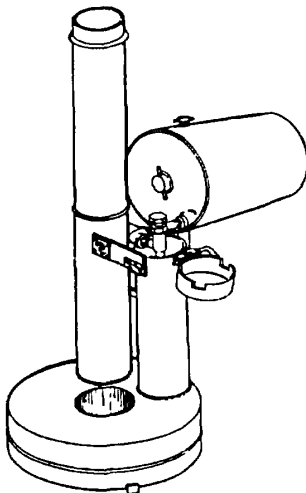


**TECHNICAL MANUAL**  
**OPERATOR'S AND**  
**ORGANIZATIONAL MAINTENANCE**  
**MANUAL,**  
**(INCLUDING REPAIR PARTS AND**  
**SPECIAL TOOLS LIST)**  
**FOR**  
**HEATER, IMMERSION, LIQUID**  
**FUEL FIRED**  
**35,000 BTU**  
**OUTPUT FOR CORRUGATED**  
**CANS**  
  
**(MILITARY MODEL M67)**  
**NSN 4540-00-469-6593**



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**\*This manual supersedes TM 5-4540-202-12&P, 19  
September 1986, including all changes.**

**Distribution Statement A: Approved for public release,  
distribution is unlimited.**

**HEADQUARTERS, DEPARTMENT OF THE ARMY**  
**12 NOVEMBER 1996**

**WARNING**

**DEATH OR SERIOUS INJURY**

**USE OF EMERGENCY FUELS  
JP-4, JP-5, JP-8, DF-A, DF-1, and DF-2**

- Emergency fuels may be used with limited success as long as the same safety precautions taken with gasoline are followed. This includes mixtures of gasoline diesel blends, which are authorized.
- Operation with the emergency fuels will usually result in increased lighting difficulties, decreased efficiency, more frequent adjustments to the fuel flow rate, increased smoke output and shorter intervals between scheduled cleaning.
- Ignition with JP-4 is identical to gasoline and the same lighting procedure applies. Normal ignition procedures cannot be used with JP-5, JP-8 and the diesel fuels. The igniter cup wick can be lighted with a match, however, with these fuels over-saturation of the wick will create lighting difficulties. If the wick cup is over-filled, the heater will have to be dismantled to drain the cup. Ignition with these heavier fuels is accomplished by pre-heating the burner flue in the normal way, then ignite a piece of paper, dropping it onto the burner plate and start the fuel flow.

**WARNING**

- Use heater in a well ventilated area. If heater is used inside building or tent, be sure exhaust fumes are piped outside. Exhaust fumes are poisonous and can cause illness or death if inhaled.
- Do not expose face to burner compartment while lighting or adjusting fuel flow.
- Wear heat protective gloves when igniting fuel with igniter cup.
- Handle any smokestack carefully. They may be hot due to operation of the heater.
- Dry cleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100°F 138°F (38°C - 59°C).
- When gasoline is unavailable, the authorized alternate or emergency fuels are: Kerosene, Diesel, JP-4, JP-5, and JP-8 or mixtures thereof. These fuels may be used with limited success as long as the same safety precautions taken with gasoline are followed. However, the heavier fuels, primarily Diesel, may be limited in low temperature operability by the pourpoint. Only fuels with a pourpoint below the lowest anticipated operating temperature should be used. The ability of each fuel to ignite (Flash Point) will vary with each fuel and will also depend on the fuel temperature. The key point is, in order for fuel to burn, it first must be heated to a certain temperature.

**WARNING****DEATH OR SERIOUS INJURY**

- Under all conditions and with all fuels, the possibility of a flashback can occur. This can result if the burner is ignited before the draft has been established in the burner flue with fuel vapor present in the base of the heater. The operator must always be aware that the draft must be established by pre-heating the burner flue before lighting. The operator's face should not be exposed to the burner compartment while lighting or adjusting the fuel flow.
  - Operation of the heater with diesel fuel is very unsatisfactory and may be limited in very low temperature operation when diesel fuel becomes thick and difficult to pour. Combustion of diesel fuel is very unstable and unburned fuel may accumulate in the bottom of the heater. This accumulation may later re-ignite after the fuel is shut off, by the still hot baffle plate, creating a potential safety problem. If accumulation occurs, shut heater down and allow to completely cool down (approximately 1/2 hour). Do NOT move heater until completely cool, and do NOT add water to aid cool-down. Then drain excess fuel from burner compartment of heater prior to relocation and storage of heater. If free from contamination, drain unused fuel back into supply container. Contaminated/unusable fuel may be considered hazardous waste; dispose in accordance with Federal, State, DOD and DA hazardous waste regulations. Consult local environmental personnel for proper disposal guidance.
  - Emergency fuels may be used with limited success as long as the same safety precautions taken with gasoline are followed. This includes mixtures of gasoline-diesel blends, which are authorized.
  - Operation with the alternate or emergency fuels will usually result in increased lighting difficulties, decreased efficiency, more frequent adjustments to the fuel flow rate, increased smoke output and shorter intervals between scheduled cleaning.
-

## TECHNICAL MANUAL

NO. 9-4540-202-12&amp;P

HEADQUARTERS  
DEPARTMENT OF THE ARMY  
WASHINGTON, D.C., 12 NOVEMBER 1996

OPERATOR'S AND ORGANIZATIONAL MAINTENANCE MANUAL,  
(INCLUDING REPAIR PARTS AND SPECIAL TOOLS LIST)  
FOR  
HEATER, IMMERSION, LIQUID FUEL FIRED  
35,000 BTU OUTPUT FOR CORRUGATED CANS  
(MILITARY MODEL M67) NSN 4540-00-469-6593

Current as of 25 July 1996

**REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS**

You can help improve this manual. If you find any mistakes, or if you know of a way to improve these procedures, please let us know. Mail your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in the back of this manual directly to: Commander, US Army Aviation and Troop Command, ATTN: AMSAT-I-MP, 4300 Goodfellow Blvd., St. Louis, MO 63120-1798 You may also submit your recommended changes by E-mail directly to <mpmt%Oavma28@st-louis-emh7.army.mil> A reply will be furnished directly to you. Instructions for sending an electronic 2028 may be found at the back of this manual immediately preceding the hard copy 2028.

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\*This manual supersedes TM 5-4540-202-12&P, 19 September 1986, including all changes.

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## CHAPTER 1

### INTRODUCTION

---

#### SECTION I. GENERAL INFORMATION

##### **1-1. SCOPE**

This manual is for your use in operating and maintaining the immersion heater (Military Model M67).

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

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

##### **1-3. REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIR)**

If your immersion heater needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design. Tell us why a procedure is hard to perform. Put it on an SF 368 (Quality Deficiency Report). Mail it to us at Commander, Headquarters, U. S. Army Aviation and Troop Command, ATTN: AMSAT-I-MDO, 4300 Goodfellow Boulevard, St. Louis, MO 63120-1798. We'll send you a reply.

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

Commands will decide, according to the tactical situation, when to destroy the immersion heater. A destruction plan will be prepared by the using organization, unless one has been prepared by higher authority. For general destruction procedures for this equipment refer to TM 750-244-3, Procedures for Destruction of Equipment to Prevent Enemy Use.

##### **1-5. PREPARATION FOR STORAGE OR SHIPMENT**

Refer to Chapter 4, Section V, Preparation for Storage or Shipment.

## SECTION II. EQUIPMENT DESCRIPTION

### 1-6. EQUIPMENT CHARACTERISTICS, CAPABILITIES, AND FEATURES

The immersion heater is a self contained unit used for heating water in a corrugated can. The construction is of sheet steel and consists of a doughnut-shaped combustion chamber and two vertical pipes. The larger pipe houses the burner.

There is a partition in the combustion chamber located between the two pipes. When air enters the larger pipe and is heated in the chamber, the combustion gases leave the heater through the smaller, or flue pipe. The burner compartment houses an igniter cup assembly which is used to preheat the flue compartment and ignite the burner.

A hanger is welded to the heater and has two locking screws which clamp the corrugated can between two steel plates securing the heater to the corrugated can. The square sleeve welded on the bottom of the fuel tank fits over the square stud located above the locking screws.

The fuel tank is equipped with a valve assembly, vent cap, and a filler plug all located on the same end of the fuel tank. The heater is equipped with an 8-foot (2.4m) pipe, hereafter called a smokestack, consisting of four sections (Figure 1-1). The immersion heater utilizes Combat Gas or MO GAS (leaded or unleaded) as normal fuel. See Appendix E, Section II, Expendable Supplies and Materials List for authorized emergency fuels.

The immersion heater has two identification plates, one instruction plate, and one caution plate.

**a. Fuel Tank Nameplate.** The fuel tank nameplate is located on the end of the fuel tank opposite the filler plug. It specifies fuel tank nomenclature and National Stock Number.

**b. End Item Nameplate.** The end item nameplate is located at the front of the heater on the welded steel plate that joins the burner compartment with the flue compartment. It specifies end item nomenclature and National Stock Number.

**c. Instruction Plate.** The instruction plate is located on the hinged hood which covers the top of the burner compartment. It gives instructions for operating the heater.

**d. Caution Plate.** The caution plate is located on the side of the fuel tank. It gives caution information for lighting procedure and for adjusting the fuel flow to the heater during operation.

### 1-7. LOCATION AND DESCRIPTION OF MAJOR COMPONENTS

**FUEL SYSTEM.** Consists of the fuel tank with the fuel valve, the fuel filler plug, and the fuel vent cap. All are located on the same end of the tank. The fuel tank has a capacity of 2.2 gallons (8.33 liters).

**HEATER BODY ASSEMBLY.** Consists of the burner hood, igniter handle, burner compartment, combustion chamber, flue compartment, mounting dampers and locking screws.

**SMOKESTACK ASSEMBLY.** Consists of four separate smokestack sections with split rivets.

**BURNER ASSEMBLY.** Free standing device which rests in the base of the burner compartment.



1-7. LOCATION AND DESCRIPTION OF MAJOR COMPONENTS - Continued

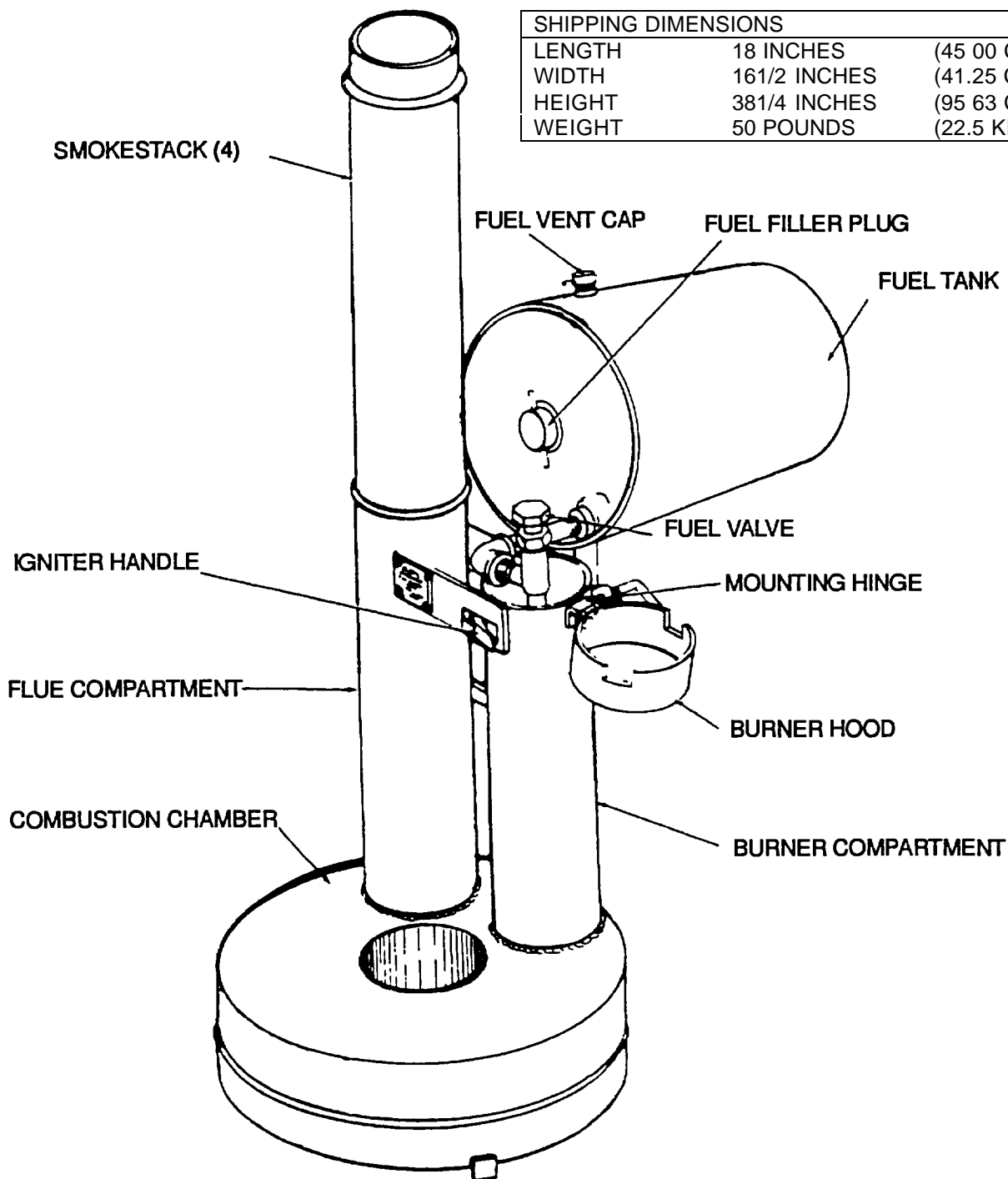


Figure 1-1. Immersion Heater, Three-Quarter View with Shipping Dimensions

**1-8. EQUIPMENT DATA**

|                             |                                     |
|-----------------------------|-------------------------------------|
| Capacities                  |                                     |
| Fuel tank .....             | 2.2 gallons (8.33 liters)           |
| Heat output .....           | 35,000 British Thermal Units        |
| Cubage, crated .....        | 5.6 cubic feet (0.159 cubic meters) |
| Diameter                    |                                     |
| Combustion chamber .....    | 14 inches (35.6 cm)                 |
| Pipe .....                  | 4 inches (10.2 cm)                  |
| Length                      |                                     |
| Burner .....                | 8 7/8 inches (22.5 cm),             |
| Heater only .....           | 34 inches (86.4 cm)                 |
| Heater with fuel tank ..... | 35 1/4 inches (89.5 cm)             |
| Weight                      |                                     |
| Complete .....              | 35 pounds (15.9 kilograms)          |
| Crated .....                | 50 pounds (22.7 kilograms)          |

**1-9. DIFFERENCES BETWEEN MODELS**

Model M67 is the only model covered in this manual.

**SECTION III. TECHNICAL PRINCIPLES OF OPERATION****1-10. HEATING**

After the flue has been preheated to provide the needed draft, the heater is ready to be lit. With the fuel valve open, the stream of fuel is ignited with the burning igniter cup.

The fuel falls over the burner vaporizer plate in the burner compartment and is burned in the combustion chamber.

The heater is vented through the flue compartment and the smokestack

## CHAPTER 2

## OPERATING INSTRUCTIONS

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

**2-1. OPERATOR'S CONTROLS**

a. **Fuel Valve With Handle.** The fuel valve is located at the end of the fuel tank, to the right side of and below the filler plug. It is attached to the fuel tank with a pipe elbow and nipple. When the fuel tank is mounted on the heater, the fuel valve extends down into the burner compartment. It is used to control flow of fuel from tank to burner. Turn valve handle counterclockwise to begin, or increase, flow of fuel and turn handle clockwise to decrease, or stop, flow of fuel (Figure 2-1).

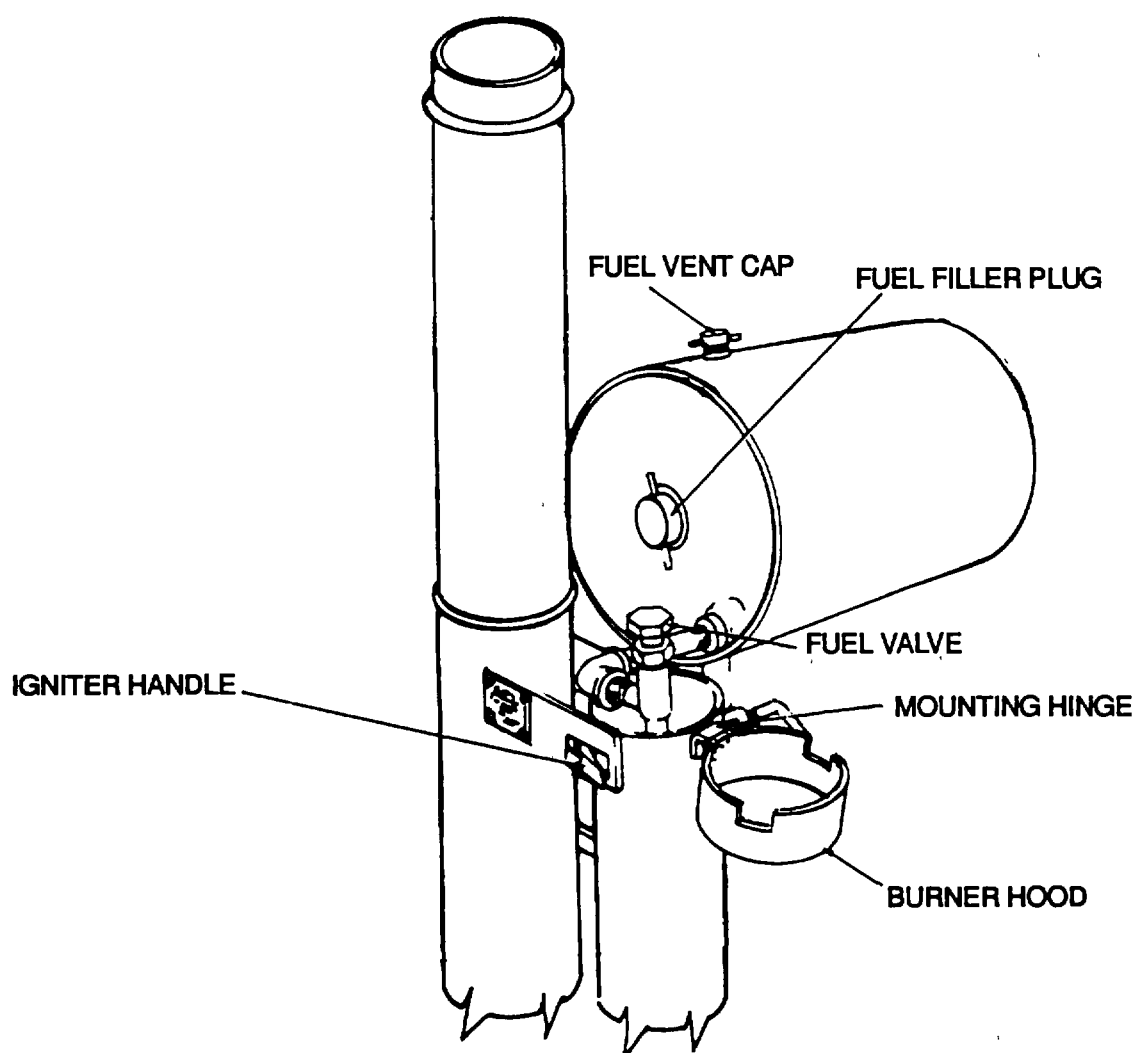


Figure 2-1. Immersion Heater Controls

**2-1. OPERATOR'S CONTROLS - Continued**

b. **Igniter Handle.** The igniter handle is located on the front side of the heater. The handle extends through the opening in the steel plate that joins the burner compartment with the flue compartment. The handle has a spring which makes it a spring return type of control. The igniter cup is mounted on the opposite end of the handle shaft. The cup is normally positioned in the flue compartment with the handle on the right hand side of the opening in the steel plate. The cup, when ignited, is used to preheat the flue compartment and to ignite the burner fuel for operation. Push handle toward the left hand side of opening to position cup in burner compartment for fuel flow. Release hand pressure on handle and spring action will return handle to right hand side position, and position cup back into fuel compartment (Figure 2-1).

c. **Fuel Vent Cap.** The fuel vent cap is located at the top of the fuel tank. The vent cap is used to let air into the tank when the fuel valve is opened, thus permitting fuel flow (Figure 2-1).

**CAUTION**

**Ensure vent cap is dosed when filling fuel tank.**

**SECTION II. OPERATOR PREVENTIVE MAINTENANCE CHECKS AND SERVICES****2-2. GENERAL**

a. The Preventive Maintenance Checks and Services Table lists the inspection and required care of the immersible heater to keep it in good operating condition.

b. The interval column of the PMCS table tells you when to do a certain check or service.

c. The procedure column of your PMCS table tells you how to do the required checks and services. Carefully follow these instructions. If you do not have the tools, or if the procedure tells you to, have organizational maintenance do the work. d. If your equipment does not perform as required, refer to Chapter 3 under troubleshooting for possible problems. Report any malfunctions or failures on the proper DA Form 2404 or refer to DA PAM 738-750.

e. The equipment is not ready/available if column tells you when and why your equipment cannot be used.

**2-2. GENERAL -Continued**

Table 2-1. Operator/Crew 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   | For Readiness Reporting   |
|----------|----------|---|---|---|---|---|------------------------------------|--|---|
|          | B        | D | A | W | M |   |                                    | Check for and have repaired or adjusted as necessary   | Equipment is Not Ready/Available if:  |
| 1        | •        |   | • |   |   |   | HEATER BODY AND COMBUSTION CHAMBER | <p><b>WARNING</b><br/>heaters are used in a shelter, be sure to pipe exhaust fumes outside</p> <p><b>NOTE</b><br/>Visually Inspect for evidence of fuel leaks concurrently with daily service checks.</p> <p>Inspect for holes and broken welds.</p> | <p>Evidence of fuel leakage.</p> <p>Hole larger than 1/2 inch (1.27cm) in diameter in baffle plate.</p> |
|          |          |   |   |   |   |   |                                    | <p>Check for unburned fuel, water, or other foreign matter in the combustion chamber.</p>  |   |
| 2        | •        | • |   |   |   |   | HEATER ASSEMBLY INSTALLATION       | Check that the heater is properly assembled, installed, and damped tight to the can.   |   |

**2-2. GENERAL-Continued**

Table 2-1. Operator/Crew Preventive Maintenance Checks and Services - Continued

**NOTE**

Within designated Interval, these checks are to be performed in the order listed.

| Item No. | Interval |   |   |   |   | C | Item to be Inspected | Procedures<br>Check for and have repaired or adjusted as necessary   | Equipment is Not Ready/Available if: |
|----------|----------|---|---|---|---|---|----------------------|--|--------------------------------------|
|          | B        | D | A | W | M |   |                      |  |                                      |
| 3        | •        | • |   |   |   |   | FUEL TANK            | <p>Check that the fuel tank is filled with the correct fuel.</p> <p>Check that the fuel tank is properly installed.</p> <p>Check that fuel tank vent is in the open position.</p> <p>Inspect for leaks and spilled fuel.</p> <p>Drain the fuel tank.</p> | Evidence of fuel leakage.            |
| 4        | •        | • |   |   |   |   | FUEL VALVE           | Check that the fuel valve controls the flow of fuel just below the smoke level.  |                                      |
| 5        | •        |   |   |   |   |   | WATER LEVEL          | Inspect the water level to make sure that it is six inches below the top of the heater collar.   |                                      |
| 6        | •        |   | • |   |   |   | BURNER ASSEMBLY      | <p>Inspect for clean condition.</p> <p>Check that it is installed correctly in heater body.</p>  |                                      |
| 7        | •        |   | • |   |   |   | SMOKE-STACK          | <p>Inspect for security and dean condition.</p> <p>Check that it is assembled and installed correctly.</p>   |                                      |

## SECTION III. OPERATION UNDER USUAL CONDITIONS

**2-3. ASSEMBLY AND PREPARATION FOR USE****WARNING**

Use heater in a well ventilated area. If heater is used inside building or tent, be sure exhaust fumes are piped outside. Exhaust fumes are poisonous and can cause illness or death if inhaled.

- a. **Location.** Select a site that is level and sheltered as possible

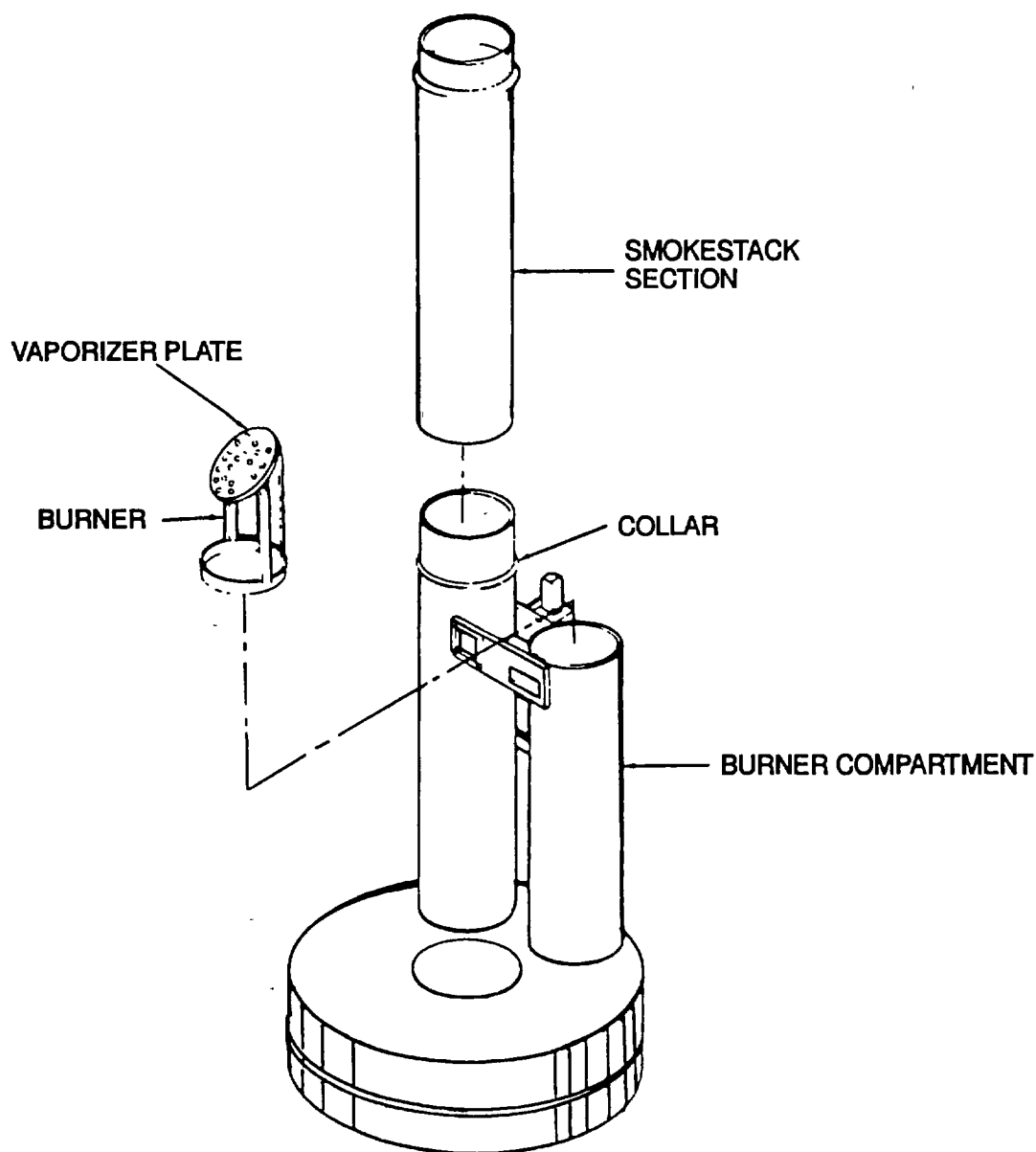


Figure 2-2. Immersion Heater, Compartment

**2-3. ASSEMBLY AND PREPARATION FOR USE - Continued**

## b. Setting Up The Heater.

- (1) Install burner in burner compartment with cast iron vaporizer plate facing up (Figure 2-2).
- (2) Assemble each section of smokestack using two split rivets per section.
- (3) Attach the four sections of the smokestack to the collar on the flue compartment.

**CAUTION**

**Do not set the fuel tank on the heater until after heater is installed in the corrugated can. To do so will cause the unbalanced heater to fall.**

- (4) Place heater in corrugated can with heater hanger resting on rim of can wall and with wall between mounting clamp and rear plate on heater (Figure 2-3).
- (5) Turn two locking screws in hanger clockwise until they are tight against mounting clamp and the heater is secure in position.
- (6) Fill can with water to within 6 inches of the collar assembly.
- (7) Check that fuel tank is full of fuel.
- (8) Place fuel tank on heater by placing mounting sleeve on tank over square stud on heater mounting bracket (Figure 2-3).



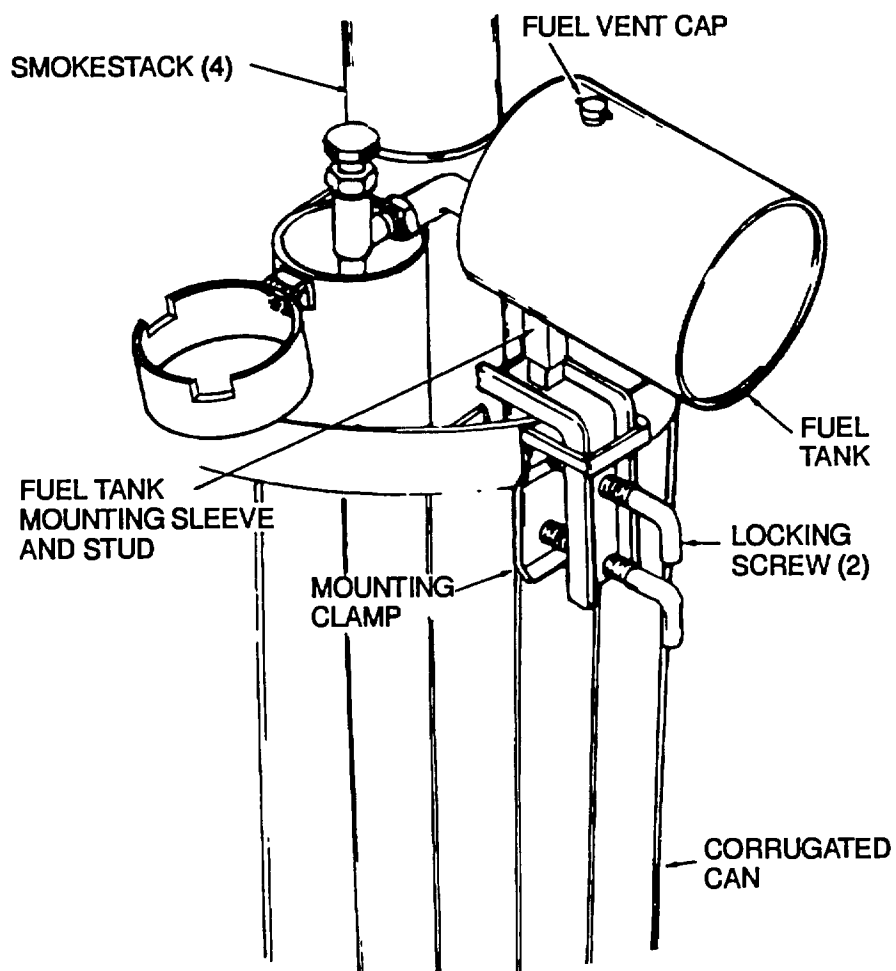
**2.3. ASSEMBLY AND PREPARATION FOR USE - Continued**

Figure 2-3. Immersion Heater and Fuel Tank Installation

**2-4. OPERATING PROCEDURES****WARNING**

**Death or Injury from explosion could result if heater is lit when fuel has accumulated in burner chamber. Drain the fuel first.**

**NOTE**

**Follow the procedures below if the heater is to be used immediately. If not, just drain the fuel and let the burner chamber air out overnight.**

a. Procedures to drain accumulated fuel from burner chamber are as follows:

- (1) Remove fuel tank, smokestacks and heater body.
- (2) Thoroughly rinse the flue, burner and combustion chambers with plenty of water.
- (3) Drain water out
- (4) Assemble heater.

**WARNING**

**Do not attempt to light heater if there is an accumulation of fuel in burner chamber.**

**Do not expose face to burner compartment while lighting or adjusting fuel flow.  
Wear heat protective gloves when igniting fuel with igniter cup.**

b. Starting procedures for the immersion heater are as follows:

- (1) Preparation for Starting. Perform the before operation preventive maintenance checks and services (PMCS) described in Table 2-1.
  - (2) Preheating Flue.
    - (a) Open burner hood (Figure 2-4).
    - (b) Open the fuel vent cap.
    - (c) Push the igniter handle to the left to swing igniter cup below the fuel valve.
    - (d) Open fuel valve and fill igniter cup 1/4 full of fuel (Item 2, Appendix E) or until the asbestos is completely saturated.
    - (e) Close fuel valve.
-

**2-4. OPERATING PROCEDURES - Continued**

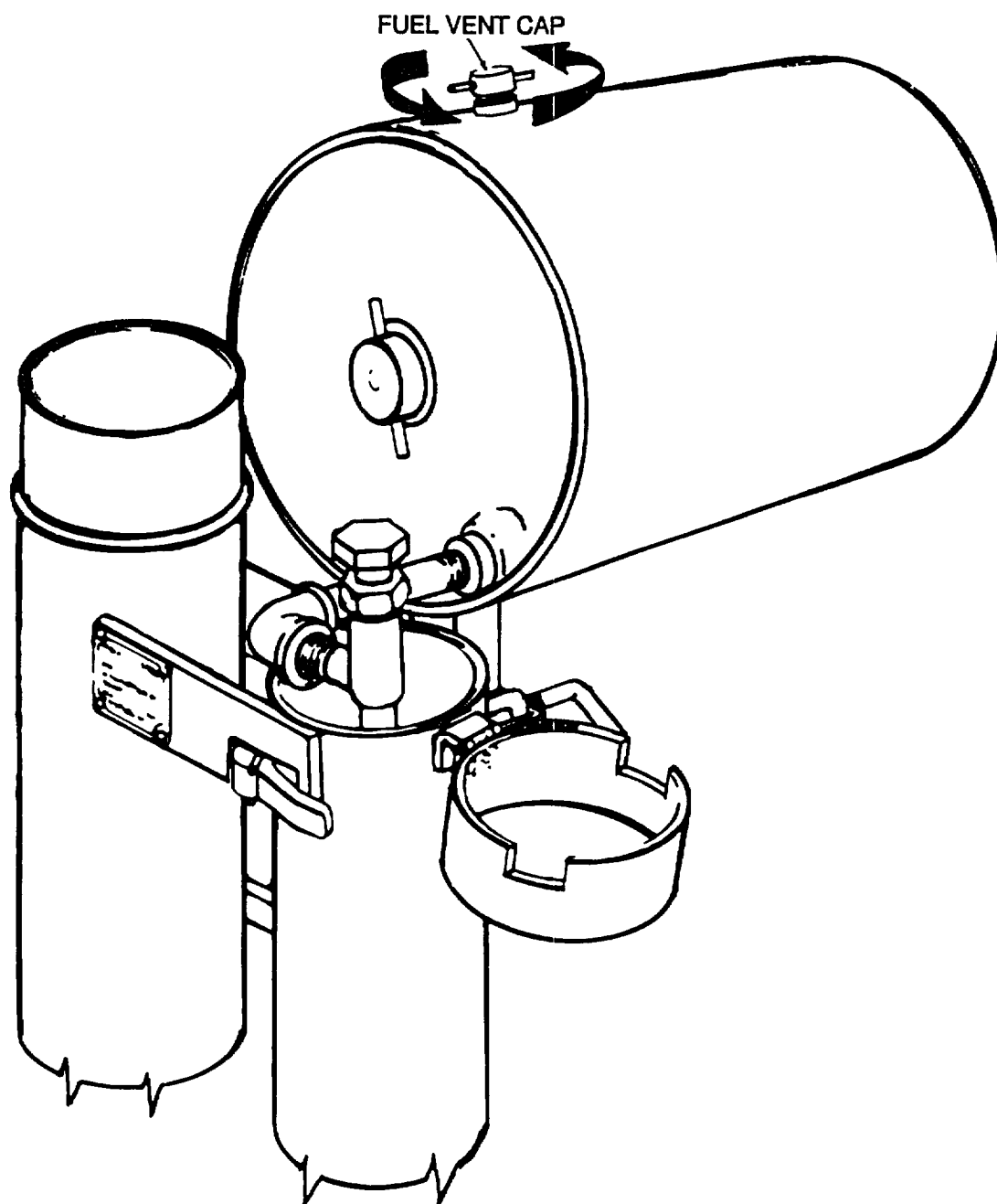
- (f) Ignite fuel in igniter cup with a match (Item 3, Appendix E).
- (g) Move igniter handle to the right and return cup to flue compartment to preheat the flue.
- (h) Reheat the flue for approximately one to two minutes, this will establish the draft necessary for safe starting of heater.

**WARNING**

**Under all conditions and with all fuels, the possibility of a flashback can occur. This can result if the burner is ignited before the draft has been established in the burner flue with fuel vapor present in the base of the heater. The operator must be aware that the draft must be established by preheating the burner flue before lighting. The operator's face should not be exposed to the burner compartment while lighting or adjusting the flame.**

**(3) Starting the Heater.**

- (a) Using igniter handle, move igniter cup into burner compartment until edge of cup is below fuel valve (Figure 2-4).
- (b) Wearing heat protective gloves (Item 4, Appendix E), open the fuel valve (Figure 2-5) and ignite the stream of fuel with the burning cup. The burning fuel will fall on the burner vaporizer plate.
- (c) Return igniter cup to flue compartment.
- (d) Adjust fuel flow to just below smoke point, or to where the drops of fuel resemble a string of beads.
- (e) Close hood and leave closed during operation.

**2-4. OPERATING PROCEDURES - Continued**

*Figure 2-4. Preheating Flue with Igniter Handle*

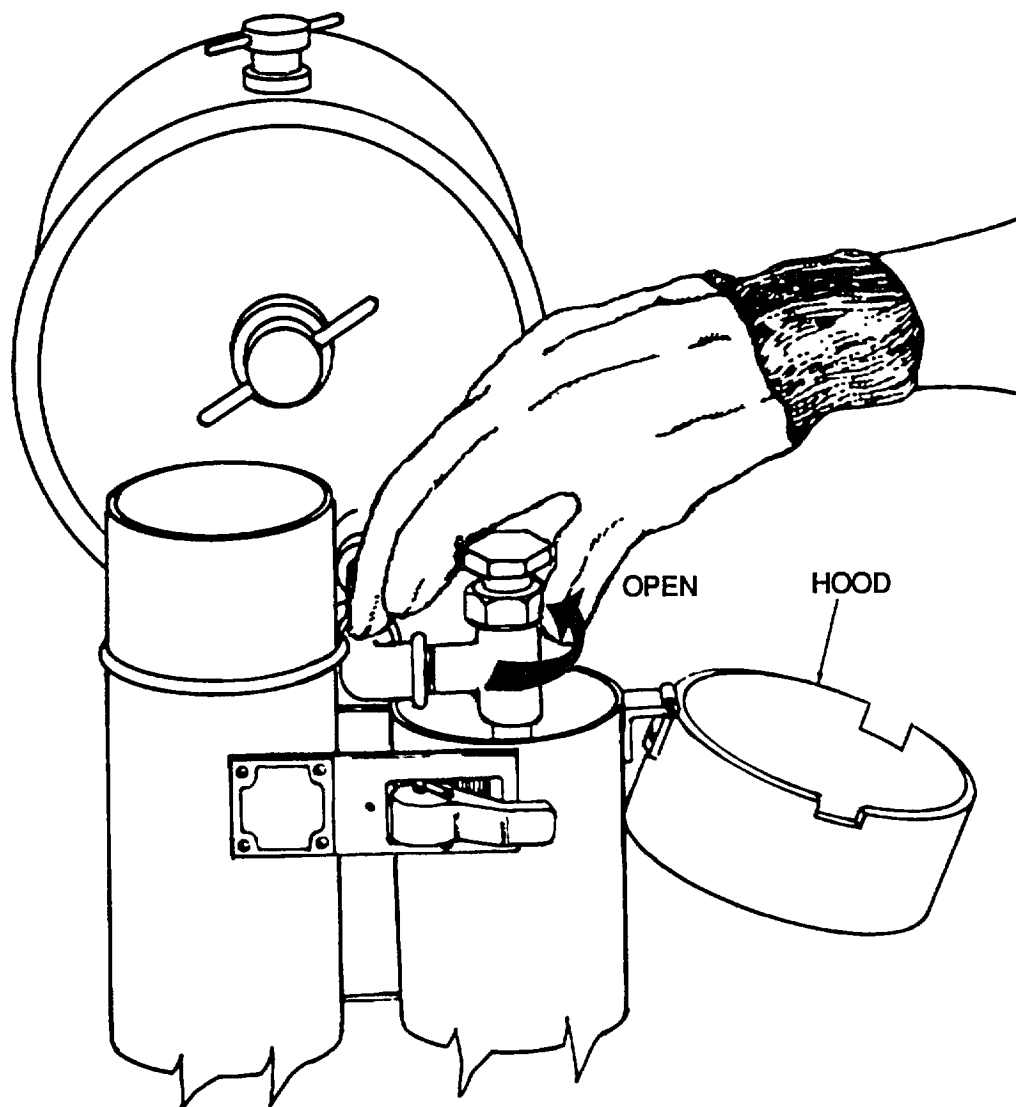
**2-4. OPERATING PROCEDURES - Continued**

Figure 2-5. Lighting Burner and Adjusting Fuel Valve

**2-4. OPERATING PROCEDURES - Continued**

## c. Stopping and Shutdown of Heater.

- (1) Open the hood and close the fuel valve (Figure 2-6).
- (2) Close the fuel vent plug (Figure 2-7).

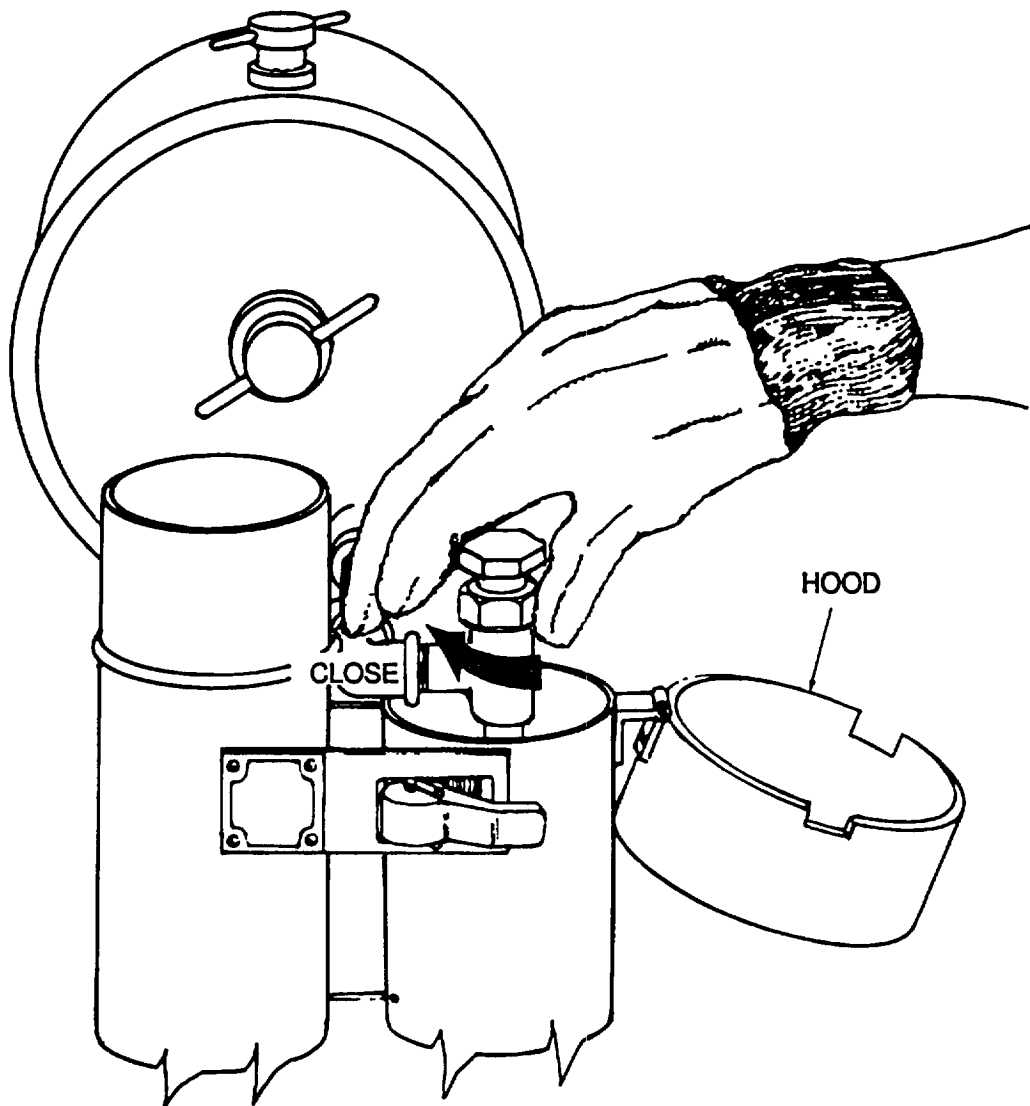


Figure 2-6. Shutting Down Heater (Closing Fuel Valve)

**2-4. OPERATING PROCEDURES - Continued**

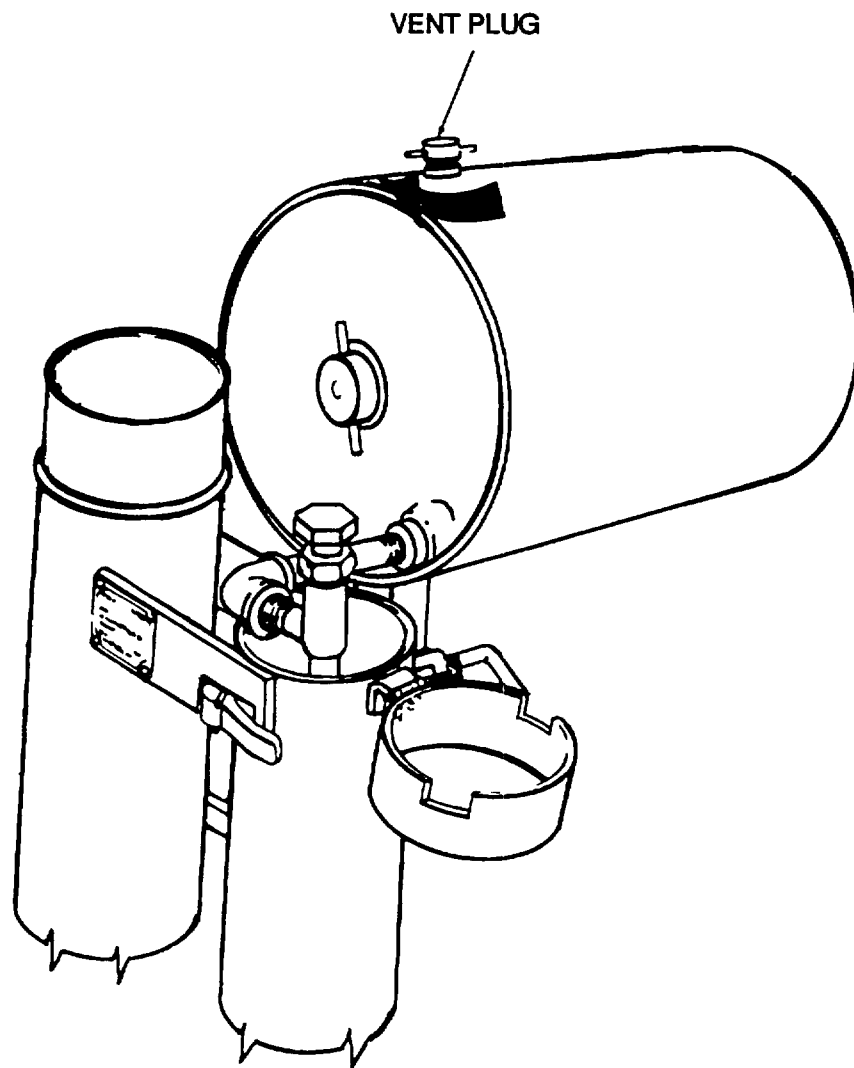
- (3) Allow the remaining fuel in combustion chamber to bum out.
- (4) Remove the fuel tank from the heater.
- (5) Drain the tank.
- (6) Clean the outside of the tank with a stiff brush (Item 9, Appendix E), and hot water.
- (7) With the fuel valve removed, flush the fuel tank with a small amount of fuel to be sure all sediment and foreign matter are removed.

**NOTE**

**Removing the fuel valve and opening either the vent plug or the filler plug will eliminate possible vacuum and allow all liquid to drain from the tank.**

- (8) Inspect the tank for leaks. Replace the tank as required.
- (9) After the smokestacks have cooled, remove them from the heater (Figure 2-2).
- (10) Remove the soot from the smokestack sections.

**2-4. OPERATING PROCEDURES - Continued**



*Figure 2-7. Shutting Down Heater (Closing Fuel Tank Vent Plug)*



**2-4. OPERATING PROCEDURES - Continued**

- (11) Wash the exterior of the smokestack sections with a brush (Item 9, Appendix E) and hot water.
  - (12) Dry the smokestack sections thoroughly. Do not apply paint to the smokestack sections.
  - (13) Inspect the smokestack for holes, dents, and excessive rusting conditions. Replace the sections as required.
  - (14) Remove heater from corrugated can or tank and turn upside down to catch the burner assembly from the burner compartment and also allow any accumulated fuel in the combustion chamber to drain out.
- d. After Shutdown. Perform preventive maintenance checks and services described in Table 2-1.

**2-5. PREPARATION FOR MOVEMENT**

- a. Short Distance.
- (1) Remove smokestack assembly and separate into sections.
  - (2) Remove fuel tank from heater.
  - (3) Wipe heater dry and clean soot from smokestack and burner.
  - (4) If unit is being moved to another space in the same area it can be hand carried.
- b. Long Distance.
- (1) Provide a suitable container for the unit. Refer to TM 38-230-1 for instructions in container fabrication.
  - (2) Provide suitable blocking and tiedown to prevent the unit from shifting during transport.
- c. Installation After Movement. Installation instructions are essentially the same as outlined in Paragraph 2-3.

**SECTION IV. OPERATION UNDER UNUSUAL CONDITIONS****2-6. OPERATION IN UNUSUAL WEATHER****a. Extreme Cold.**

- (1) During extreme cold weather, operate heater in a shelter if possible. Be certain to pipe exhaust fumes outside.
- (2) Provide a windbreak such as a tent, building, tarpaulin, or truck if heater must be operated outside.
- (3) Leave igniter cup or lighter in flue compartment for 3 to 5 minutes instead of normal time of 1 to 2 minutes when preheating flue.

**b. Extreme Heat.**

- (1) Use greater care in lighting and operating heater in extreme heat because of the more rapid evaporation of gasoline under this condition.
- (2) Under tropical conditions, remove condensation from heater with dry cloth to keep heater free from moisture.

**c. Heavy Rain.**

- (1) Up-end heater before each operation and drain any water from combustion chamber.
- (2) Protect the heater with an overhead shelter whenever possible.
- (3) Protect burner from moisture to prevent buildup of rust on vaporizer plate which will interfere with heater operation.

CHAPTER 3

OPERATOR/CREW MAINTENANCE INSTRUCTIONS

SECTION I. LUBRICATION INSTRUCTIONS

No lubrication is required on this equipment.

SECTION II. TROUBLESHOOTING PROCEDURES

**3-1. GENERAL**

- a. The troubleshooting table (Table 3-1) lists the most common malfunctions which you may find during the operation of the immersion heater or its components. You should perform the test/inspections and corrective actions in the order listed.
- b. This manual cannot list all malfunctions which may occur, or all tests or inspections and corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, notify your supervisor.

Table 3-1. Operator/Crew Troubleshooting

| MALFUNCTION        |
|--------------------|
| TEST OR INSPECTION |
| CORRECTIVE ACTION  |

IMMERSION HEATER ASSEMBLY

1. HEATER FAILS TO START

Step 1. Check for closed vent cap.

Open the vent cap by turning it counterclockwise.

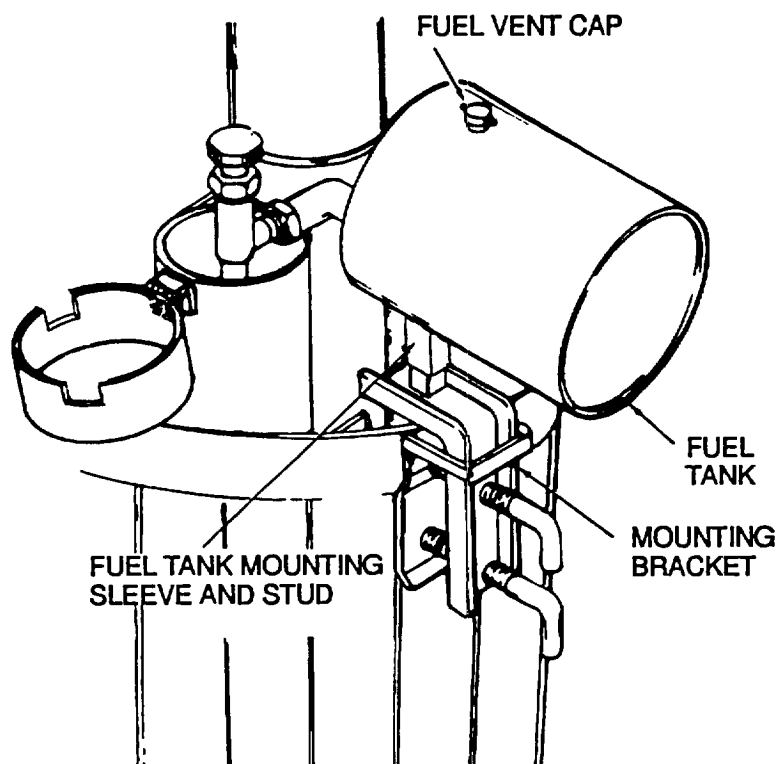
Step 2. Check for an empty fuel tank

Remove the fuel tank and fill.

- a. Remove the fuel tank from the heater by lifting the fuel tank off square mounting stud on heater mounting bracket (Figure 3-1).
- b. Place the tank on end so the fuel filler plug is on top, remove the plug, and fill the tank through the filler plug opening.
- c. Replace the filler plug and place the fuel tank over the square mounting stud on the heater mounting bracket (Figure 3-1).

**3-1. GENERAL-Continued***Table 3-1. Operator/Crew Troubleshooting - Continued*

| MALFUNCTION | TEST OR INSPECTION | CORRECTIVE ACTION |
|-------------|--------------------|-------------------|
|-------------|--------------------|-------------------|

*Figure 3-1. Immersion Heater Fuel Tank Filling Procedure***WARNING**

**Do not attempt to light heater if there is an accumulation of fuel in burner chamber**

Step 3. Check for sufficient preheating of the flue.

Re-preheat for one to two minutes.

- a. Check that the fuel vent plug is open (Figure 3-2).
- b. Push the igniter handle to the left and swing the igniter cup below the fuel valve.

**3-1. GENERAL - Continued**

Table 3-1. Operator/Crew Troubleshooting - Continued

| MALFUNCTION | TEST OR INSPECTION | CORRECTIVE ACTION |
|-------------|--------------------|-------------------|
|-------------|--------------------|-------------------|

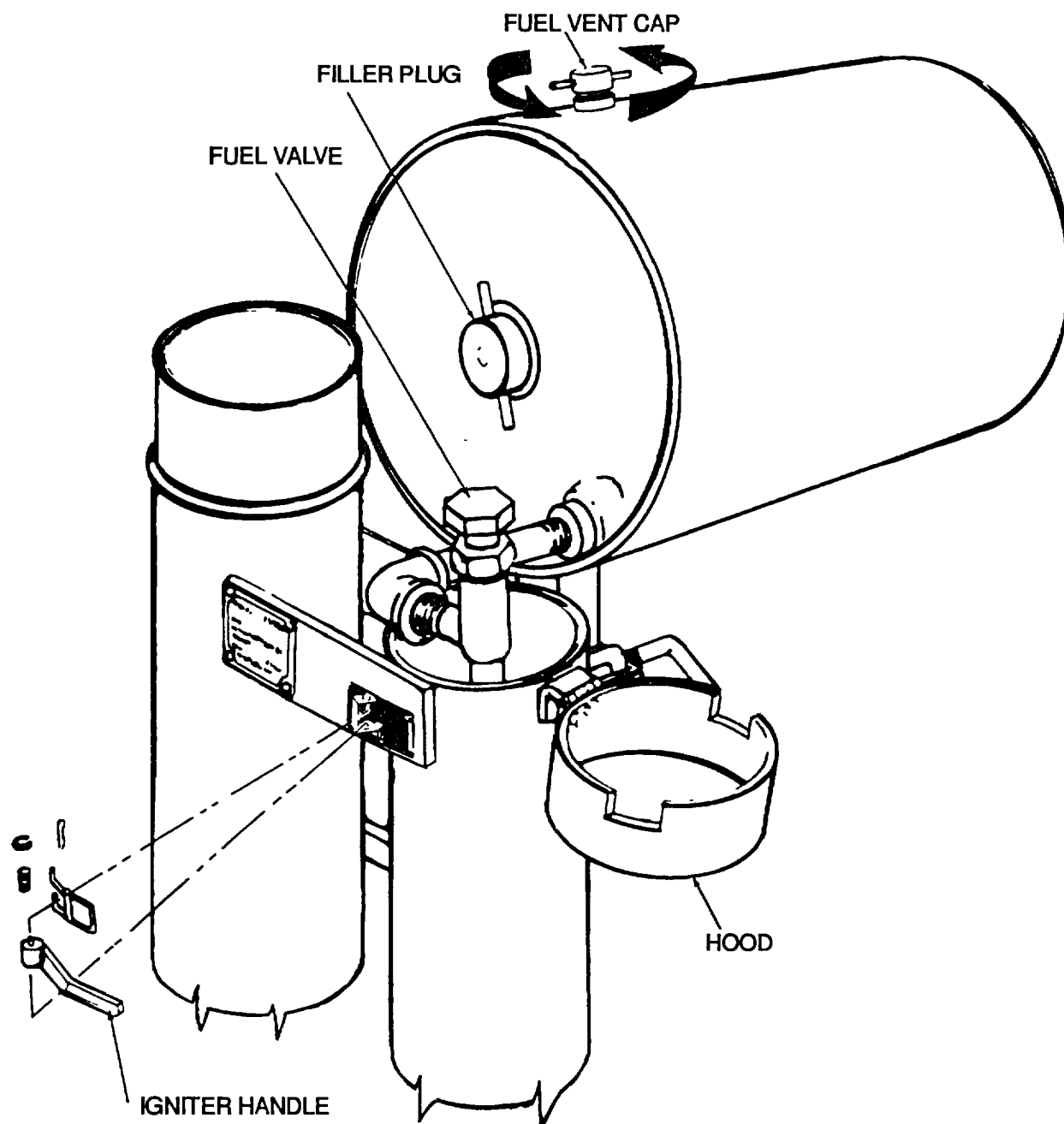


Figure 3-2. Operating Components

**3-1. GENERAL - Continued***Table 3-1. Operator/Crew Troubleshooting - Continued*

| <b>MALFUNCTION</b>         | <b>TEST OR INSPECTION</b>                          | <b>CORRECTIVE ACTION</b>  |
|----------------------------|--|---|
|                            |  | <ul style="list-style-type: none"> <li>c. Open the fuel valve and fill the igniter cup 1/4 full of fuel (Item 2, Appendix E).</li> <li>d. Close fuel valve.</li> <li>e. Ignite fuel in the igniter cup with a match.</li> <li>f. Move igniter handle to the right and return the cup to the flue compartment to preheat the flue for one or two minutes.</li> </ul>   |
|                            | Step 4. Check for water in the combustion chamber. | <ul style="list-style-type: none"> <li>a. Turn off heater.</li> <li>b. Remove the smokestack from the immersion heater collar.</li> <li>c. Using a flashlight, look down the flue compartment into the combustion chamber to see if any water is present in the chamber.</li> </ul>   |
|                            | Clear water from the combustion chamber.           | <ul style="list-style-type: none"> <li>(1) Lift fuel tank off square mounting stud on heater mounting bracket (Figure 3-1).</li> <li>(2) Turn the heater upside down so that any accumulation of fuel or water in the combustion chamber can drain out.</li> <li>(3) Reinstall burner inside heater body.</li> <li>(4) Position fuel tank on the square mounting stud on the heater mounting bracket.</li> <li>(5) Reinstall smokestack.</li> </ul> |
| <b>2. BURNER GOES OUT.</b> |  |   |
|                            | Step 1. Check for a dosed or clogged vent plug.    |   |
|                            | Clear vent plug.                                   | <ul style="list-style-type: none"> <li>a. Open the vent plug by turning the plug counterclockwise.</li> <li>b. Clean out a clogged vent plug with a pointed tool or stiff wire.</li> </ul>  |

**3-1. GENERAL - Continued***Table 3-1. Operator/Crew Troubleshooting - Continued*

| <b>MALFUNCTION</b>   | <b>TEST OR INSPECTION</b> | <b>CORRECTIVE ACTION</b> |
|--|---------------------------|--------------------------|
| <hr/>  |                           |                          |
| Step 2. Check for empty fuel tank  |                           |                          |
| Remove the fuel tank and fill. Refer to Step 2. under HEATER FAILS TO START and fill the tank.                               |                           |                          |
| Step 3. Check for slow fuel flow.  |                           |                          |
| Increase fuel flow by opening the fuel valve, turning it counterclockwise slightly.  |                           |                          |
| Step 4. Check if flame is blown out.   |                           |                          |
| Shield heater from the wind and restart.   |                           |                          |
| <b><u>WARNING</u></b>  |                           |                          |
| <b>Do not attempt to light heater if there is an accumulation of fuel in burner chamber.</b>                                 |                           |                          |
| <b>Do not expose face to burner compartment while lighting or adjusting fuel flow.</b>                                       |                           |                          |
| <b>Wear heat protective gloves when igniting fuel with igniter cup.</b>  |                           |                          |
| Re-preheat the flue for one or two minutes. Refer to Step 3. under HEATER FAILS TO START and perform the same procedures.    |                           |                          |
| Step 5. Check the combustion chamber for water.  |                           |                          |
| a. Shut down the heater.   |                           |                          |
| b. Remove the smokestack   |                           |                          |
| c. Remove burner from inside heater body.  |                           |                          |
| d. Using a flashlight, look down the flue compartment into the combustion chamber to see if water is present in the chamber. |                           |                          |
| Clear water from combustion chamber. Refer to Step 4. under HEATER FAILS TO START and perform the same procedures.           |                           |                          |
| <hr/>  |                           |                          |

**3-1. GENERAL - Continued***Table 3-1. Operator/Crew Troubleshooting - Continued*


---

|                           |
|---------------------------|
| <b>MALFUNCTION</b>        |
| <b>TEST OR INSPECTION</b> |
| <b>CORRECTIVE ACTION</b>  |

---

**3. HEATER SMOKES.**

Step 1. Check if fuel rate is too fast.

Close the fuel valve slightly by turning it clockwise.

Step 2. Check for sufficient smokestack sections.

Use at least four sections of smokestack.

**SECTION III. OPERATOR/CREW MAINTENANCE PROCEDURES****3-2. GENERAL**

This section covers general heater cleaning and touch up painting as well as operator/crew maintenance procedures for the heater.

**3-3. HEATER CLEANING**

Clean all surfaces by hand sanding with a scouring pad (Item 5, Appendix E) or by using extra fine sandpaper. Clean all rust, corrosion products, oil, grease, moisture, dirt, loose and blistered paint, deteriorated areas from heater prior to paint application.

**3-4. TOUCH-UP PAINTING**

a. The following surfaces require paint, i.e. primer and enamel.

- (1) External surfaces of the heater. External burner compartment and flue tube surface down to a horizontal line 6 inches below the top of the burner compartment.
  - (2) Hanger. Paint all surfaces except screw threads.
  - (3) Igniter assembly. Paint all surfaces except wick and retainer spring.
  - (4) Fuel tank Paint outside surfaces of the fuel tank, filler plug, vent cap and fuel valve. Close filler plug, vent cap and fuel valve before painting.
  - (5) Hood. Paint all exposed surfaces, excluding the instruction plate, including the surfaces of the hinge.
-



**3-4. TOUCH-UP PAINTING - Continued**

- b. Primer shall conform to Specification TT-P-636.
- c. Enamel shall conform to Class A or B of Specification TT-E-529. The color shall approximate color number X24087, olive drab of Federal Standard 595.

**NOTE**

Painting of material should be done in the open during dry weather while the temperature is not below 50°F (10°C). Adequate forced draft ventilation for indoor work should be provided to carry off fumes.

**3-5. IMMERSION HEATER**

- a. Burner. Operator/crew maintenance is limited to installation which consists of placing the burner down inside the heater body (Figure 3-3).

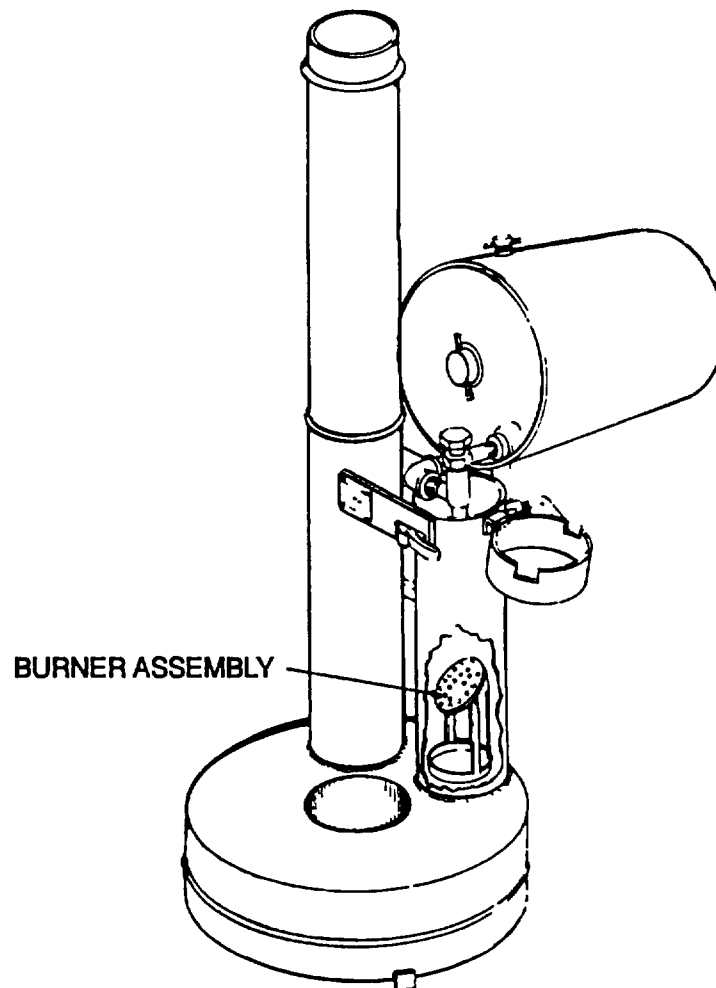
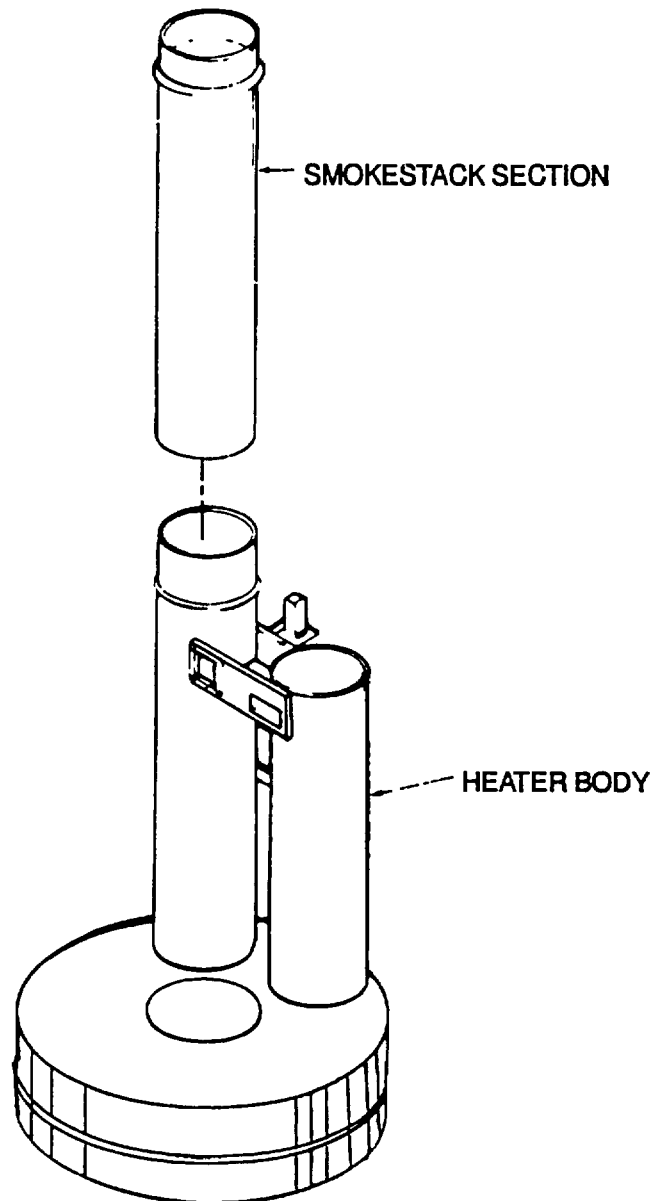


Figure 3-3. Immersion Heater Burner Installation

**3-5. IMMERSION HEATER - Continued****NOTE**

**Install burner with the vaporizer plate facing up.**

- b. Smokestack. Operator/crew maintenance procedures include service, replacement and installation.
- (1) Disassembly. Separate the four 2-foot sections of smokestack, by pulling pipes apart at each joint (Figure 3-4).



*Figure 3-4. Immersion Heater Smokestack Removal and Installation*

**3-5. IMMERSION HEATER - Continued**

## (2) Cleaning.

- (a) Remove soot from pipe sections.
- (b) Wash exterior of smokestack with brush and hot water.
- (c) Dry sections of smokestack thoroughly. Do not apply paint to smokestack.

**NOTE**

**Under most climatic conditions It is not cost effective to paint smokestack. However, In a humid or saltwater environment the smokestack may be painted using heat resistant paint only If materials, equipment, and facilities are already available. Do not requisition materials or equipment.**

- (d) Replace sections as required.
- (3) Installation. Attach four 2-foot sections of smokestack together at the joints and attach bottom section to the heater body.

## CHAPTER 4

ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

---

## SECTION I. SERVICE UPON RECEIPT OF MATERIAL

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

- a. Inspection.
  - (1) Inspect the entire heater assembly for signs of physical damage.
  - (2) Inspect the heater to be sure that it is properly assembled, secure, dean, correctly adjusted, and no evidence of fuel leaks.
  - (3) Correct deficiencies within the scope of organizational maintenance before placing the heater in service.
- b. Servicing. Perform the preventive maintenance checks and services described in Table 4-1.

**4-2. INSTALLATION OR SETTING UP INSTRUCTIONS**

Refer to Paragraph 2-3 for instructions on setting up the immersion heater.

## SECTION II. ORGANIZATIONAL PREVENTIVE MAINTENANCE CHECKS AND SERVICES

### 4.3. GENERAL

To insure that the immersion heater 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 by organizational maintenance personnel are listed and described in Table 4-1. Defects discovered during operation of the unit shall be noted for future corrections 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 was 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.

### 4.4. ORGANIZATIONAL PREVENTIVE MAINTENANCE CHECKS AND SERVICES

The preventive maintenance checks and services to be performed at the organizational level of maintenance are listed and defined in Table 4-1. A quarterly interval, equal to three calendar months is recommended for usual operating conditions. It should be noted that the Item Number column shown in the table is used as a source of item numbers for the TM Number column on DA Form 2404 in recording results of PMCS.

Table 4-1. Organizational Preventive Maintenance Checks and Services

| Item No. | Item To Be Inspected            | Procedure<br>Check for and have repaired,<br>replaced, adjusted as necessary   | For Readiness Reporting,<br>Equipment Is<br>Not Ready/Available if: |
|----------|---------------------------------|--|---|
| 1        | IMMERSION<br>HEATER<br>ASSEMBLY | <p><b>NOTE</b><br/>Preventive maintenance services are identical for all Immersion heater models except where noted.</p> <p>Inspect for clean condition. If necessary dean all surfaces using a scouring pad (NSN 7920-00-753-5242) or by using extra fine sandpaper. Clean all rust, corrosion products, oil, grease, moisture, dirt, loose and blistered paint, deteriorated areas from heater. Remove scale from heater as follows:</p> | Dirty, rusty, missing or damaged parts.                             |

Table 4-1. Organizational Preventive Maintenance Checks and Services - Continued

| Item No. | Item To Be Inspected                     | Procedure<br>Check for and have repaired,<br>replaced, adjusted as necessary  | For Readiness Reporting,<br>Equipment Is<br>Not Ready/Available if:   |
|----------|--|---|---|
| 2        | COMBUSTION<br>CHAMBER AND<br>HEATER BODY | <p>a. Set up the heater in a 32 gallon (121.12 liter) can and fill the can with water. Add 5 cups (1.18 liters) of Scale Removing Compound (Item 14, Appendix E) and stir until dissolved.</p> <p>b. Fire up the heater and heat the solution for 30 minutes. Check the color of the solution and look for remaining scale. If the solution is yellow and there's still scale on the heater, add 5 more cups (1.18 liters) of compound and heat for another 30 minutes.</p> <p>c. When the solution remains red or pink and the scale is gone, turn off the heat and pour out the solution. Rinse thoroughly with fresh water.</p>  | <p>Broken welds that would permit water leakage into combustion chamber.</p> <p>Opening or hole larger than 1/2 inch in diameter in flue partition or baffle.</p> |
|          |  | Inspect for any broken welds and holes and for the presence of any contaminants.  |   |
|          |  | <p>a. An opening of any size or shape in either flue partition or the baffle in the base of the heater should not be considered a safety hazard. No adverse condition will occur if an opening is present. Depending on the size and location of the opening, a decrease in output of the heater may result in excessive water heating time. This would be considered inefficient for a unit's designated mission.</p> <p>b. An opening in the baffle greater than 1/2 inch in diameter is a sign that the metal has deteriorated beyond repair and the heater should be turned in to the authorized activity for disposal.</p> <p>c. Inspection can be made by inserting a light down the flue tube and checking the adjacent side for leaks or holes.</p> |   |
|          |  |   |   |

Table 4-1. Organizational Preventive Maintenance Checks and Services - Continued

| Item No. | Item To Be Inspected                       | Procedure<br>Check for and have repaired,<br>replaced, adjusted as necessary  | For Readiness Reporting,<br>Equipment Is<br>Not Ready/Available if: |
|----------|--|---|---|
| 3        | COMBUSTION CHAMBER AND HEATER BODY - Cont. | d. Authorized maintenance expenditure limits for immersion heater are listed in TB 43-0002-23.  | Fuel leakage or damage is apparent.                                 |
|          | FUEL SYSTEM                                | e. Up-end heater to ensure that not unburned fuel, water or other foreign matter is present.  |   |
|          |  | Check that the fuel tank filler plug and the vent plug gasket are in serviceable condition.   |   |
| 4        |  | Check that the fuel valve on the fuel tank operates freely.<br>Drain the fuel tank  |   |
|          |  | a. Remove the fuel tank from the heater by lifting it off the square stud on the heater mounting bracket.   |   |
|          |  | b. Open the fuel tank vent plug and remove the filler plug, and drain the fuel tank observing for the presence of water or other contaminants in the tank |   |
| 5        |  | c. Reinstall fuel tanks as follows:   |   |
|          |  | (1) Refill the fuel tank through the filler plug with fuel after dosing vent plug if the heater is being returned to service.                             |   |
|          |  | (2) Close the filler plug.  |   |
| 4        | BURNER ASSEMBLY                            | Inspect for dean condition and broken welds.  | Distorted, cracked or broken  |
| 5        | SMOKESTACK                                 | Inspect for dean condition and serviceability.  | Damaged or holes in pipe.   |

### SECTION III. ORGANIZATIONAL TROUBLESHOOTING

#### **4-5. GENERAL**

a. This section contains troubleshooting information for locating and correcting most of the operating troubles which may develop in the Immersion heater. Each malfunction for an individual component, unit, or system is followed by a list of tests or inspections which will help you to determine 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.

#### **4-6. ORGANIZATIONAL MAINTENANCE TROUBLESHOOTING**

Refer to Table 4-2. for troubleshooting procedures applicable to the organizational maintenance level.

#### **NOTE**

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



**4-6. ORGANIZATIONAL MAINTENANCE TROUBLESHOOTING - Continued***Table 4-2. Organizational Troubleshooting*

| MALFUNCTION | TEST OR INSPECTION | CORRECTIVE ACTION |
|-------------|--------------------|-------------------|
|-------------|--------------------|-------------------|

**IMMERSION HEATER ASSEMBLY****1. HEATER FLAME IS NOT STEADY.**

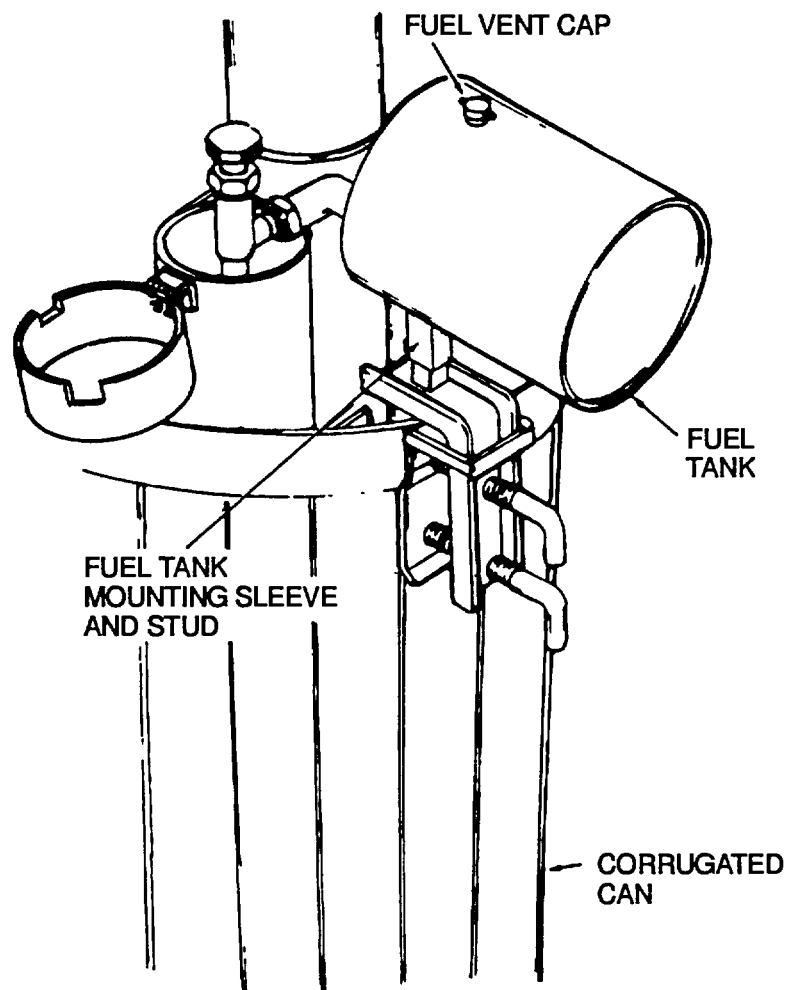
Step 1. Check for water in the fuel tank

- a. Turn off the heater. Remove the fuel tank from the heater by lifting it off the square stud on the heater mounting bracket.
- b. Open the fuel tank vent plug and remove the filler plug and drain the fuel tank observing for the presence of water in the tank (Figure 4-1).
- c. Reinstall fuel tank as follows:
  - (1) Refill the fuel tank, through the filler plug, with gasoline after dosing vent plug.
  - (2) Close the filler plug.
  - (3) Reinstall the fuel tank on the square stud on the heater mounting bracket.
- d. Start the heater and check for a steady flame.

Step 2. Check for water in the combustion chamber.

- a. Turn off the heater.
- b. Remove the smokestack from the immersion heater collar.
- c. Remove the burner from inside the heater body.
- d. Using a flashlight, look down the flue compartment into the combustion chamber to see if any water is present in the combustion chamber.
- e. Clear water from the combustion chamber.
  - (1) Remove fuel tank from heater.
  - (2) Turn two locking screws on mounting counterclockwise until the clamp is loose.
  - (3) Lift out the heater.
  - (4) Turn the heater upside down so that any accumulation of fuel or water in the combustion chamber can drain out.

**4-6. ORGANIZATIONAL MAINTENANCE TROUBLESHOOTING - Continued**



*Figure 4-1. Emptying Fuel Tank*

Table 4-2 Organizational Troubleshooting - Continued

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|                           |
|---------------------------|
| <b>MALFUNCTION</b>        |
| <b>TEST OR INSPECTION</b> |
| <b>CORRECTIVE ACTION</b>  |

---

**IMMERSION HEATER ASSEMBLY - Continued**

- (5) Reinstall heater and tighten locking screws to secure heater.
- (6) Reinstall burner inside heater body.
- (7) Replace the fuel tank
- (8) Reinstall the smokestack on the heater collar.

Step 3. Check fuel valve and fuel line for dogging.

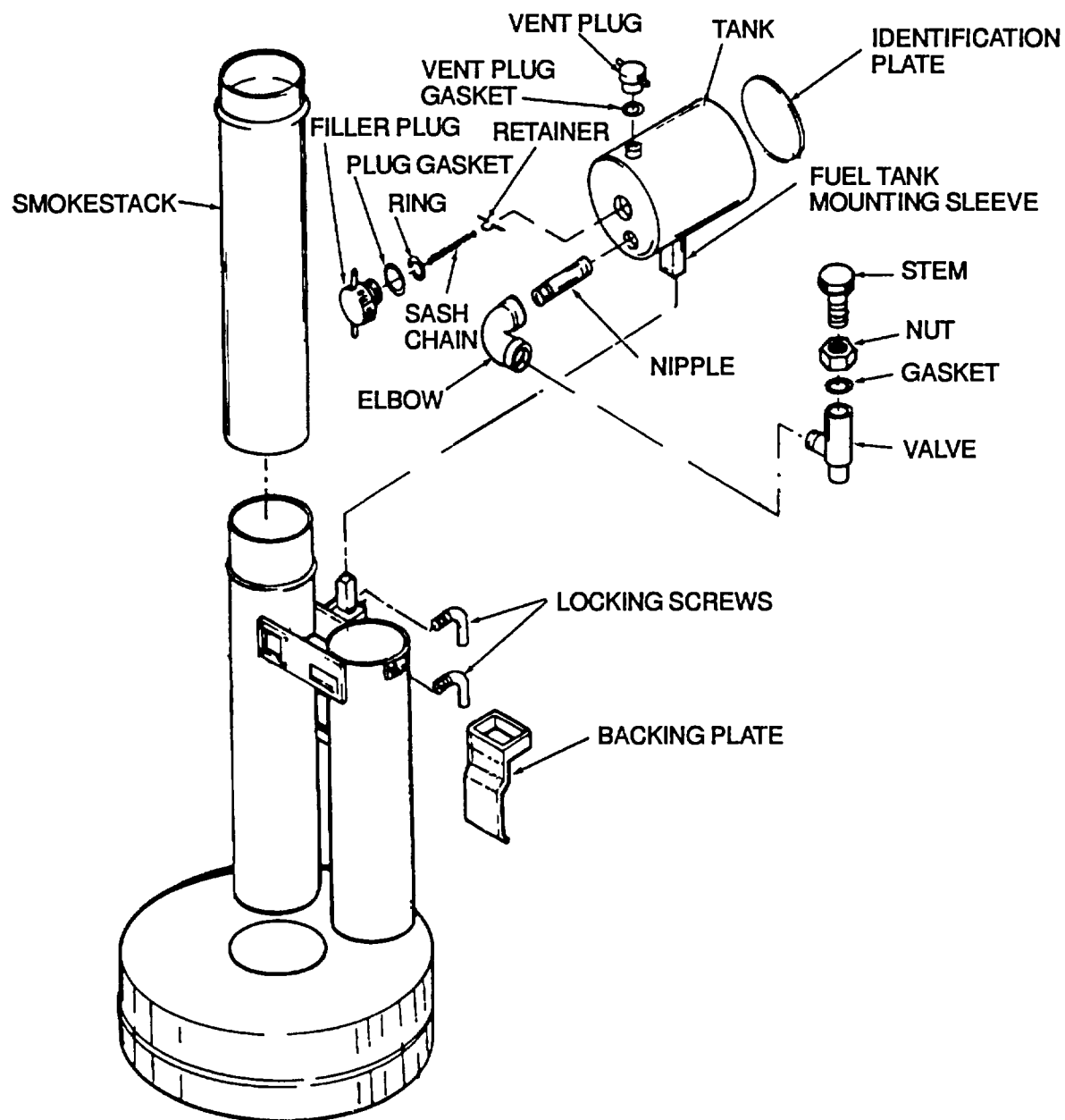
Disconnect the fuel valve and fuel line and clear dogging as follows:

- a. Close the fuel tank vent plug and remove the fuel tank from the heater mounting bracket (Figure 4-2).
- b. Open the fuel tank vent plug and filler plug and drain the fuel tank
- c. Unscrew the fuel valve elbow and nipple from the fuel tank
- d. Unscrew elbow from nipple.
- e. Unscrew hex nut from valve body and remove gasket and valve stem.
- f. Scrape or rub off any corrosion from the valve, and clean out any obstructions from inside the valve passages.
- g. Clean out any obstructions from inside the elbow and from inside the nipple.
- h. Reassemble and install the fuel valve.
- i. Refill the fuel tank with fuel through the filler plug opening.
- j. Close the filler plug and install the fuel tank

Step 4. Check burner evaporator plate for dogged holes.

Clean burner as follows:

- a. Remove the burner by lifting it out of the heater body.
-

**4-6. ORGANIZATIONAL MAINTENANCE TROUBLESHOOTING - Continued**

**NOTE:**  
BURNER HOOD REMOVED FOR CLARITY

Figure 4-2. Immersion Heater Components Removal and Installation

**4-6. ORGANIZATIONAL MAINTENANCE TROUBLESHOOTING - Continued***Table 4-2. Organizational Troubleshooting- Continued***MALFUNCTION****TEST OR INSPECTION****CORRECTIVE ACTION****IMMERSION HEATER ASSEMBLY - Continued**

- b. Clean burner with a stiff bristle brush to remove carbon, grit, rust and other foreign matter from the holes of the burner plate.
- c. Replace the burner in the heater body.

**2. HEATER CONTINUES TO BURN WHEN FUEL VALVE IS OFF.**

Step 1. Check for worn or leaking fuel valve.

Replace fuel valve. (Refer to Figure 4-2).

**SECTION IV. ORGANIZATIONAL MAINTENANCE PROCEDURES****4-7. HEATER BODY**

- a. Disassembly.
  - (1) Refer to Figure 4-3. Remove two nuts (17), lockwashers (18), flat washers (19), and screws (20). Remove hood (23) from the burner compartment.
  - (2) If necessary, remove four rivets (21) and instruction plate (22 ) from hood.
  - (3) Remove cotter pin (25) and igniter spring (26). Remove igniter (29).
  - (4) Remove retainer spring (27) and wicking (28) from igniter.
  - (5) If necessary, remove four rivets (30) and name plate (31) from heater body.
  - (6) If necessary, remove hook bolts (32) and mounting clamp (33).
- b. Cleaning.
  - (1) Clean dust and dirt off heater body. Include all the components of the heater body.
  - (2) Remove rust and corrosion from the heater body and hanger assembly with a scouring pad (Item 5, Appendix E) or with extra fine sandpaper.

## 4-7 HEATER BODY - Continued

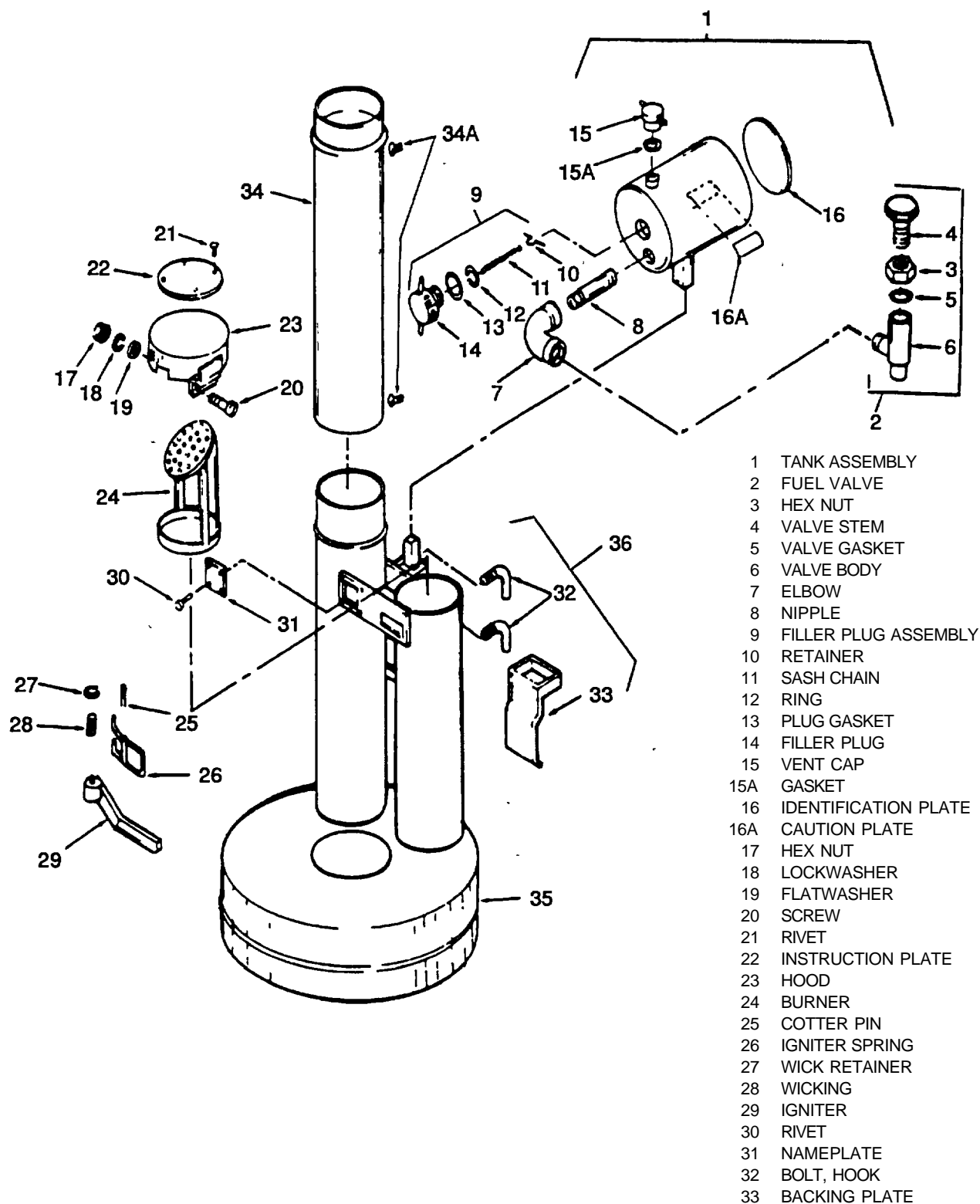


Figure 4-3. Immersion Heater Components Removal and Installation

**4-7 HEATER BODY-Continued**

- (3) Clean inside the flue chamber with brush (Item 9, Appendix E). Pick up heater body and dump residue. The next usage of the heater will bum out balance of residue.
  - (4) The burner chamber does not require cleaning.
  - (5) Do not use solvent or cleaning compound on interior of heater body as it will leave a greasy film.
  - (6) Do not use a protective coating on interior of burner or flue chamber.
- c. Inspection.
- (1) Inspect heater body for dents, holes or broken welds. Broken welds should be reported to your supervisor.
  - (2) Inspect igniter wick for evidence of deterioration. Replace as required.
  - (3) Inspect lighter cup assembly for broken or distorted condition. Replace as required.
  - (4) Inspect the hood for a distorted condition/broken hinge. Replace as required.
  - (5) Inspect the hanger assembly for serviceability.
- d. Installation.
- (1) Refer to Figure 4-3. If necessary, install mounting damp (33) and locking screws (32).
  - (2) If necessary, install nameplate (31) on heater with four rivets (30).
  - (3) Install new wicking (28) in igniter (29). Install retainer spring (27).
  - (4) Install igniter (29), igniter spring (26), and cotter pin (25).
  - (5) If necessary install instruction plate (22) on hood with four rivets (21).
  - (6) Install hood (23) on heater body with two screws (20), flatwashers (19), lockwashers (18), and nuts (17).

**4-8. FUEL TANK**

## a. Removal.

Refer to Figure 4-3. Remove fuel tank (1) by lifting it up and over the square mounting stud.

## b. Disassembly.

- (1) Refer to Figure 4-3. Unscrew fuel valve (2), elbow (7), and nipple (8) from fuel tank (1).
- (2) Unscrew elbow (7) from nipple (8).
- (3) Unscrew hex nut (3) from valve body (6) and remove gasket (5) and valve stem (4).
- (4) Unscrew and remove filler plug (14).
- (5) Remove retainer (10), sash chain (11), ring (12), and gasket (13) from the body (9).
- (6) Unscrew vent cap (15) approximately three turns, being careful not to remove the vent cap from the tank.
- (7) Remove gasket (15A) by stretching it over the vent cap.
- (8) If necessary, remove identification plate (16) and caution plate (1 6A).

## c. Cleaning.

- (1) Drain fuel tank.
- (2) Clean outside of tank with stiff brush and hot water.
- (3) Flush tank with a small amount of fuel to be sure all sediment and foreign matter is removed. If tank is to be stored, refer to Chapter 4, Section V, Preparation for Storage or Shipment.
- (4) Scrape or rub off any corrosion from valve. Clean out any obstructions from inside valve passages.

## d. Inspection.

- (1) Inspect tank for leaks and replace as required.
- (2) Inspect fuel valve for evidence of excessive wear or leaking conditions. Replace as required.
- (3) Inspect filler plug for damaged gasket or threads. Replace as required.
- (4) Inspect vent cap gasket for evidence of deterioration. Replace as required. Inspect to see that vent holes are free from any foreign matter.
- (5) Inspect identification plate for legibility. Replace as required.



**4-8. FUEL TANK - CONTINUED**

## e. Reassembly.

- (1) Refer to Figure 4-3. If necessary, install identification plate (16) and caution plate (1 6A).
- (2) Install gasket (1 5A) by stretching it over vent cap (15).
- (3) Tighten vent cap (15).
- (4) Install gasket (13), ring (12), sash chain (11), and retainer (10) on heater body.
- (5) Install filler plug (14).
- (6) Install valve stem (4) and gasket (5) on valve body (6). Install hex nut (3) on valve body (6) and tighten.
- (7) Install nipple (8) in fuel tank
- (8) Install elbow (7) on nipple (8).
- (9) Install fuel valve assembly (2) in elbow (7).
- (10) Position fuel tank on square stud on the heater body.

**4-9. BURNER**

## a. Removal.

Refer to Figure 4-3. Remove burner (24) by lifting it out of the heater body.

## b. Cleaning.

- (1) Clean with a stiff bristle brush.
- (2) Remove carbon, grit, rust or other foreign matter from the holes of the burner plate.

## c. Inspection.

- (1) Inspect for excessive rust or corrosion.
- (2) Inspect for damage such as distortion, cracks or breaks. Replace as required.

## d. Installation.

Replace burner in heater body.

**4-10. SMOKESTACK**

## a. Disassembly.

Refer to Figure 4-4. Separate the four 2-foot sections by pulling the sections apart at each joint.

## b. Cleaning.

- (1) Remove soot from smokestack by running sand or fine gravel through sections.
- (2) Wash exterior of smokestack with brush and hot water.
- (3) Dry sections thoroughly. Do not apply paint to smokestack

**NOTE**

**Under most climatic conditions It is not cost effective to paint smokestack. However, In a humid or saltwater environment the smokestack may be painted using heat resistant paint only if materials, equipment, and facilities are already available. Do not requisition materials or equipment.**

## c. Inspection.

Inspect for dents, holes, excessive rusting, and missing rivets. Replace sections as required. Assemble each section with rivets.

## d. Installation.

Attach four 2-foot sections of smokestack together at the joints and attach bottom section to the heater body.

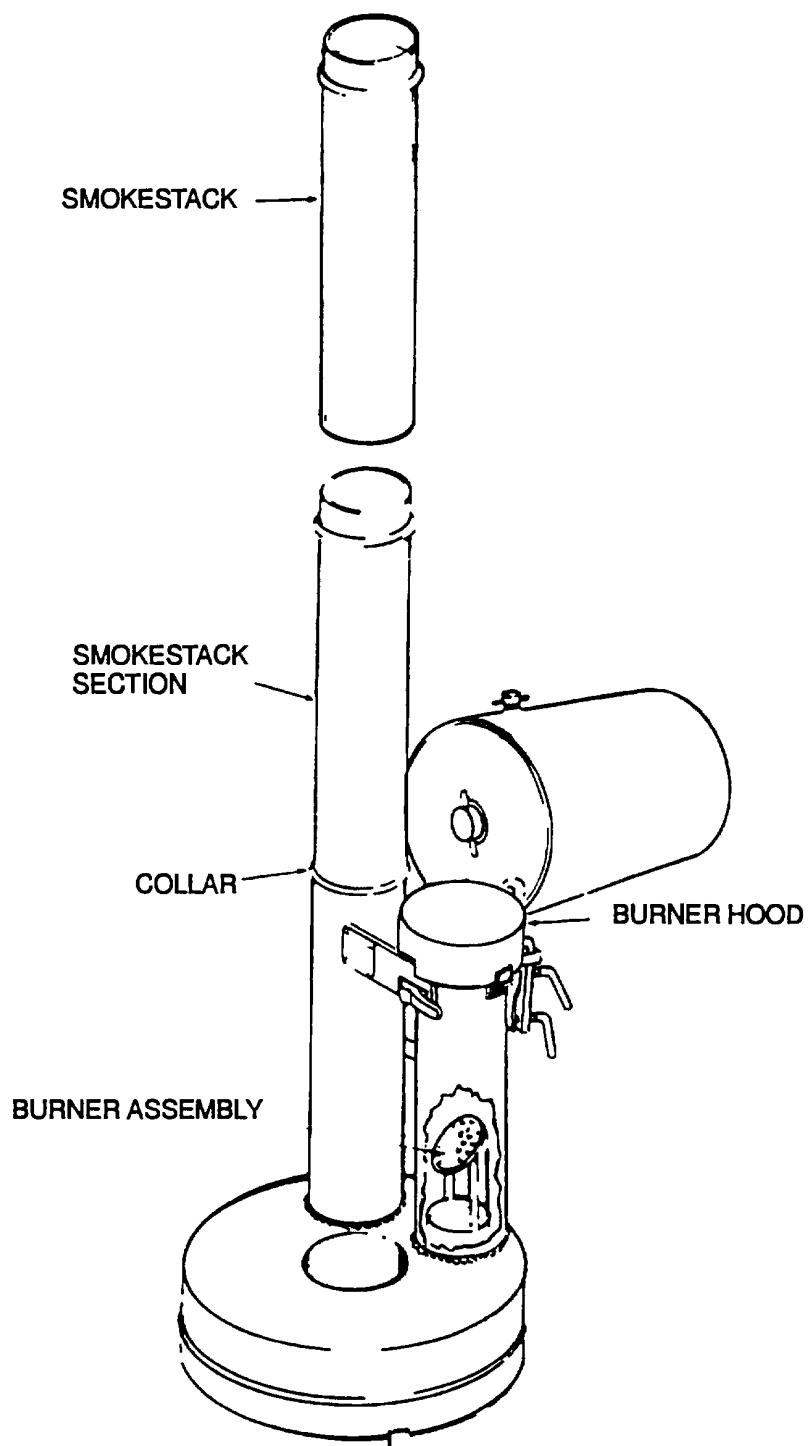
**4-10. SMOKESTACK - Continued**

Figure 4-4. Immersion Heater Smokestack

**SECTION V. PREPARATION FOR STORAGE OR SHIPMENT****4-11. PREPARATION FOR STORAGE**

- a. Heater shall have the fuel tank detached from the body of the heater. The four stovepipe lengths shall be detached from the heater and disassembled. The burner shall be removed.
- b. Use touch-up paint wherever it is needed. Paint only the parts that are called out for painting (Paragraph 3-4).
- c. Before painting, use a brush (Item 9, Appendix E), scouring pad (Item 5, Appendix E) or an extra fine sand paper (Paragraphs 3-3 and 3-4). This will remove the rust and loose paint, as well as grease and moisture from the heater.
- d. All uncoated ferrous metal surfaces of the heater and detached components shall be cleaned with dry cleaning solvent conforming to P-D-680 (Item 10, Appendix E) and thoroughly dried prior to application of preservative.
- e. Coat the interior of the fuel tank with lubricating oil (Item 1, Appendix E). Put about 8 ounces of oil into the empty tank, cap it and gently swirl it around. Pour off the extra oil.
- f. Before using the tank again, flush out the lube oil with a little clean fuel. The oil will smoke, if left to burn off with the first tank of fuel.
- g. Interior of the heater body shall be fogged with a preservative (Item 11, Appendix E).
- h. All exterior uncoated surfaces of the heater body, such as the hanger screw threads and fuel tank valve stem assembly shall be coated with a preservative (Item 11, Appendix E).
- i. The burner shall be completely wrapped with grease-proof barrier paper (Item 12, Appendix E).
- j. The four cleaned lengths of the stovepipe shall be individually coated with a preservative (Item 11, Appendix E) to protect it during storage.

**4-12. ADMINISTRATIVE STORAGE**

- a. Placement of equipment in administrative storage should be for short periods of time when a shortage of maintenance effort exists. Items should be in mission readiness within 24 hours or within the time factors as determined by the directing authority. During the storage period, appropriate maintenance records will be kept.
- b. Before placing the equipment in administrative storage, current preventive maintenance checks and services should be completed, shortcomings and deficiencies should be corrected, and all Modification Work Orders (MWO) should be applied.
- c. Storage site selection. Inside storage is preferred for items selected for administrative storage. If inside storage is not available, trucks, vans, convex containers, and other containers may be used.

**APPENDIX A****REFERENCES**

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**A-1. FIRE PROTECTION**

TB 5-4200-200-10      Hand Portable Fire Extinguishers Approved for Army Users

**A-2. PAINTING**

AR 740-1                Color Marking, and Preparation of Equipment for Shipment  
AR 746-5                Color, Marking of Army Material  
TM 43-0139             Painting Instructions for Field Use

**A-3. MAINTENANCE**

TB ORD-1031           Purging and Cleaning Fuel Tanks  
DA PAM 738-750       The Army Maintenance Management System  
TB 43-0002-23        Maintenance Expenditure Limits for FSC Group 39

**A-4. SHIPMENT AND STORAGE**

AR 735-11-2           Reporting of Item and Packaging Discrepancies (SF Form 364)  
SB 38-100              Army Preservation, Packing, and Marketing Materials, Supplies, and Equipment  
TM 38-230-1           Preservation and Packing of Military Equipment (Volume 1)  
TM 740-90-1           Administrative Storage of Equipment  
TB 740-97-2           Preservation of USAMECOM Mechanical Equipment for Shipment and Storage  
TM 38-230-2           Preservation, Packing and Packaging of Military Supplies and Equipment Packing (Volume II)

**A-5. DEMOLITION**

TM 750-244-3           Procedures for Destruction of Equipment to Prevent Enemy Use

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## APPENDIX B

## MAINTENANCE ALLOCATION CHART (MAC)

## 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 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. **TIS.** 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 dean (includes decontamination, when required), to preserve, to drain, to paint, or to replenish fuel, lubricants, hydraulic fluids, or compressed air supplies.
- d. **Adjust.** To maintain or regulate, 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 compare an instrument (measurement standard or item of test, measurement and diagnostic equipment) of unverified accuracy with an instrument of known and greater accuracy to detect and correct any discrepancy in the accuracy of the unverified instrument.
- 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.

**B-2. MAINTENANCE FUNCTIONS - Continued**

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), and item, or system.

j. **Overhaul.** To restore an item to a complete serviceable condition as prescribed by maintenance serviceable standards.

k. **Rebuild.** To restore an item to a standard as nearly as possible to original or new condition in appearance, performance, and life expectancy. This is accomplished through the maintenance technique of complete disassembly of the item, inspection of all parts or components, repair or replacement of worn or unserviceable elements using original manufacturing tolerances and specifications and subsequent reassembly of the item.

**B-3. COLUMN ENTRIES USED IN THE MAC**

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

b. **Column 2 - Component/Assembly.** Column 2 contains the 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 category of maintenance authorized to perform the function listed in Column 3. This figure represents the active time required to perform the maintenance function at the indicated level of maintenance. If the number or complexity of the tasks within the listed maintenance function varies at different maintenance categories, appropriate work time figures will be shown for each category. 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.

**B-3. COLUMN ENTRIES USED IN THE MAC - Continued**

This time includes preparation time (including any necessary disassembly/assembly time), troubleshooting/fault location 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 categories are as follows:

C ..... Operator or Crew.  
 O ..... Unit 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, when applicable, contain a letter code, in alphabetical order, which shall be keyed to the remarks contained in Section VIII.

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

Not required for this equipment.

**B-5. EXPLANATION OF COLUMNS IN SECTION III**

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

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



## SECTION II. MAINTENANCE ALLOCATION CHART

| (1)<br>GROUP<br>NUMBER | (2)<br>COMPONENT/<br>ASSEMBLY                              | (3)<br>MAINTENANCE<br>FUNCTION | (4)<br>MAINTENANCE LEVEL |     |    |    | (5)<br>TOOLS AND<br>EQUIPMENT<br>REF CODE | (6)<br>REMARKS<br>CODE |
|------------------------|--|--------------------------------|--------------------------|-----|----|----|---|------------------------|
|                        |  |                                | UNIT                     |     | DS | GS |   |                        |
|                        |  |                                | C                        | O   | F  | H  | D   |                        |
| 01                     | HEATER BODY ASSY   |                                |                          |     |    |    |   |                        |
|                        | Tube, flue   | Inspect                        |                          | 0.1 |    |    |   | A, B, L, N             |
|                        |  | Service                        |                          | 0.1 |    |    |   |                        |
|                        | Tube, burner   | Inspect                        |                          | 0.1 |    |    |   | A, B, N                |
|                        |  | Service                        |                          | 0.1 |    |    |   |                        |
|                        | Pan assembly   | Inspect                        |                          | 0.1 |    |    |   | A, B, N                |
|                        |  | Service                        |                          | 0.1 |    |    |   |                        |
|                        | Igniter assembly   | Inspect                        |                          | 0.1 |    |    |   | F                      |
|                        |  | Replace                        |                          | 0.1 |    |    |   |                        |
|                        |  | Repair                         |                          | 0.1 |    |    |   |                        |
|                        | Hood assembly  | Inspect                        |                          | 0.1 |    |    |   | M                      |
|                        |  | Service                        |                          | 0.1 |    |    |   |                        |
|                        |  | Replace                        |                          | 0.1 |    |    |   |                        |
|                        | Hanger assembly  | Inspect                        |                          | 0.1 |    |    |   | J, K                   |
|                        |  | Service                        |                          | 0.1 |    |    |   |                        |
| 02                     | FUEL SYSTEM  |                                |                          |     |    |    |   |                        |
|                        | Fuel Tank  | Inspect                        |                          | 0.1 |    |    |   | G, H                   |
|                        |  | Service                        |                          | 0.1 |    |    |   |                        |
|                        |  | Replace                        |                          | 0.1 |    |    |   |                        |
|                        |  | Install                        |                          | 0.1 |    |    |   |                        |
|                        | Valve and pipe fittings                                    | Inspect                        |                          | 0.1 |    |    |   | I, J.                  |
|                        |  | Service                        |                          | 0.1 |    |    |   |                        |
|                        |  | Replace                        |                          | 0.1 |    |    |   |                        |
|                        | I.D. plate   | Inspect                        |                          | 0.1 |    |    |   | C                      |
|                        |  | Replace                        |                          | 0.1 |    |    |   |                        |
| 03                     | BURNER ASSEMBLY  | Inspect                        |                          | 0.1 |    |    |   | D, E                   |
|                        |  | Service                        |                          | 0.1 |    |    |   |                        |
|                        |  | Replace                        |                          | 0.1 |    |    |   |                        |
|                        |  | Install                        | 0.1                      |     |    |    |   |                        |
| 04                     | SMOKESTACK ASSY<br>(PIPE, AIR CONDI-<br>TIONING - HEATING) | Inspect                        | 0.1                      |     |    |    |   | K, L                   |
|                        |  | Service                        | 0.1                      |     |    |    |   |                        |
|                        |  | Replace                        | 0.1                      |     |    |    |   |                        |
|                        |  | Install                        | 0.1                      |     |    |    |   |                        |

**SECTION III. REMARKS**

| <b>REFERENCE<br/>CODE</b> | <b>REMARKS</b>   |
|---------------------------|--|
| A                         | Inspect for dents or open seams, holes, broken welds.  |
| B                         | Clean dirt and grease from Immersion Heater Body.  |
| C                         | Inspect for legibility.  |
| D                         | Inspect burner for evidence of cracks and distortion.  |
| E                         | Clean vaporizer plate.   |
| F                         | Inspect lighter cup for evidence of distortion; also wick for distortion and loose fit of wick retainer. |
| G                         | Inspect fuel filler plug for proper fit of plug and gasket; also vent cap. Check for leaks.              |
| H                         | Fill to designated capacity.   |
| I                         | Clean any obstruction from valve.  |
| J                         | Inspect threads.   |
| K                         | Inspect serviceability, i.e., holes, sharp edges.  |
| L                         | Clean soot from pipe.  |
| M                         | Inspect burner hood for damage or distorted hinge.   |
| N                         | These items are part of the heater body weldment and are not shown separately on the illustration.       |

## APPENDIX C

COMPONENTS OF END ITEM (COEI) AND BASIC ISSUE ITEMS (BII) LISTS

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## SECTION I. INTRODUCTION

**C-1. SCOPE**

This appendix lists components of and basic issue items for the immersion heater to help you inventory items required for safe and efficient operation.

**C-2. GENERAL**

The Components of End Item (COEI) and Basic Issue Items (BII) Lists are divided into the following sections:

a. **Section II. Components of End Item.** This listing is for information purposes only, and is not authority to requisition replacements. These items are part of the immersion heater. As part of the end item, these items must be with the end item whenever it is issued or transferred between property accounts. Items of COEI are removed and separately packaged for transportation or shipment only when necessary.

b. **Section III. Basic Issue Items.** These essential items are required to place the immersion heater in operation, operate it, and to do emergency repairs. Although shipped separately packaged, BII must be with the immersion heater during operation and when it is transferred between property accounts. This list is your authority to request/requisition them for replacement based on authorization of the end item by the TOE/MTOE.

**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.

(2) **Item Number.** The number used to identify item called out in the installation.

b. **National Stock Number.** Indicates the National stock number assigned to the item and which will be used for requisitioning.

c. **Part Number.** 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.

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

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

## SECTION II. COMPONENTS OF END ITEM LIST

| (a)<br>ILLUSTRATION  |                    | (b)                         | (c)                   | (d)   | (e)      | (f)                  | (g)         | (h)      |      |      |      |
|----------------------|--------------------|-----------------------------|-----------------------|---|----------|----------------------|-------------|----------|------|------|------|
| (1)<br>FIGURE<br>NO. | (2)<br>ITEM<br>NO. | NATIONAL<br>STOCK<br>NUMBER | PART NO.<br>&<br>FSCM | DESCRIPTION   | LOCATION | USABLE<br>ON<br>CODE | QTY<br>REQD | QUANTITY |      |      |      |
|                      |                    |                             |                       |   |          |                      |             | RCVD     | DATE | DATE | DATE |
| 4-3                  | (34)               | 4520-00-277-8339            | MIL-P-551<br>(81349)  | Smokestack<br>(Air Condi-<br>tioning and<br>Healing Pipe) |          | BWB                  | 4           |          |      |      |      |
| 4-3                  | (34A)              | 5320-00-010-4448            | MS-35684-10           | Split Rivet   |          | BWB                  | 8           |          |      |      |      |

## SECTION III. BASIC ISSUE ITEMS

(NOT APPLICABLE)

## APPENDIX D

## ADDITIONAL AUTHORIZATION LIST (AAL)

## SECTION I. INTRODUCTION

**D-1. SCOPE**

This appendix lists additional items you are authorized for the support of the immersion heater.

**D-2. GENERAL**

This list identifies items that do not have to accompany the immersion heater and that do have to be turned in with it. These items are all authorized to you by CTA, MTOE, TDA, or JTA.

**D-3. EXPLANATION OF LISTING**

National stock numbers, descriptions, and quantities are provided to help you identify and request the additional items you require to support this equipment. If item required differs for different models of this equipment, the model is shown under the "Usable on" heading in the description column.

## SECTION II. ADDITIONAL AUTHORIZATION ITEMS LIST

| (1)<br>National Stock Number | (2)<br>Description<br>Part Number & FSCM      | (3)<br>Usable<br>On Code | (4)<br>U/M | (4)<br>Qty |
|------------------------------|---|--------------------------|------------|------------|
| 4540-00-483-3846             | WICK ASBESTOS<br>5-13-2679-7 (81337)          |                          | EA         | 1          |
| 4540-00-423-0255             | IGNITER ASSY<br>5-13-2684-4 (81337)           |                          | EA         | 1          |
| 4540-00-555-8531             | VALVE ASSY<br>5-13-2686-5-19 (81337)          |                          | EA         | 1          |
| 4540-00-555-8527             | PLUG, FILLER<br>5-13-2686-5-12 (81337)        |                          | EA         | 1          |
| 4540-00-533-3833             | SPRING, RETAINER<br>5-13-2684-11 (81337)      |                          | EA         | 1          |
| 7240-00-160-0440             | CAN, ASH, GALVANIZED, 32 GAL<br>RRC82 (81348) |                          | EA         | 1          |

## APPENDIX E

## EXPENDABLE SUPPLIES AND MATERIALS LIST

SECTION I. INTRODUCTION

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**E-1. SCOPE**

This appendix lists expendable supplies and materials you will need to operate and maintain the immersion heater. These items are authorized to you by CTA 50-970. Expendable items (Except Medical, Class V, Repair Parts, and Heraldic Items).

**E-2. EXPLANATION OF COLUMNS**

a. **Column 1. Item Number.** This number is assigned to the entry in the listing and is referenced in the narrative instructions to identify the item (e.g. "Use cleaning compound, Item 10, Appendix E").

b. **Column 2. Level.** This column identifies the lowest level of maintenance that requires the item.

C - Operator/crew  
O - Unit maintenance

c. **Column 3. National Stock Number.** This is the national stock number assigned to the item which you can use to requisition it.

d. **Column 4. Description.** Indicates the Federal item name and, if required, a description to identify the item. The last line for each item indicates the part number followed by the Commercial and Government Entity Code (CAGEC) in parentheses, if applicable.

e. **Column 5. Unit of Measure (U/M).** Indicates the measure used in performing the actual maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e.g., ea, in, pr). If the unit of measure differs from the unit of issue, requisition the lowest unit of issue that will satisfy your requirements.

## SECTION II. EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST

| (1)<br>ITEM NO. | (2)<br>LEVEL | (3)<br>NATIONAL STOCK<br>NUMBER | (4)<br>DESCRIPTION  | (5)<br>U/M |
|-----------------|--------------|---------------------------------|---|------------|
| 1               | O            | 9150-00-111-3199                | Oil, Lubricating<br>Grade 10, Type 1, 5 Gal   | GAL        |
| 2               | O            |                                 | Prescribed Fuels:<br><br>MOGAS (MIL-G-3056)<br>OCONUS<br><br>MOGAS, UNLEADED<br>(VV-G-1690) CONUS<br><br>Emergency Fuels:<br><br>DF-A, DF-1, DF-2<br><br>JP-4, JP-5, JP-8<br><br>W-F-800<br><br>MIL-T-5624<br><br>MIL-T-83133 | GAL        |
| 3               | O            | 9920-00-889-3367                | Matches, Non Safety   | BOX        |
| 4               | O            | 8415-01-092-3910                | Gloves, Heat Protective   | PR         |
| 5               | O            | 7920-00-753-5242                | Scouring Pad  | BOX        |
| 6               | O            | 8010-00-081-0809                | Paint, Enamel, Olive Drab   | QT         |
| 7               | O            | 8010-00-161-7425                | Paint, Primer   | GAL        |
| 8               | O            | 8020-00-889-7919                | Brush, Paint  | EA         |
| 9               | O            | 7920-00-234-9317                | Brush, Straight Head  | EA         |
| 10              | O            | 6850-00-281-1985                | Dry Cleaning Solvent, P-D-680   | GAL        |
| 11              | O            | 8030-00-251-5048                | Corrosive Preventive Petrolative  | GAL        |
| 12              | O            | 8135-00-224-8885                | Grease Proof Barrier Material   | YD         |
| 13              | O            | 9150-00-231-2361                | Preservative Lubricating Oil  | QT         |
| 14              | O            | 6850-00-637-6142                | Compound, Scale Removing  | 100 LB     |

APPENDIX F

OPERATOR'S AND ORGANIZATIONAL MAINTENANCE REPAIR PARTS AND SPECIAL TOOLS LIST

SECTION I. INTRODUCTION

F-1. SCOPE

This RPSTL lists and authorizes spares and repair parts; special tools; special test, measurement, and diagnostic equipment (TMDE); and other special support equipment required for performance of operator and unit maintenance of Heater, Immersion, Liquid. It authorizes the requisitioning, issue, and disposition of spares, repair parts and special tools as indicated by the source, maintenance and recoverability (SMR) codes.

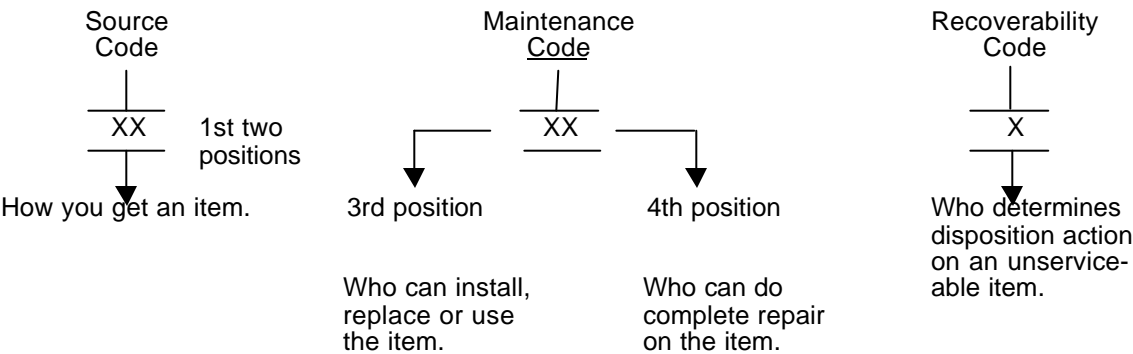
F-2. GENERAL

In addition to this section, Introduction, this Repair Parts and Special Tools List is divided into the following sections:

- a. **Section II. Repair Parts List.** A list of spares and repair parts authorized by this RPSTL for use in the performance of maintenance. This list also includes parts which must be removed for replacement of the authorized parts. Parts lists are composed of functional groups in ascending alphanumeric sequence, with the parts in each group listed in ascending figure and item number sequence. Bulk materials are listed in item name sequence. Repair parts kits are listed separately in their own functional group within Section II. Repair parts for repairable special tools are also listed in this section. Listed items are shown in the associated illustration(s)/figure(s).
- b. **Section III. Special Tools List.** A list of special tools, special TMDE, and other special support equipment authorized by this RPSTL (as indicated by Basis of Issue (BOI) information in DESCRIPTION AND USABLE ON CODE column) for the performance of maintenance.
- c. **Section IV. Cross-references Indexes.** A list, in National Item Identification Number (NIIN) sequence, of all National stock numbered items appearing in the listing, followed by a list in alphanumeric sequence of all part numbers appearing in the listings. National stock numbers and part numbers are cross-referenced to each illustration figure and item number appearance. The figure and item number index lists figure and item number in alphanumeric sequence and cross-references NSN, CAGEC and part number.

F-3. EXPLANATION OF COLUMNS (SECTIONS II AND III)




- a. **Item No. (Column (1)).** Indicates the number used to identify items called out in the illustration.
- b. **SMR Code (Column (2)).** The Source, Maintenance, and Recoverability (SMR) code is a 5-position code containing supply/requisitioning information, maintenance category authorization criteria, and disposition instruction, as shown in the following breakout:







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

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

| Code | Explanation   |  |
|------|---|--|
| PA   |  | Stocked items; use the applicable NSN to request/requisition items with these source codes. They are authorized to the category indicated by the code entered in the 3rd position of the SMR code.   |
| PB   |   |  |
| PC** |   |  |
| DD   |   |  |
| PE   |  | **NOTE: Items coded PC are subject to deterioration.   |
| PF   |   |  |
| PG   |   |  |
| KD   |  | Items with these codes are not to be requested/requisitioned individually. They are part of a kit which is authorized to the maintenance category indicated in the 3rd position of the SMR code. The complete kit must be requisitioned and applied. |
| KF   |   |  |
| KB   |   |  |

|  | Explanation   |   |
|--|---|---|
| MO - (Made at org/AVUM Level)                    |   | Items with these codes are not to be requested/requisitioned individually. They must be made from bulk material which is identified by the part number in the DESCRIPTION and USABLE ON CODE (UOC) column and listed in the Bulk Material group of the repair parts list in this RPSTL H the item is authorized to you by the 3rd position code of the SMR code, but the source code indicates it is made at a higher level, order the item from the higher level of maintenance. |
| MF - (Made at DS/AVUM Level)                     |   |   |
| MH - (Made at GS Level)                          |   |   |
| ML - (Made at Specialized Repair Activity (SRA)) |   |   |
| MD - (Made at Depot)                             |   |   |
| AO - (Assembled by org/AVUM Level)               |  | Items with these codes are not to be requested/requisitioned individually. The parts that make up the assembled item must be requisitioned or fabricated and assembled at the level of maintenance indicated by the source code. If the 3rd position code of the SMR code authorizes you to replace the item, but the source code indicates the items are assembled at a higher level, order the item from the higher level of maintenance.                                       |
| AF - (Assembled by DS/AVIM Level)                |   |   |
| AH - (Assembled by GS Category)                  |   |   |
| AL - (Assembled by SRA)                          |   |   |
| AD - (Assembled by Depot)                        |   |   |

| Code | Explanation  |
|------|--|
| XA - | Do not requisition "XA"-coded item. Order its next higher assembly. (Also, refer to the NOTE below.)                                       |
| XB - | If an "XB" item is not available from salvage, order it using the CAGEC and part number given.   |
| XC - | Installation drawing, diagram, instruction sheet, field service drawing, that is identified by manufacturer's part number.                 |
| XD - | Item is not stocked. Order an "XD"-coded item through normal supply channels using the CAGEC and part number given if no NSN is available. |

**NOTE**

**Cannibalization or controlled exchange, when authorized, may be used as a source of supply for items with the above source codes, except for those source coded "XA" or those aircraft support items restricted by requirements of AR 700-42.**

(2) **Maintenance Code.** Maintenance codes tell you the level(s) of maintenance authorized to USE and REPAIR support items. The maintenance codes are entered in the third and fourth positions of the SMR code as follows:

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

| <b>Maintenance Code</b> | <b>Application/Explanation</b>   |
|-------------------------|--|
| C -                     | Crew or operator maintenance done with unit or aviation unit maintenance.            |
| O -                     | Unit or aviation unit category can remove, replace, and use the item.                |
| F -                     | Direct support or aviation intermediate level can remove, replace, and use the item. |
| H -                     | General support level can remove, replace, and use the item.                         |
| L -                     | Specialized repair activity can remove, replace, and use the item.                   |
| D -                     | Depot level can remove, replace, and use the item.                                   |

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

**NOTE**

**Some limited repair may be done on an item at a lower level of maintenance, if authorized by the Maintenance Allocation Chart (MAC) and SMR codes. This position will contain one of the following maintenance codes.**

| <b>Code</b> | <b>Application/Explanation</b>  |
|-------------|---|
| O -         | Unit or (aviation unit) is the lowest level that can do complete repair of the item.  |
| F -         | Direct support or aviation intermediate is the lowest level that can do complete repair of the item.  |
| H -         | General Support is the lowest level that can do complete repair of the item.  |
| L -         | Specialized repair activity is the lowest level that can do complete repair of the item.  |
| D -         | Depot is the lowest level that can do complete repair of the item.  |
| Z -         | Nonrepairable. No repair is authorized.   |
| B -         | No repair is authorized. (No parts or special tools are authorized for the maintenance of a "B" coded item.) However, the item may be reconditioned by adjusting, lubricating, etc., at the user level. |

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

| Recoverability Codes | Application/Explanation   |
|----------------------|---|
| Z                    | - Nonrepairable item. When unserviceable, condemn and dispose of the item at the level of maintenance shown in 3d position of SMR Code.   |
| O                    | - Repairable item. When not economically repairable, condemn and dispose of the item at unit or aviation unit level.  |
| F                    | - Repairable item. When uneconomically repairable, condemn and dispose of the item at the direct support or aviation intermediate level.  |
| H                    | - Repairable item. When uneconomically repairable, condemn and dispose of the item at the general support level.  |
| D                    | - Repairable item. When beyond lower level repair capability, return to depot. Condemnation and disposal of item not authorized below depot level.  |
| L                    | - Repairable item. Condemnation and disposal not authorized below specialized repair activity (SRA).  |
| A                    | - Item requires special handling or condemnation procedures because of specific reasons (e.g., precious metal content, high dollar value, critical material, or hazardous material). Refer to appropriate manuals/directives for specific instructions. |

c. **CAGEC (Column (3)).** The Commercial and Government Entity Code (CAGEC) is a5 -digit numeric code which is used to identify the manufacturer, distributor, or Government agency/activity that supplies the item.

d. A-1.2 **PART NUMBER (Column (4)).** Indicates the primary number used by the manufacturer, (individual, company, firm, corporation, or Government activity), which controls the design and characteristics of the item by means of its engineering drawings, specifications standards, and inspection requirements to identify an item or range of items.

#### NOTE

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

e. **DESCRIPTION AND USABLE ON CODE (UOC) (Column (5)).** This column includes the following information:

- (1) The Federal item name and, when required, a minimum description to identify the item.
- (2) The physical security classification of the item is indicated by the parenthetical entry, e. g., Phy Sec C1 - Confidential, Phy Sec C1 (S) - Secret, Phy Sec C1 (T) - Top Secret.
- (3) Items that are included in kits and sets are listed below the name of the kit or set.
- (4) Spare/repair parts that made up an assembled item are listed immediately following the assembled item line entry.
- (5) Part numbers for bulk materials are referenced in this column in the line item entry for the item to be manufactured/fabricated.
- (6) When the item is not used with all serial numbers of the same model, the effective serial numbers are shown on the last line(s) of the description (before UOC).
- (7) The usable on code, when applicable (see Paragraph F-5, Special Information).
- (8) In the Special Tools List section, the basis of issue (BOI) appears as the last line(s) in the entry for each special tool, special TMDE, and other special support equipment. When density of equipment supported exceeds density spread indicated in the basis of issue, the total authorization is increased proportionately.

(9) The statement "END OF FIGURE" appears just below the last item description in Column 5 for a given figure in both Section II and Section III.

(10) The indenture, shown as dots appearing before the repair part, indicates that the item is a repair part of the next higher assembly.

f. **QTY (Column (6)).** The QTY (quantity per figure column) indicates the quantity of the item used in the breakout shown on the illustration figure, which is prepared for a functional group, subfunctional group, or an assembly. A "V" appearing in this column in lieu of a quantity indicates that the quantity is variable and may vary from application to application.

#### **F-4. EXPLANATION OF COLUMNS (SECTION IV)**

##### **a. National Stock Number (NSN) Index**

(1) **Stock Number Column.** This column lists the NSN in national item identification number (NIIN) sequence. The NIIN consists of the last nine digits of the NSN, i.e.

|                  |      |
|------------------|------|
|                  | NSN  |
| 5305-01-574-1467 |      |
|                  | NIIN |

When using this column to locate an item, ignore the first 4 digits of the NSN. However, the complete NSN should be used when ordering items by stock number.

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

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

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

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

(2) **Part Number Column.** Indicates the primary number used by the manufacturer (individual, firm, corporation, or Government activity), which controls the design and characteristics of the item by means of its engineering drawings, specifications standards, and inspection requirements to identify an item or range of items.

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

(4) **Figure Column.** This column lists the number of the figure where the item is identified/located in Sections II and III.

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

##### **c. Figure and Item Number Index.**

(1) **Figure Column.** This column lists the number of the figure where the item is identified/located in Section II and III.

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

(3) **Stock Number Column.** This column lists the NSN for the item.

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

(5) **Part Number Column.** Indicates the primary number used by the manufacturer (individual, firm, corporation, or Government activity), which controls the design and characteristics of the item by means of its engineering drawings, specifications standards, and inspection requirements to identify an item or range of items.

#### **F-5. SPECIAL INFORMATION**

a. **Usable on Code.** The usable on code appears in the lower left corner of the Description column heading. Usable on codes are shown as "UOC:..." in the Description Column justified left) on the last line applicable item description/nomenclature. Uncoded items are applicable to all models.

b. **Associated Publications.** Not applicable.

#### **F-6. HOW TO LOCATE REPAIR PARTS**

a. When National Stock Number or Part Number Is NOT Known.

(1) **First.** Using the table of contents, determine the assembly group or subassembly group to which the item belongs. This is necessary since figures are prepared for assembly groups and subassembly groups, and listings are divided into the same groups.

(2) **Second.** Find the figure covering the assembly group or subassembly group to which the item belongs.

(3) **Third.** Identify the item on the figure and note the item number.

(4) **Fourth.** Refer to the Repair Parts List for the figure to find the part number for the item number noted on the figure.

(5) **Fifth.** Refer to the Part Number Index to find the NSN, if assigned.

b. **When National Stock Number or Part Number Is Known.**

(1) **First.** Using the Index of National Stock Numbers and Part Numbers, find the pertinent National Stock Number or Part Number. The NSN index is in National Item Identification Number (NIIN) sequence (see paragraph F-4.a(1)). The part numbers in the Part Number index are listed in ascending alphanumeric sequence (see paragraph F-4.b). Both indexes cross-reference you to the illustration figure and item number of the item you are looking for.

(2) **Second.** After finding the figure and item number, verify that the item is the one you are looking for, then locate the item number in the repair parts list for the figure.

#### **F-7. ABBREVIATIONS**

Abbreviations used in this manual are listed in MIL-STD-12.

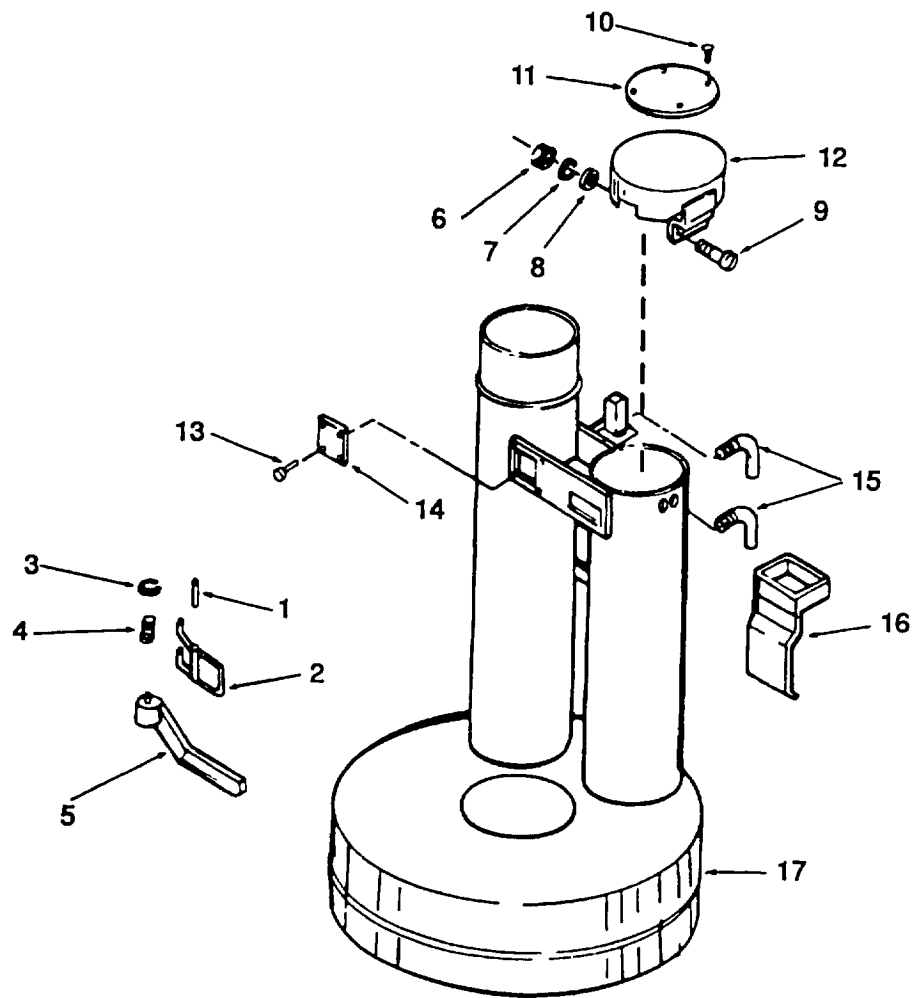


Figure F-1. Immersion Heater Body Assembly Components

## SECTION II.

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| (1)<br>ITEM<br>NO | (2)<br>SMR<br>CODE | (3)<br>CAGEC | (4)<br>PART<br>NUMBER | (5)<br>DESCRIPTION AND USABLE ON CODES (UOC)             | (6)<br>QTY |
|-------------------|--------------------|--------------|-----------------------|--|------------|
|                   |                    |              |                       | GROUP 01. HEATER BODY ASSEMBLY                           |            |
|                   |                    |              |                       | FIGURE F-1. IMMERSION HEATER BODY<br>ASSEMBLY COMPONENTS |            |
| 1                 | PAOZZ              | 96906        | MS24665-495           | PIN, COTTER 3/16 IN. DIA. X 1-1/2<br>IN.LG .....         | 1          |
| 2                 | PAOZZ              | 81337        | 5-13-2684-10          | SPRING, IGNITER .....                                    | 1          |
| 3                 | PAOZZ              | 81337        | 5-13-2684-11          | RING, RETAINING .....                                    | 1          |
| 4                 | PAOZZ              | 81337        | 5-13-2679-7           | WICK .....   | 1          |
| 5                 | PAOZZ              | 81337        | 5-13-2684-4           | IGNITOR ASSEMBLY, HE .....                               | 1          |
| 6                 | PAOZZ              | 96906        | MS35649-202           | NUT, PLAIN, HEXAGON HEAD .....                           | 2          |
| 7                 | PAOZZ              | 81337        | 5-13-2682-2-28        | WASHER, LOCK .....                                       | 2          |
| 8                 | PAOZZ              | 81337        | 5-13-2682-2-27        | WASHER, FLAT .....                                       | 2          |
| 9                 | PAOZZ              | 96906        | MS35206-261           | SCREW, MACHINE 10-24 X 3/8 IN. LG .....                  | 2          |
| 10                | PAOZZ              | 07707        | SD42BS                | RIVET, BLIND .....                                       | 4          |
| 11                | PAOZZ              | 81337        | 5-13-2684-2-23        | PLATE, INSTRUCTION .....                                 | 1          |
| 12                | PAOZZ              | 81337        | 5-13-2682-2-20        | HOOD ASSEMBLY .....                                      | 1          |
| 13                | PAOZZ              | 07707        | SD42BS                | RIVET, BLIND .....                                       | 4          |
| 14                | XDOZZ              | 81337        | 5-13-2684-14          | PLATE, IDENTIFICATION .....                              | 1          |
| 15                | PAOZZ              | 31577        | 56956-1               | BOLT, HOOK .....   | 2          |
| 16                | PAOZZ              | 81337        | 5-13-2687-8           | PLATE, BACKING .....                                     | 1          |
| 17                | XAOZZ              | 81337        | 5-13-2680-2           | BODY, HEATER .....                                       | 1          |

END OF FIGURE

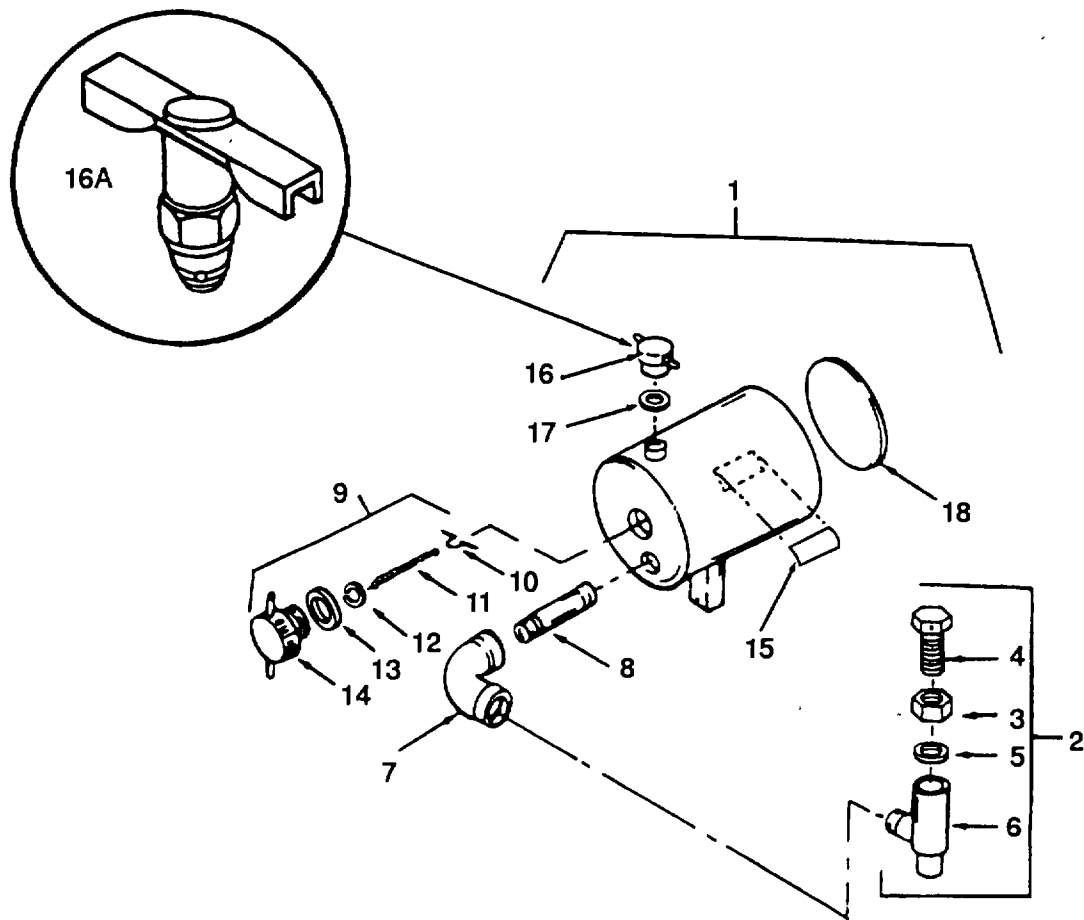


Figure F-2. Immersion Heater Fuel System Components

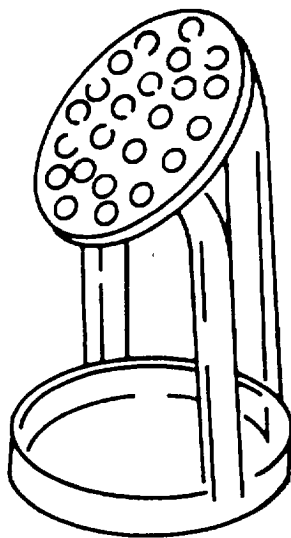


## SECTION II.

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| (1)<br>ITEM<br>NO                                      | (2)<br>SMR<br>CODE | (3)<br>CAGEC | (4)<br>PART<br>NUMBER   | (5)<br>DESCRIPTION AND USABLE ON CODES (UOC)                                      | (6)<br>QTY |
|--|--------------------|--------------|-------------------------|---|------------|
| GROUP 02. FUEL SYSTEM                                  |                    |              |                         |   |            |
| FIGURE F-2. IMMERSION HEATER FUEL<br>SYSTEM COMPONENTS |                    |              |                         |   |            |
| 1  | PAOZZ              | 81337        | 5-13-2685-5             | FUEL TANK ASSEMBLY .....  | 1          |
| 2  | PAOZZ              | 81337        | 5-13-458 VALVE          | ..VALVE ASSEMBLY .....  | 1          |
| 3  | XAOZZ              | 81337        | 5-13-2686-5-24          | ..NUT, HEXAGON .....  | 1          |
| 4  | XAOZZ              | 81337        | 5-13-2686-5-21-5-<br>23 | ..STEM, VALVE .....   | 1          |
| 5  | PAOZZ              | 81337        | 5-13-2686-5-22          | ..GASKET .....  | 1          |
| 6  | XAOZZ              | 81337        | 5-13-2686-5-20          | ..BODY, VALVE .....   | 1          |
| 7  | PAOZZ              | 81348        | WWP521                  | ..ELBOW, PIPE 90 DEG, 1/8 IN. NPT .....   | 1          |
| 8  | PAOZZ              | 96906        | MS51953-10              | ..NIPPLE, PIPE .....  | 1          |
| 9  | PAOZZ              | 81337        | 5-13-457                | ..PLUG, FILLER .....  | 1          |
| 10   | XAOZZ              | 81337        | 5-13-2686-5-15          | ..RETAINER .....  | 1          |
| 11   | XAOZZ              | 81337        | 5-13-2686-5-18          | ..CHAIN, SASH .....   | 1          |
| 12   | XAOZZ              | 81337        | 5-13-2686-5-16          | ..RING .....  | 1          |
| 13   | XAOZZ              | 81337        | 5-13-2686-5-17          | ..GASKET, PLUG .....  | 1          |
| 14   | XAOZZ              | 81337        | 5-13-2686-5-13          | ..BODY .....  | 1          |
| 15   | PAOZZ              | 81337        | 5-13-2684-5-29          | ..PLATE, CAUTION .....  | 1          |
| 16   | XAOZZ              | 81337        | 5-13-2686-5-9           | ..PLUG, VENT WHEN NO LONGER<br>SERVICEABLE, REQ DRAIN COCK, PN<br>MS35782-4 96906 |            |
| 17   | PAOZZ              | 81337        | 5-13-2686-5-11          | ..GASKET, VENT CAP .....  | 1          |
| 18   | XBOZZ              | 81337        | 5-13-2684-5-27          | ..PLATE IDENT .....   | 1          |

END OF FIGURE

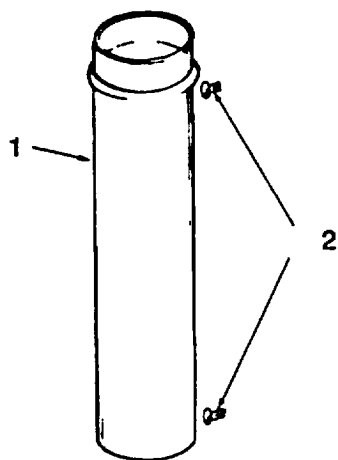


*Figure F-3. Immersion Heater Burner Assembly*

## SECTION II.

TM 9-4540-202-12&amp;P

| (1)<br>ITEM<br>NO | (2)<br>SMR<br>CODE | (3)<br>CAGEC | (4)<br>PART<br>NUMBER | (5)<br>DESCRIPTION AND USABLE ON CODES (UOC)    | (6)<br>QTY |
|-------------------|--------------------|--------------|-----------------------|---|------------|
|                   |                    |              |                       | GROUP 03. BURNER ASSEMBLY                       |            |
|                   |                    |              |                       | FIGURE F-3. IMMERSION HEATER<br>BURNER ASSEMBLY |            |
| 1                 | PAOZZ              | 81337        | 5-13-2683-3           | BURNER .....                                    | 1          |
|                   |                    |              |                       | END OF FIGURE                                   |            |



*Figure F-4. Immersion Heater Air Conditioning-Heat Pipe*

## SECTION II.

TM 9-4540-202-12&amp;P

| (1)<br>ITEM<br>NO | (2)<br>SMR<br>CODE | (3)<br>CAGEC | (4)<br>PART<br>NUMBER | (5)<br>DESCRIPTION AND USABLE ON CODES (UOC)                          | (6)<br>QTY |
|-------------------|--------------------|--------------|-----------------------|---|------------|
|                   |                    |              |                       | GROUP 04. SMOKESTACK ASSEMBLY<br>(PIPE, AIR CONDITIONING-<br>HEATING) |            |
|                   |                    |              |                       | FIGURE F-4. IMMERSION HEATER AIR<br>CONDITIONING-HEAT PIPE            |            |
| 1                 | PAOZZ              | 81349        | MIL-P-551             | PIPE, AIR CONDITIONING & HEAT .....                                   | 4          |
| 2                 | PAOZZ              | 96906        | MS35684-10            | RIVET, SPLIT 9-64 IN. X 1-4 IN. LG, STEEL .....                       | 2          |

END OF FIGURE

**SECTION II.****TM 9-4540-202-12&P**

| (1)<br>ITEM<br>NO | (2)<br>SMR<br>CODE | (3)<br>CAGEC | (4)<br>PART<br>NUMBER | (5)<br>DESCRIPTION AND USABLE ON CODES (UOC) | (6)<br>QTY |
|-------------------|--------------------|--------------|-----------------------|--|------------|
|                   |                    |              |                       | GROUP 05. BULK MATERIALS                     |            |
|                   |                    |              |                       | FIG. BULK<br>NOT APPLICABLE                  |            |

**SECTION III. SPECIAL TOOLS LIST**

**Not Applicable**

## APPENDIX F

## SECTION IV.

## CROSS-REFERENCE INDEXES

## NATIONAL STOCK NUMBER INDEX

| STOCK NUMBER     | FIG. | ITEM | STOCK NUMBER | FIG. | ITEM |
|------------------|------|------|--------------|------|------|
| 5320-00-010-4448 | F-4  | 2    |              |      |      |
| 5310-00-014-5850 | F-1  | 8    |              |      |      |
| 5310-00-045-3296 | F-1  | 7    |              |      |      |
| 4540-00-139-3428 | F-2  | 1    |              |      |      |
| 4730-00-196-1482 | F-2  | 8    |              |      |      |
| 5315-00-234-1664 | F-1  | 1    |              |      |      |
| 4730-00-249-1474 | F-2  | 7    |              |      |      |
| 4520-00-277-8339 | F-4  | 1    |              |      |      |
| 4540-00-423-0255 | F-1  | 5    |              |      |      |
| 4540-00-483-3846 | F-1  | 4    |              |      |      |
| 5365-00-533-3833 | F-1  | 3    |              |      |      |
| 5360-00-536-2524 | F-1  | 2    |              |      |      |
| 5330-00-540-3724 | F-2  | 5    |              |      |      |
| 4540-00-555-8527 | F-2  | 9    |              |      |      |
| 4540-00-555-8531 | F-2  | 2    |              |      |      |
| 5306-00-829-2220 | F-1  | 15   |              |      |      |
| 5320-00-879-4473 | F-1  | 10   |              |      |      |
|                  | F-1  | 13   |              |      |      |
| 5310-00-934-9758 | F-1  | 6    |              |      |      |
| 5305-00-984-6208 | F-1  | 9    |              |      |      |
| 4540-01-011-7357 | F-3  | 1    |              |      |      |
| 9905-01-089-4211 | F-1  | 11   |              |      |      |
| 4520-01-136-5495 | F-1  | 12   |              |      |      |
| 4540-01-150-3076 | F-1  | 16   |              |      |      |
| 4540-01-155-9388 | F-2  | 15   |              |      |      |
| 5330-01-172-1181 | F-2  | 17   |              |      |      |
| 9905-01-207-8441 | F-1  | 14   |              |      |      |



## SECTION IV.

## CROSS-REFERENCE INDEXES

## PART NUMBER INDEX

| CAGEC | PART NUMBER         | STOCK NUMBER     | FIG. | ITEM |
|-------|---------------------|------------------|------|------|
| 81349 | MIL-P-551           | 4520-00-277-8339 | F-4  | 1    |
| 96906 | MS24665-495         | 5315-00-234-1664 | F-1  | 1    |
| 96906 | MS35206-261         | 5305-00-984-6208 | F-1  | 9    |
| 96906 | MS35649-202         | 5310-00-934-9758 | F-1  | 6    |
| 96906 | MS35684-10          | 5320-00-010-4448 | F-4  | 2    |
| 96906 | MS51953-10          | 4730-00-196-1482 | F-2  | 8    |
| 07707 | SD42BS              | 5320-00-879-4473 | F-1  | 10   |
|       |                     |                  | F-1  | 13   |
| 81348 | WWP521              | 4730-00-249-1474 | F-2  | 7    |
| 81337 | 5-13-2679-7         | 4540-00-483-3846 | F-1  | 4    |
| 81337 | 5-13-2680-2         |                  | F-1  | 17   |
| 81337 | 5-13-2682-2-20      | 4520-01-136-5495 | F-1  | 12   |
| 81337 | 5-13-2682-2-27      | 5310-00-014-5850 | F-1  | 8    |
| 81337 | 5-13-2682-2-28      | 5310-00-045-3296 | F-1  | 7    |
| 81337 | 5-13-2683-3         | 4540-01-011-7357 | F-3  | 1    |
| 81337 | 5-13-2684-10        | 5360-00-536-2524 | F-1  | 2    |
| 81337 | 5-13-2684-11        | 5365-00-533-3833 | F-1  | 3    |
| 81337 | 5-13-2684-14        | 9905-01-207-8441 | F-1  | 14   |
| 81137 | 5-13-2684-2-23      | 9905-01-089-4211 | F-1  | 11   |
| 81337 | 5-13-2684-4         | 4540-00-423-0255 | F-1  | 5    |
| 81337 | 5-13-2684-5-27      |                  | F-2  | 18   |
| 81337 | 5-13-2684-5-29      | 4540-01-155-9388 | F-2  | 15   |
| 81337 | 5-13-2685-5         | 4540-00-139-3428 | F-2  | 1    |
| 81337 | 5-13-2686-5-11      | 5330-01-172-1181 | F-2  | 17   |
| 81337 | 5-13-2686-5-13      |                  | F-2  | 14   |
| 81137 | 5-13-2686-5-15      |                  | F-2  | 10   |
| 81337 | 5-13-2686-5-16      |                  | F-2  | 12   |
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| 81337 | 5-13-2686-5-18      |                  | F-2  | 11   |
| 81337 | 5-13-2686-5-20      |                  | F-2  | 6    |
| 81337 | 5-13-2686-5-21-5-23 |                  | F-2  | 4    |
| 81337 | 5-13-2686-5-22      | 5330-00-540-3724 | F-2  | 5    |
| 81337 | 5-13-2686-5-24      |                  | F-2  | 3    |
| 81337 | 5-13-2686-5-9       |                  | F-2  | 16   |
| 81337 | 5-13-2687-8         | 4540-01-150-3076 | F-1  | 16   |
| 81337 | 5-13-457            | 4540-00-555-8527 | F-2  | 9    |
| 81337 | 5-13-458VALVE       | 4540-00-555-8531 | F-2  | 2    |
| 31577 | 56956-1             | 5306-00-829-2220 | F-1  | 15   |

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|------|------|------------------|-------|---------------------|
| F-1  | 1    | 5315-00-234-1664 | 96906 | MS24665-495         |
| F-1  | 2    | 5360-00-536-2524 | 81337 | 5-13-2684-10        |
| F-1  | 3    | 5365-00-533-3833 | 81337 | 5-13-2684-11        |
| F-1  | 4    | 4540-00-483-3846 | 81337 | 5-13-2679-7         |
| F-1  | 5    | 4540-00-423-0255 | 81337 | 5-13-2684-4         |
| F-1  | 6    | 5310-00-934-9758 | 96906 | MS35649-202         |
| F-1  | 7    | 5310-00-045-3296 | 81337 | 5-13-2682-2-28      |
| F-1  | 8    | 5310-00-014-5850 | 81337 | 5-13-2682-2-27      |
| F-1  | 9    | 5305-00-984-6208 | 96906 | MS35206-261         |
| F-1  | 10   | 5320-00-879-4473 | 07707 | SD42BS              |
| F-1  | 11   | 9905-01-089-4211 | 81337 | 5-13-2684-2-23      |
| F-1  | 12   | 4520-01-136-5495 | 81337 | 5-13-2682-2-20      |
| F-1  | 13   | 5320-00-879-4473 | 07707 | SD42BS              |
| F-1  | 14   | 9905-01-207-8441 | 81337 | 5-13-2684-14        |
| F-1  | 15   | 5306-00-829-2220 | 31577 | 56956-1             |
| F-1  | 16   | 4540-01-150-3076 | 81337 | 5-13-2687-8         |
| F-1  | 17   |                  | 81337 | 5-13-2680-2         |
| F-2  | 1    | 4540-00-139-3428 | 81337 | 5-13-2685-5         |
| F-2  | 2    | 4540-00-555-8531 | 81337 | 5-13-458VALVE       |
| F-2  | 3    |                  | 81337 | 5-13-2686-5-24      |
| F-2  | 4    |                  | 81337 | 5-13-2686-5-21-5-23 |
| F-2  | 5    | 5330-00-540-3724 | 81337 | 5-13-2686-5-22      |
| F-2  | 6    |                  | 81337 | 5-13-2686-5-20      |
| F-2  | 7    | 4730-00-249-1474 | 81348 | WWP521              |
| F-2  | 8    | 4730-00-196-1482 | 96906 | MS51953-10          |
| F-2  | 9    | 4540-00-555-8527 | 81337 | 5-13-457            |
| F-2  | 10   |                  | 81337 | 5-13-2686-5-15      |
| F-2  | 11   |                  | 81337 | 5-13-2686-5-18      |
| F-2  | 12   |                  | 81337 | 5-13-2686-5-16      |
| F-2  | 13   |                  | 81337 | 5-13-2686-5-17      |
| F-2  | 14   |                  | 81337 | 5-13-2686-5-13      |
| F-2  | 15   | 4540-01-155-9388 | 81337 | 5-13-2684-5-29      |
| F-2  | 16   |                  | 81337 | 5-13-2686-5-9       |
| F-2  | 17   | 5330-01-172-1181 | 81337 | 5-13-2686-5-11      |
| F-2  | 18   |                  | 81337 | 5-13-2684-5-27      |
| F-3  | 1    | 4540-01-011-7357 | 81337 | 5-13-2683-3         |
| F-4  | 1    | 4520-00-277-8339 | 81349 | MIL-P-551           |
| F-4  | 2    | 5320-00-010-4448 | 96906 | MS35684-10          |

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03082

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23. Figure: 7
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|---------|------------|-----------|----------|
| 6       | 2-1<br>a   |           |          |
| B1      |            | 4-3       |          |

In line 6 of paragraph 2-1a the manual states the engine has 6 cylinders. The engine on my set only has 4 cylinders. Change the manual to show 4 cylinders.

Callout 16 in figure 4-3 is pointed to a bolt. In key to figure 4-3, item 16 is called a shim. Please correct one or the other

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TEAR ALONG PERFORATED LINE

## 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 = 0.35 ounce  
 1 dekegram = 10 Grams = .35 ounce  
 1 hectogram = 10 dekagrams = 3.52 ounces  
 1 kilogram = 10 hectograms = 2.2 pounds  
 1 quintal = 100 kilograms = 220.46 pounds  
 1 metric ton = 10 quintals = 1.1 short tons

### ***Liquid Measure***

1 centiliter = 10 milliliters = .34 fluid ounce  
 1 deciliter = 10 centiliters = 3.38 fluid ounces  
 1 liter = 10 deciliters = 33.81 fluid ounces  
 1 dekaliter = 10 liters = 2.64 gallons  
 1 hectoliter = 10 dekaliters = 27.42 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 = 125.5 sq. inches  
 1 sq. meter (centare) = 100 sq decimeters = 10.76 sq. feet  
 1 sq. dekameter (are) = 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. decimeters = 61.02 cu. inches  
 1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

## Approximate Conversion Factors

| <b><i>To change</i></b> | <b><i>To</i></b>   | <b><i>Multiply by</i></b> | <b><i>To change</i></b> | <b><i>To</i></b> | <b><i>Multiply by</i></b> |
|-------------------------|--------------------|---------------------------|-------------------------|------------------|---------------------------|
| 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                     |
| pounds-inches           | newton-meters      | .11296                    |                         |                  |                           |

### **Temperature (Exact)**

|    |                        |                            |                     |    |
|----|------------------------|----------------------------|---------------------|----|
| °F | Fahrenheit Temperature | 5/9 (after subtracting 32) | Celsius Temperature | °C |
|    | temperature            | subtracting                | temperature         |    |

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