(1) Remove power from the unit.

(2) Remove the cover from the assembly.

(3) Ensure that the volume of water flow meets the specifications.

(4) Check all lines for leaks.

b. **Test the Fuse.**

(1) Remove the fuse from the fuse holder.

(2) Test the fuse using a digital multimeter (DMM). Test for approximately zero ohms.

CAUTION: Fill the reservoir or connect a water supply to the pump BEFORE performing an operational check.

c. **Check the Pump.**

(1) Assemble the unit.

(2) Prime the pump.

(3) Apply power.

(4) Test the pump.

(a) Put the plug valve handle in the PUMP position.

(b) Move the toggle switch labeled PUMP to the ON position.

(c) Move the knee lever to the right (activated) position. Water should begin to flow within thirty seconds. If the water does not flow, troubleshoot for the problem.

(d) Ensure that the volume of control is within the specifications.

(e) With the pump operating, check all lines for leaks.

d. **Inspect and Test the Fan.**

(1) Remove the assembly cover.

(2) Inspect the fan for cleanliness. Clean it if necessary.

(3) Inspect the wires for signs of deterioration.

(4) Apply power to the fan and verify that it operates.

e. **Test the Heater.**

(1) Prime the pump.

(2) Apply power.

(a) Toggle the switch labeled HEATER to the ON position.

(b) Move the knee-operated lever to the activated position (right). This will supply power to the heater.

(c) Ensure that the indicator light lights to indicate the heater is operating. Ensure the water heats to temperatures shown in the specifications.

f. **Inspect the Lamp.** Verify that the lamp operates when the unit is energized.

g. **Inspect the Hose Assembly.** Inspect all hoses for leaks and signs of deterioration.

h. **Inspect the Washers.** Visually inspect washers for signs of deterioration.

i. **Inspect the Surgical Detergent Dispenser.** Visually check for cracks, leaking, and deterioration.

j. **Inspect the Lever Control.** Check for looseness, binding, and proper operation.

k. **Test the Cam Micro Switch.** Rotate the lever control. Verify that the pump energizes, and the heater works when activated.

Continue with Exercises

EXERCISES, LESSON 2

INSTRUCTIONS: Answer the following exercises by marking the lettered response that best answers the question or best completes the sentence.

After you have answered all of the exercises, turn to "Solutions to Exercises" at the end of the lesson and check your answers. For each exercise answered incorrectly, reread the lesson material referenced with the solution.

1. You are reviewing the specifications for the field sink. What is the acceptable line voltage (ac)?

   a. 110v.

   b. 115v.

   c. 120v.

   d. 140v.

2. You are reviewing the specifications for heater performance of the pump. What is the acceptable flow rate (quarts per minute) when using the left knee lever?

   a. 2.8 ± 0.1.

   b. 2.3 ± 0.1.

   c. 1.8 ± 0.1.

   d. 1.3 ± 0.1.

3. You are reviewing the specifications for heater performance during a gravity operation. The flow rate is 1.5 quarts per minute. What should the approximate temperature of the water be?

   a. 98ºF.

   b. 108ºF.

   c. 112ºF.

   d. 120ºF.

4. You are performing an operational checkout of the pump. You activate the pump by moving the knee lever to the:

   a. Left position.

   b. Middle position.

   c. Back position.

   d. Right position.

5. When you test the heater, which of the following tasks do you perform?

   a. Ensure that the water begins to flow within thirty seconds after the pump is activated.

   b. Inspect the surgical detergent dispenser.

   c. Inspect the fan for cleanliness.

   d. Prime the pump.

Check Your Answers on Next Page

SOLUTIONS TO EXERCISES, LESSON 2

1. b (figure 2-1)
2. c (figure 2-2)
3. a (figure 2-2)
4. d (para 2-5a(3))
5. b (para 2-6e(1))

End of Lesson 2

APPENDIX

TROUBLESHOOTING GUIDE FOR THE REFRIGERATOR

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
1. Compressor will not start; no hum.	Line switch open.	Close switch; test/replace switch.
	Fuse removed or blown.	Replace fuse.
	Overload protector tripped.	Test and replace, if required.
	Control stuck in open position.	Test, repair, or replace control.
	Control off due to cold location.	Adjust control.
	Wiring improper or loose.	Check wiring against diagram and repair.
2. Compressor will not start; hums, but trips on overload protector.	Low voltage to unit.	Troubleshoot electrical circuit and correct.
	Starting capacitor defective.	Replace capacitor.
	Relay failing to close.	Determine reason and correct; replace if necessary.
	Compressor motor has a winding open or shorted.	Replace compressor.
	Internal mechanical trouble in compressor.	Replace compressor.
	Improperly wired.	Check wiring against diagram and repair.

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
3. Compressor starts, but does not switch off from start winding.	Low voltage to unit.	Troubleshoot electrical circuit and correct.
	Relay fails to open.	Determine reason and repair or replace relay.
	Run capacitor is defective.	Replace run capacitor.
	Excessively high discharge pressure.	Check discharge shut-off valve for possible overcharge or insufficient cooling of the condenser.
	Compressor motor has a winding open or shorted.	Replace compressor.
	Internal mechanical trouble in compressor (tight).	Replace compressor.
	Improperly wired.	Check wiring against diagram and repair.
4. Compressor starts and runs, but short cycles on overload protector.	Excessive discharge pressure.	Ensure the ventilation is adequate and remove restrictions in refrigeration lines.
	Low voltage to unit.	Troubleshoot electrical circuit and correct.
	Overload protector defective.	Replace protector.
	Run capacitor defective.	Replace capacitor.
	Compressor too hot; return gas hot.	Check refrigerant charge; fix leak; add refrigerant as required.

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
4. (Compressor starts and runs, but short cycles on overload protector--Continued)	Suction pressure too high.	Check refrigeration cycle.
	Compressor motor has a winding shorted.	Replace compressor.
	Excessive current passing through overload protector.	Check wiring diagram; check possible incorrect connection of fan motors, lamps, or heater, and correct.
5. Unit runs ok, but short cycles.	Overload protector.	Replace defective protector.
	Thermostat.	Adjust differential.
	High pressure cut-out due to insufficient circulation.	Check air supply to condenser; correct problem.
	High pressure cut-out due to refrigerant overcharge.	Reduce charge.
	High pressure cut-out due to air in system.	Purge air from system; add refrigerant, as required.
	Low pressure cut-out due to liquid line solenoid leaking.	Repair line.
	Low pressure cut-out due to compressor valve leak.	Replace valve.
	Low pressure cut-out due to undercharge.	Fix leak, add refrigerant.
	Low pressure cut-out due to restriction in expansion device.	Replace device.

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
6. Unit operates long or continuously.	Shortage of refrigerant.	Fix leak; add refrigerant.
	Control contacts stuck or frozen.	Clean contacts or replace control.
	Refrigerated or air-conditioned space has excessive heat load or poor insulation.	Determine fault and correct.
	Dirty condenser.	Clean condenser.
	Evaporator coil iced.	Defrost. Check defrost circuit.
	Restriction in refrigeration system.	Determine location and remove.
	Filter dirty.	Clean or replace filter.
	Run capacitor open, shorted, or blown.	Replace capacitor.
	Excessively high line voltage (110% of rated maximum).	Determine reason and correct.
	Incorrect run capacitor.	Replace with proper capacitor.
	Relay contacts do not open properly.	Clean contacts and replace relay, if required.

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
7. Prolonged operation on start cycle.	Start capacitor open, shorted, or blown.	Replace capacitor.
	Relay mounted incorrectly.	Remount relay in correct position.
	Relay being influenced by loose or vibrating mounting.	Remount rigidly.
	Prolonged operation on start cycle due to high starting load.	Correct by using pump down arrangement, if necessary.
8. Space temperature too high.	Control setting too high.	Reset control.
	Environmental control unit (ECU) temperature too high.	Adjust ECU.
	Inadequate air circulation.	Improve air movement.
9. Suction line frosted or sweating.	Expansion valve passing excess refrigerant.	Replace valve.
	Expansion valve stuck open.	Replace valve.
	Evaporator fan not running.	Test fan motor; replace fan motor, if required.
	Overcharge of refrigerant.	Correct charge.

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
10. Liquid line frosted or sweating.	Restriction in filter drier.	Replace filter drier.
	Liquid shut-off (king valve) partially closed.	Open valve fully.
11. Unit noisy off line.	Loose parts or mountings.	Find loose parts or mountings and tighten.
	Tubing rattling.	Reform tubing so that it is free of contact.
	Bent fan blade causing vibration.	Replace blade.
	Fan motor bearing worn.	Replace bearings or motor, if required.
12. Unit cools but does not get to set point.	Fan not operating.	Check fan motor and circuits. Replace motor if required.
13. Surveillance module upper solution light emitting diode (led) lamp off; displayed temperature correct.	Led lamp defective.	Replace led lamp.
	Led circuit defective.	Determine reason and repair.
14. Surveillance module lower solution led lamp off when selection pushbutton switch depressed; displayed temperature correct.	Switch defective.	Test and replace if required.
	Led lamp defective.	Replace led lamp.
	Led circuit defective.	Determine reason and correct.

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
15. Surveillance module displayed incorrect temperature; led lamps onor off and pushbutton Selection switch notdepressed or depressed momentarily.	Upper/lower solution sensor disconnected.	Check and reconnect sensor.
	Upper/lower solution sensor defective.	Replace sensor(s).
	Digital temperature display defective.	Replace display.
16. Door status led lamp constantly on or flashing and monitor section audible alarm constantly on or pulsing; door closed.	Reset switch defective.	Replace switch.
17. Door status led lamp constantly on or flashing; no audible alarm; door open.	Door switch(es) defective.	Replace switch(es).
	Switch circuits defective.	Determine reason and correct.
	Silence/reset switch defective.	Replace switch.
	Switch or audible alarm circuits defective.	Determine reason and correct.
	Audible alarm defective.	Perform other tests involving alarm and replace, if required.
18. Door status led lamp off; monitor section audible alarm operating correctly; door open.	Led lamp defective.	Replace lamp.
	Circuit defective.	Determine reason and correct.

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
19. Monitor temperature led safe lamp on; power on led lamp on; Power failure led lamp flashing; audible alarm pulsing.	Battery condition low.	Replace the battery.
20. Monitor Temperature led lamps off; power on led lamp on; power failure led lamp off; audible alarm off.	Monitor temperature led lamp(s) defective.	Replace lamp(s).
	Circuit defective.	Determine reason and correct.
21. Monitor temperature led lamps on; power on led lamp on; power failure led lamp off; audible alarm off.	Circuit(s) defective.	Determine reason and correct.
22. Monitor temperature led safe lamp off; power on led lamp off; power failure led lamp flashing; audible alarm pulsing.	Battery test switch in off (down) position.	Place in up position.

End of Appendix