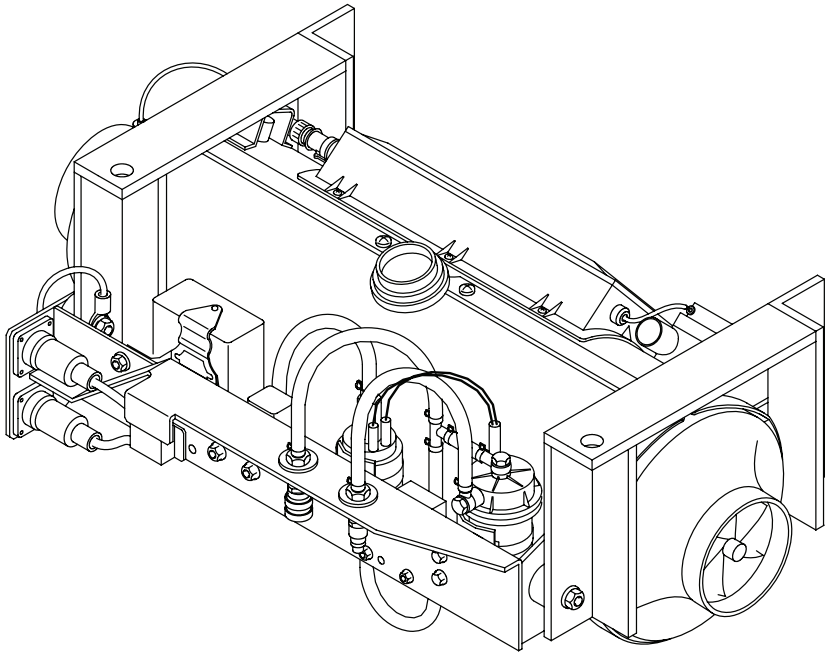
TECHNICAL MANUAL

FIELD AND SUSTAINMENT MAINTENANCE MANUAL (INCLUDING REPAIR PARTS AND SPECIAL TOOLS LIST)

FOR

HEATER, VEHICULAR COMPARTMENT, ESPAR V7S

(NSN 2540-01-511-5293)



* Supersedes TM 9-2540-220-24&P dated 31 August 2007.

HEADQUARTERS, DEPARTMENT OF THE ARMY
NOVEMBER 2007

WARNING SUMMARY

WARNING SUMMARY

This list summarizes critical WARNINGs in this manual. They are repeated here to let you know how important they are. Study these WARNINGs carefully; they can save your life and the lives of personnel you work with.

GENERAL WARNINGS NOT FOUND IN WP PROCEDURES

The following WARNINGs are general safety statements. They are not unique to any specific procedures and, therefore, do not appear elsewhere in this TM. All personnel operating this equipment or working near this equipment must understand and continually observe the precautions in these WARNINGs.

WARNING

Carbon monoxide is colorless, odorless, DEADLY POISONOUS gas which, when breathed, deprives the body of oxygen and causes SUFFOCATION. Exposure to air contaminated with carbon monoxide produces symptoms of headache, dizziness, loss of muscle control, apparent drowsiness, or coma. Permanent BRAIN DAMAGE or DEATH can result from exposure.

Carbon monoxide occurs in the exhaust fumes of fuel-burning heaters and becomes DANGEROUSLY CONCENTRATED under conditions of INADEQUATE VENTILATION. The following precautions MUST be observed to insure safety of personnel whenever heaters are operated:

- DO NOT operate heater in enclosed place unless it is ADEQUATELY VENTILATED.
- BE ALERT at all times during heater operation for exhaust odors and exposure symptoms. If either is present, IMMEDIATELY VENTILATE area. If symptoms persist, remove affected personnel from area, and treat as follows: expose to fresh air; keep warm; DO NOT PERMIT PHYSICAL EXERCISE; if necessary, administer artificial respiration.

REMEMBER: The best defense against carbon monoxide poisoning is adequate ventilation.

WARNING SUMMARY - Continued

WARNING

Heater can flood and leak fuel. JP-8 can catch fire and kill or seriously injure personnel and damage equipment.

Do not attempt to start flooded heater or use starting aids such as ether to assist in heater startup. If heater does not start after three attempts, notify unit maintenance.

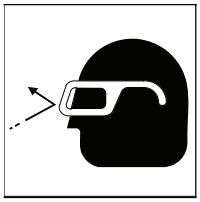
WARNING

Exhaust gas from personnel heater is poisonous and can kill you. Make sure exhaust is unobstructed and vented outside the work area when operating heater. Do not breathe exhaust gases. See warning in the front of this manual.

LIST OF WARNINGS IN WP PROCEDURES

This list includes all the critical WARNINGs in the WP procedures. Study these WARNINGs carefully. They can save your life and the lives of personnel with whom you work.

WARNING



Compressed air can injure you or others.

Do not aim compressed air at yourself or other personnel. Always wear goggles when working with compressed air. Do not use more pressure than 30 psi (207 kPa) with air nozzles.

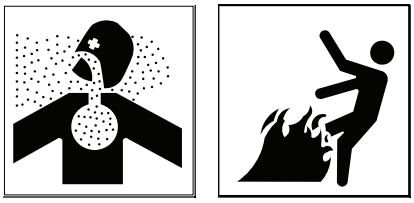
WARNING SUMMARY - Continued

WARNING

Diesel fuel can catch fire and seriously injure or kill personnel and damage or destroy equipment.

Empty fuel from heater and disassembled fuel system components. Wipe up fuel spills immediately. Do not smoke or allow sparks and flame near fuel or fuel system components when working on fuel system.

WARNING



Cleaning solvent is mildly toxic. Solvent evaporates and both the fumes and liquid are flammable. Continued contact with solvent can cause skin problems.

- Ensure there is good air flow when using solvent, and work area is away from heat and flames.
- Keep fire extinguisher nearby.
- Do not breathe solvent fumes.
- Avoid skin contact, use gloves or a brush if necessary.
- Wash hands after using solvent.
- Wear eye protection if solvent could splash into eyes.
- If solvent gets in eyes, flush with fresh water for at least 15 minutes and get medical assistance.

Do not use PD-680 solvent, dry cleaning solvent, benzene (benzol), paint thinner, gasoline or diesel fuel oil as solvent replacements. These materials are all more flammable, more toxic, and can damage materials that approved solvent does not.

FIRST AID

For first aid information, see FM 4-25.11.

INSERT LATEST UPDATED PAGES/WORK PACKAGES. DESTROY SUPERSEDED DATA.

LIST OF EFFECTIVE PAGES/WORK PACKAGES

Date of issue is:

Original .....0 ..... 30 November 2007

TOTAL NUMBER OF PAGES FOR FRONT AND REAR MATTER IS 30 AND TOTAL NUMBER OF WORK PACKAGES IS 48 CONSISTING, OF THE FOLLOWING:

Page/WP No.	*Change No.	Page/WP No.	*Change No	Page/WP No.	*Change No
Cover	0				
a – c/d blank	0				
A/B blank	0				
i – vi	0				
Chapter 1 Index	0				
WP 0001 00 – 0003 00	0				
Chapter 2 Index	0				
WP 0004 00 – 0009 00	0				
Chapter 3 Index	0				
WP 0010 00 – 0014 00	0				
Chapter 4 Index	0				
WP 0015 00 – 0036 00	0				
Chapter 5 Index	0				
WP 0037 00 – 0048 00	0				
Index-1 – Index-6	0				

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HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 30 November 2007

TECHNICAL MANUAL

FIELD AND SUSTAINMENT MAINTENANCE MANUAL (INCLUDING REPAIR PARTS AND SPECIAL TOOLS LIST)

FOR

**HEATER, VEHICULAR COMPARTMENT
ESPAR V7S (NSN 2540-01-511-5293)**

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this publication. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Submit your DA Form 2028 (Recommended Changes to Equipment Technical Publications), through the Internet, on the Army Electronic Product Support (AEPS) website. The Internet address is https://aeps.ria.army.mil. The DA 2028 is located under the Public Application section in the APES Public Home Page. Fill out the form and click on SUBMIT. Using this form on the AEPS will enable us to respond quicker to your comments and better manage the DA Form 2028 program. You may also mail, fax, or E-mail your letter or DA Form 2028 direct to: TACOM Life Cycle Management Command, ATTN: AMSTA-LC-LMPP/TECH PUBS, TACOM-RI, 1 Rock Island Arsenal, Rock Island, IL 61299-7630. The e-mail address is ROCK-TACOM-TECH-PUBS@conus.army.mil. The fax number is DSN 793-0726 or Commercial (309) 782-0726.

CURRENT AS OF 31 March 2007

DISTRIBUTION STATEMENT A – Approved for public release; distribution is unlimited.

TABLE OF CONTENTS

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TABLE OF CONTENTS - Continued

HOW TO USE THIS MANUAL

HOW TO USE THIS MANUAL

This manual tells you how to perform maintenance for the ESPAR V7S Vehicular Heater.

Before starting a task or procedure, make sure you have read this HOW TO USE section and the General Maintenance Instructions Work Package.

WHAT'S IN THE MANUAL – FRONT TO BACK

This TM is divided into chapters and front and rear matter. The chapters are further divided into Work Packages (WPs) for ease of use.

The WARNING SUMMARY section provides safety and first aid information. This section includes general warnings not found in the TM text and a list of the most important detailed warnings extracted from the WPs. All of these warnings cover hazards that could kill or injure personnel.

The TABLE OF CONTENTS lists the WPs in each chapter.

CHAPTER 1 covers General Information, Equipment Description, and Theory of Operation. The Equipment Description WP gives a brief description of major parts and features of the component. The Theory of Operation WP provides information that will help you understand how the component works.

CHAPTER 2 contains the Unit Maintenance General Maintenance Instructions, Repair Parts, Special Tools; Test, Measurement and Diagnostic Equipment (TMDE); and Support Equipment. It also includes the Preventive Maintenance Checks and Services (PMCS) and other maintenance WPs.

CHAPTER 3 contains the Direct and General Support Repair Parts, Special Tools; Test, Measurement and Diagnostic Equipment (TMDE); and Support Equipment, Troubleshooting Procedures, and other maintenance WP's.

CHAPTER 4 provides the supporting information for the TM. It includes the following WPs:

- The REFERENCES WP lists references to be used by personnel in operating and maintaining the heater. These references include technical manuals and other publications.
- The MAINTENANCE ALLOCATION CHART (MAC) WP contains a listing for the heater.
- The REPAIR PARTS AND SPECIAL TOOLS LISTS provides common repair parts, common tools, and special tools used to maintain or repair the heater.
- The EXPENDABLE/DURABLE SUPPLIES AND MATERIALS WP lists expendable supplies and materials used to maintain or repair the heater.

The INDEX is an alphabetical listing of all the major controls, procedures, indicators, and subsystems covered in this manual. Each entry is cross-referenced to the WP number and page number.

DA Form 2028 is used to report errors and to recommend improvements for procedures in this manual. Three blank DA Forms 2028 are in the back of this manual. A sample is provided to show you how to fill out the DA Form 2028.

The back cover includes a METRIC CONVERSION CHART that can be used to convert U.S. customary measurements to their metric equivalents. Measurements in this manual are given in U.S. customary units and metric units in parentheses.

USING YOUR MANUAL ON THE JOB

The best way to learn about this manual is to practice using it. Knowing how to use this manual will save both time and energy.

HOW TO USE THIS MANUAL - Continued

HOW TO USE THE WORK PACKAGES

How to find the WP you need

Pick a key word from the component to be used. Look in the INDEX for this key word or the name of the action you will perform. Turn to the WP and page indicated.

How to read the WP

Pay attention to all **WARNINGs, CAUTIONs,** and **NOTEs**. These can appear in all types of procedures. They help you avoid harm to yourself, other personnel, and equipment. They also tell you things you should know about the procedures.

Before you start a procedure, get all the tools, supplies, and personnel you need to do the procedure. These items will be listed in the INITIAL SETUP of the WP.

Start with Step 1 and do each step in the order given. Numbered primary steps tell you WHAT to do. Alpha sub steps tell you HOW to do it.

Look at the illustrations. Locators show you where the equipment and parts are located on the vehicle. Close-up illustrations show the details you need to do the procedure.

Maintenance Procedures WPs

Maintenance Procedures WPs keep the heater in shape to operate. Maintenance procedures are used to present maintenance instructions. Each maintenance procedure details steps which you need to perform. If the heater and parts need maintenance that is not included in any procedure in the manual, notify your supervisor.

The legend below defines each item of information shown in THIS WORK PACKAGE COVERS and INITIAL SETUP sections on the first page of a WP.

LEGEND

TITLE	The name of the procedure.
SUMMARY	A listing of the general actions to be performed, cross-referenced to the page where each action begins.
MAINTENANCE LEVEL	The level of maintenance authorized to perform the procedures in the WP.
TOOLS AND SPECIAL TOOLS	The tools and equipment needed to do the procedures in the WP.
MATERIALS/PARTS	The supplies and parts needed to do the procedures in the WP.
PERSONNEL REQUIRED	The personnel needed to do the procedures in the WP.
REFERENCES	Other WPs, TMs, and publications you will need to do the procedures in the WP.
EQUIPMENT CONDITION	Any special equipment conditions required before the procedure can be started.

Some WPs will include all of the items. Other WPs will include only some of the items.

HOW TO USE THIS MANUAL – Continued

Read the INITIAL SETUP section carefully before you start any procedure. Get the tools and supplies listed and the personnel needed. Be sure the equipment is in the condition required.

The legend below defines each item of information to watch for when performing the procedures in a WP. Read all steps, sub steps, warnings, cautions, and notes before starting the WP procedure.

LEGEND

STEP	This tells you WHAT to do.
SUBSTEP	This tells you HOW to do it.
WARNING	This describes some danger to yourself and other personnel.
CAUTION	This describes possible damage to equipment.
NOTE	This gives you additional information which may not be obvious the first time you do the procedure.
LOCATOR	An illustration that locates the equipment on the vehicle.
CLOSEUP	A detailed illustration of the equipment.

Some WPs will include all of the above items. Some will not.

Read all of the WP before starting. Follow the steps in the order given.

FOLLOW-THROUGH STEPS tell you what to do after the maintenance task is done. The words END OF TASK will tell you when you have finished the procedure.

Troubleshooting WPs

Troubleshooting WPs help you locate faulty parts. They direct you to the maintenance procedure to correct these faults. Chapter 3, Troubleshooting, contains detailed information on how to perform troubleshooting procedures. Read INTRODUCTION TO TROUBLESHOOTING (WP 0011 00) before performing the troubleshooting procedures in the chapter.

Preventive Maintenance Checks and Services (PMCS) WP

Preventive maintenance is required to keep your heater in good running condition. The PMCS procedures are performed on a periodic basis.

The following legend shows you what to look for when you read a PMCS procedure. For more information, see PMCS WP (WP 0007 00).

LEGEND

ITEM NUMBER	This is the sequence for doing the PMCS.
INTERVAL	This tells you when to perform the PMCS check.
ITEM TO BE CHECKED OR SERVICED	The name of the system or component being checked.
PROCEDURE	This tells you what needs to be done.

HOW TO USE THIS MANUAL – Continued

DEFINITION OF WP TERMS

Warnings, Cautions, and Notes

Pay attention to all warnings and cautions within the WP. Ignoring a warning could cause death or injury to yourself or other personnel. Ignoring a caution could cause damage to equipment. Notes contain facts to make the procedure easier. Warnings, cautions, and notes always appear just above the step to which they apply.

WARNINGs	Call attention to things that could kill or injure personnel. Warnings are also listed in the Warning Summary section.
CAUTIONs	Call attention to actions or materials that could damage equipment.
NOTEs	Contain important facts to make the procedure easier.

Helper

Helpers are needed in procedures that require more than one person. A helper may be needed to help lift objects or act as an outside observer.

If a helper is needed to perform a procedure, the INITIAL SETUP will list “Helper (H)” under the PERSONNEL REQUIRED heading.

If a helper assists with a step or sub step, the step or sub step will include: “Have helper assist.”

If a helper performs the action alone, the step will start with “(H):.”

REFERENCES

References within a procedure refer to a different manual or to another procedure in the same manual. They are found in the INITIAL SETUP and in the FOLLOW-THROUGH steps.

For all procedures, the following comments apply:

Parts which are discarded when removed will be referred to as “new” in the procedure step when installed. Examples are: gaskets, lock washers, some preformed packings, and some retaining rings.

These and other new parts are listed under MATERIALS/PARTS in the INITIAL SETUP.

GENERAL MAINTENANCE

Cleaning, inspecting, checking for leaks, and similar procedures which apply to most procedures are found in Chapter 2, GENERAL MAINTENANCE INSTRUCTIONS. Use these steps to clean and inspect any part being removed, repaired, or installed. Special cleaning will be covered in the procedure step.

CHAPTER 1

INTRODUCTORY INFORMATION

WORK PACKAGE INDEX

GENERAL INFORMATION 0001 00

SCOPE

Type of Manual: Organizational, Direct Support, and General Support Maintenance (including Repair Parts and Special Tools Lists).

Model Number and Equipment Name: ESPAR VS7 2239 Vehicular Compartment Heater.

Purpose of Equipment: Supplies warm air to the cab and cargo area for crew comfort and windshield defrosting.

MAINTENANCE FORMS, RECORDS, AND REPORTS

Department of the Army forms and procedures used for equipment maintenance will be those prescribed by DA Pamphlet 750-8, The Army Maintenance Management System (TAMMS) User's Manual.

REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIR)

EIRs can and must be submitted by anyone who is aware of an unsatisfactory condition with the equipment design or use. It is not necessary to show design or list a better way to perform a procedure; just simply tell why the design in unfavorable or why a procedure was difficult. EIRs may be submitted on SF 368 (Quality Deficiency Report). Mail directly to Commander, U.S. Army Tank-Automotive Command, Attn: AMSTA TR-QCL, Warren MI, 48397-5000.

CORROSION PREVENTION AND CONTROL (CPC)

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

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

If a corrosion problem is identified, it can be reported using Standard Form 368 (Quality Deficiency Report). Use of key words such as "corrosion," rust," "deterioration," or "cracking" will assure that the information is identified as a CPC problem. The form should be submitted to: Director, US Army Armament Research, Development, and Engineering Center, ATTN: AMSTA-AR-QAW-A (R), Rock Island, IL 61299-7300.

DESTRUCTION OF ARMY MATERIEL TO PREVENT ENEMY USE

See the following technical manuals for information on destruction of Army materiel:

TM 750-244-6 Procedures for Destruction of Tank-Automotive Equipment to Prevent Enemy Use.
TM 750-244-7 Procedures for Destruction of Equipment in Federal Supply Classifications 1000, 1005, 1015, 1020, 1025, 1030, 1055, 1090, and 1095 to Prevent Enemy Use.

LIST OF ABBREVIATIONS/ACRONYMS

Abbreviations used in this manual are listed below. Learn what each one means. It will make your job easier.

BOI	Basis of Issue
CAGEC	Commercial and Government Entity Code
CPC	Corrosion Prevention Control
EIR	Equipment Improvement Recommendation
EMP	Electromagnetic Pulse
HCI	Hardness Critical Item
MAC	Maintenance Allocation Chart
NIIN	National Item Identification Number
NSN	National Stock Number
PMCS	Preventive Maintenance Checks and Services
P/N	Part Number
QTY	Quantity
RPSTL	Repair Parts and Special Tools List
SMR	Source, Maintenance and Recoverability
SRA	Specialized Repair Activity
TM	Technical Manual
TMDE	Test, Measurement, and Diagnostic Equipment
UOC	Usable On Code
WP	Work Package

SAFETY, CARE, AND HANDLING

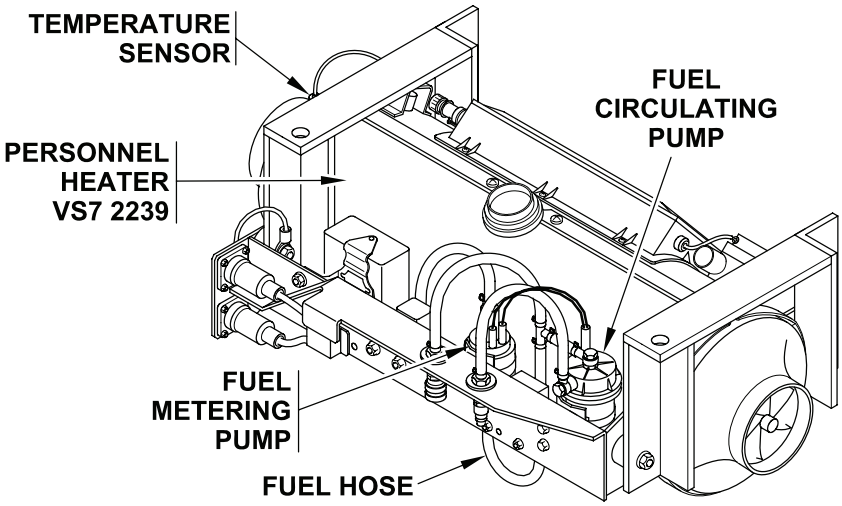
Read warnings in WARNING SUMMARY.

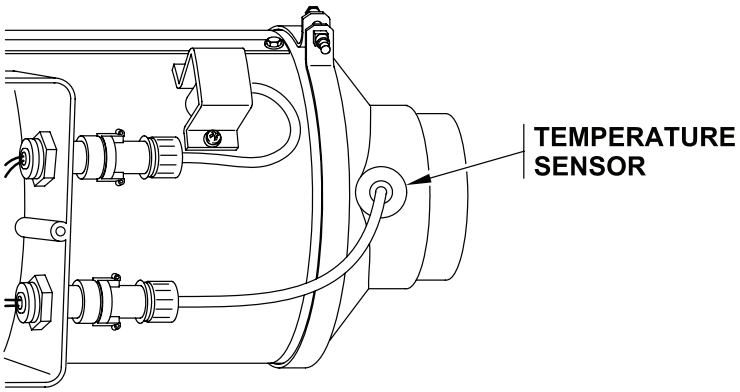
EQUIPMENT CHARACTERISTICS, CAPABILITIES, AND FEATURES

The heater is mounted in the engine compartment and is operated by controls in the cab. The driver's instrument panel allows the operator to turn on and off and adjust the desired heat output. The driver's instrument panel is part of the vehicle; its operation and maintenance are not covered in this manual. The operator controls of the heater in the carrier are covered in TM 9-1450-646-10 and TM 9-1450-646-20-1.

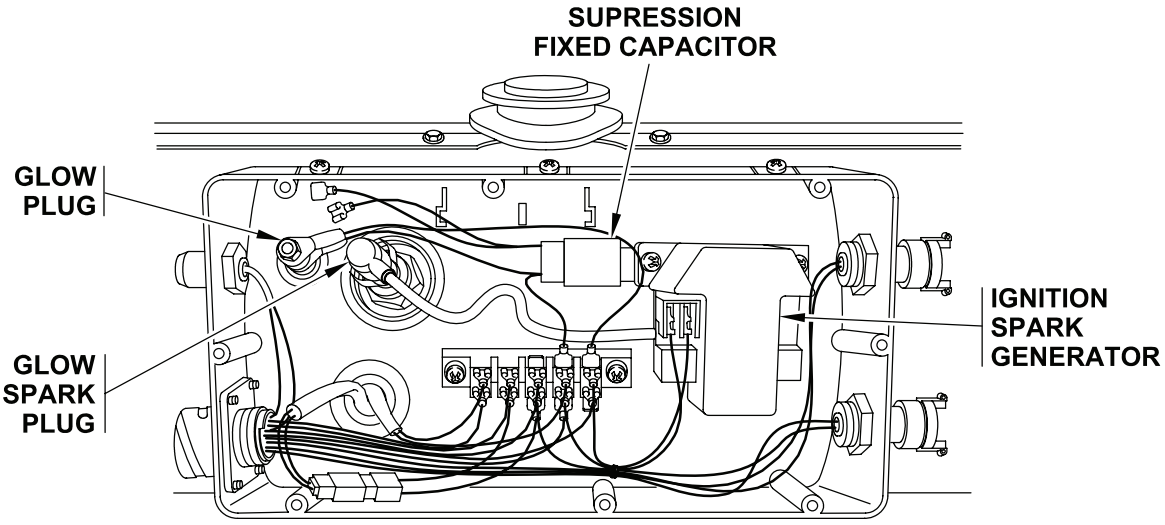
LOCATION AND DESCRIPTION OF MAJOR COMPONENTS

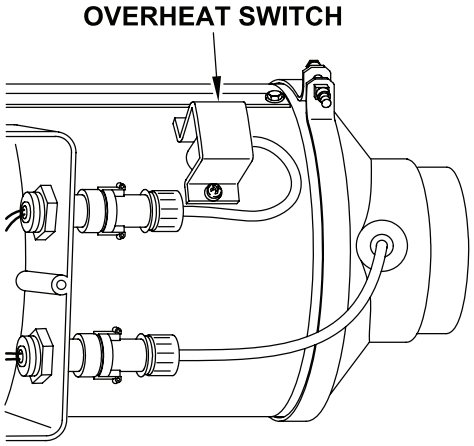
Fuel System





Ignition System





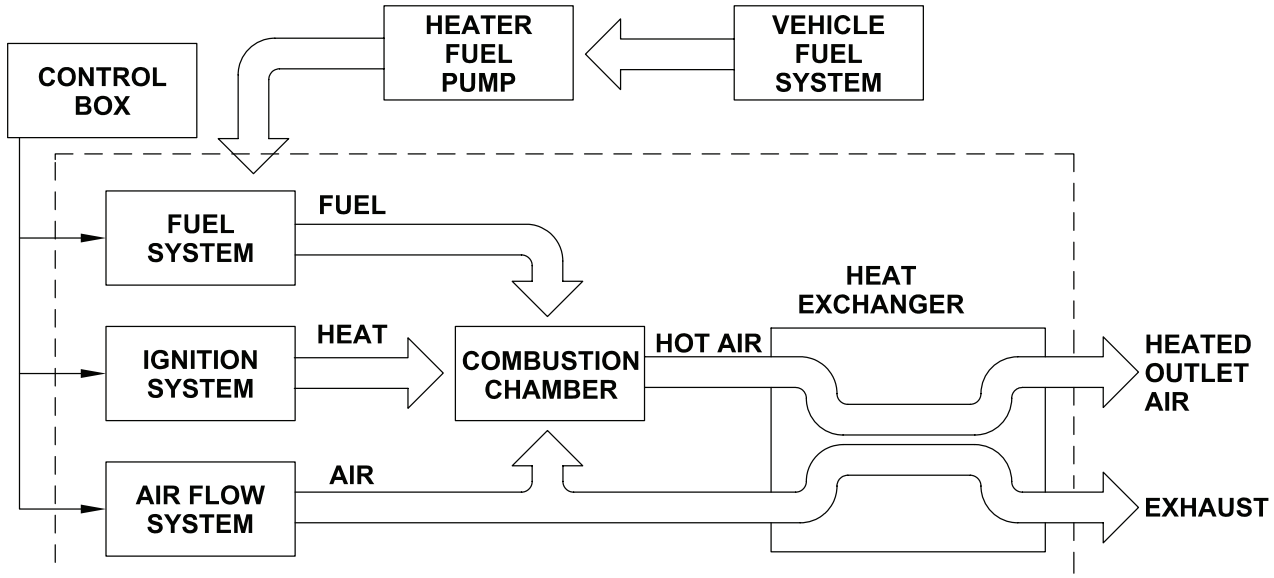
THEORY OF OPERATION 0003 00

BASIC HEATER OPERATION

The personnel heater produces heat by burning fuel. You need three things to make the heater work:

Fuel for burning
A way to light the fuel
A supply of air to mix with the fuel

To see how these three things are brought together in the heater, see the flow diagram below.



The fuel system controls fuel flow into the combustion chamber.
The ignition system lights the fuel.
The air flow system sends air into the combustion chamber for burning.

After combustion, the heater works like this:

The hot air from the combustion chamber goes through the heat exchanger.
The heat exchanger transfers the heat to fresh air supplied by the air flow system.
The heated fresh air is sent through the vehicle ductwork.
The exhaust gases are sent outside the vehicle.

FUEL SYSTEM

Fuel Metering Pump

Meters fuel delivery into heater.

Fuel Circulating Pump

Regulates pressure of incoming fuel.

Fuel Hose

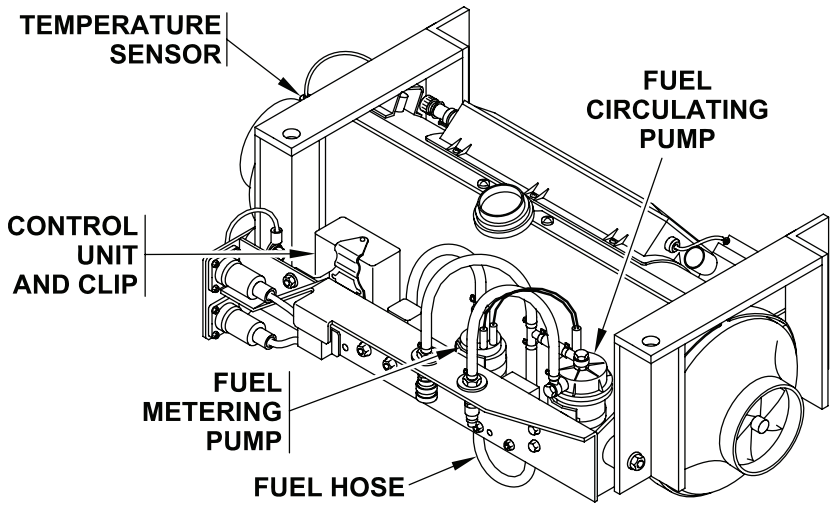
Flexible hose used to deliver fuel to heater.

Temperature Transmitter (Temperature Sensor)

A temperature-sensitive resistor used to monitor heater output. Its resistance and the resistance of the heat regulator on the control box are used by the impulse switch to determine the operating frequency of circulating pump.

Control Unit

BIT Function of the heater.



IGNITION SYSTEM

Heater Igniter (Ignition Spark Generator)

Provides power to operate igniter. Also turns on igniter during periods of low flame to prevent flooding.

Glow Spark Plug

Limits current applied to igniter.

Glow Plug

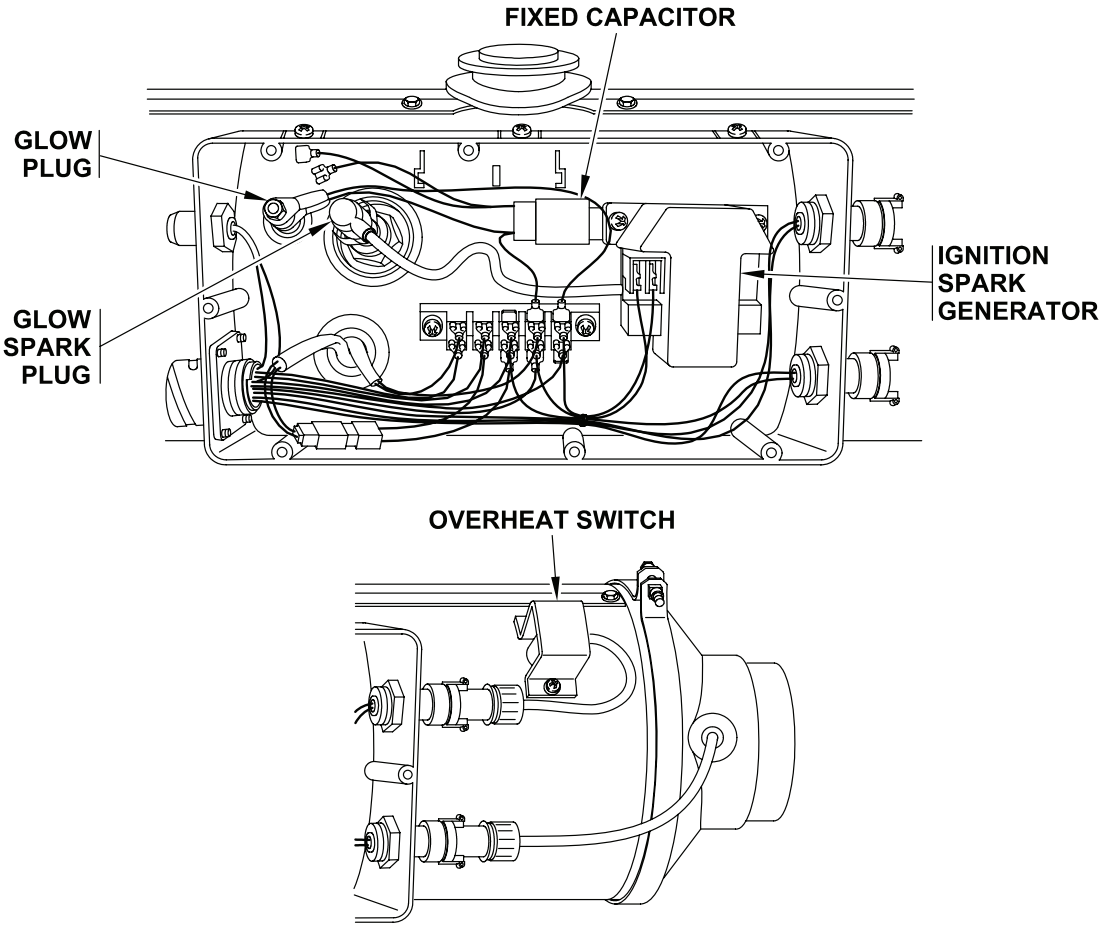
Provides heat for lighting fuel/air mixture by glowing red-hot when energized.

Fixed Capacitor (Suppression Capacitor)

Prevents any radio frequency interference that may be caused by ignition system.

Temperature Transmitter (Overheat Switch)

Disengages power to the heater when an overheat condition is sensed.



AIR FLOW SYSTEM

Blower Motor

Turns impeller, combustion fan assembly, and fuel atomizer.

Impeller

Forces air through heater, around heat exchanger, and out to vehicle ductwork.

Burner Assembly

Draws air from outside vehicle and forces it through fuel atomizer.

Fuel Atomizer

Combines fuel and combustion air and creates a fine mist.

Heat Exchanger

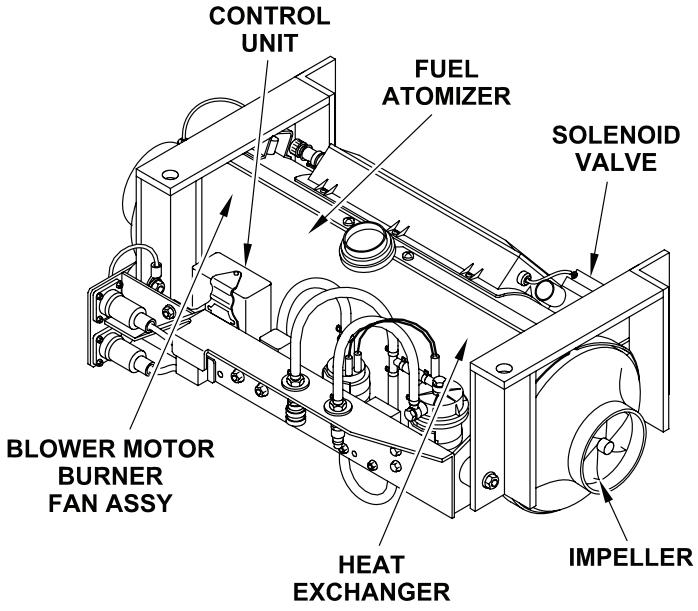
Place where fuel mist is burned and heat is transferred from hot gases inside to fresh air outside. Hot gases outside are forced out exhaust port and piped out of vehicle.

Solenoid Valve

Regulates amount of air drawn in by combustion fan assembly to control fuel/air mix ratio.

Control Unit

Controls personnel heater STARTUP and SHUTDOWN procedures as well as monitoring the operation of the personnel heater with Built-In-Testing (BIT) through sensors throughout the heater assembly. Flashing the ON light on the Driver's Instrument Panel alerts the operator of a fault within the heater, or maintenance personnel can short two pins on the control unit to initiate the BIT function and faults through a series of flashes of the ON light.



CHAPTER 2

UNIT MAINTENANCE INFORMATION

WORK PACKAGE INDEX

GENERAL MAINTENANCE INSTRUCTIONS 0004 00

SCOPE

These General Maintenance Instructions contain general shop practices and specific methods you must be familiar with to properly maintain the heater. You should read and understand these practices and methods before starting tasks on the heater.

WORK SAFETY

Before starting a task, think about the risks and hazards to your safety as well as others. Wear protective gear such as protective goggles or lenses, rubber shoes, rubber apron or gloves. Protect yourself against injury. Observe all WARNINGS and CAUTIONS.

GENERAL INFORMATION

Before beginning a task, find out how much repair, conversion, or replacement is needed to fix the equipment as described in this manual. Sometimes the reason for equipment failure can be seen right away, and complete teardown is not necessary. Disassemble equipment only as far as necessary to repair or replace damaged or broken parts.

All tags and forms attached to the equipment must be checked to learn the reason for removal from service. Also, check all Modification Work Orders (MWO) and Technical Bulletins (TB) for equipment changes and updates.

In some cases, a part may be damaged by removal. If the part appears to be good, and other parts behind it are not defective, leave it on and continue the procedure.

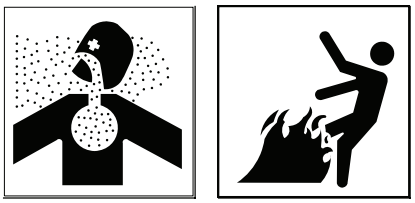
Replace all gaskets, seals, and packings.

CLEANING INSTRUCTIONS

1. The cleaning instructions will be the same for the majority of parts and components which make up the heaters.

2. The importance of cleaning must be thoroughly understood by maintenance personnel. Great care and effort are required in cleaning. Dirt and foreign material are a constant threat to satisfactory maintenance. The following should apply to all cleaning, inspection, repair, and assembly operations.

WARNING



Cleaning solvent is mildly toxic. Solvent evaporates and both the fumes and liquid are flammable. Continued contact with solvent can cause skin problems.

- **Ensure there is good air flow when using solvent, and work area is away from heat and flames.**
- **Keep fire extinguisher nearby.**
- **Do not breathe solvent fumes.**
- **Avoid skin contact, use gloves or a brush if necessary.**
- **Wash hands after using solvent.**
- **Wear eye protection if solvent could splash into eyes.**
- **If solvent gets in eyes, flush with fresh water for at least 15 minutes and get medical assistance.**

Do not use PD-680 solvent, dry cleaning solvent, benzene (benzol), paint thinner, gasoline or diesel fuel oil as solvent replacements. These materials are all more flammable, more toxic, and can damage materials that approved solvent does not.

CAUTION

Washing electrical cables and flexible hoses with dry-cleaning solvents or mineral spirits will cause serious damage or destroy the material.

NOTE

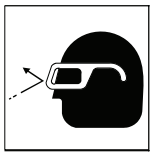
Wash electrical cables and flexible hoses with water and mild soap solution, and wipe dry.

a. Clean all parts before inspection, after repair, and before assembly.

b. Grease collects dust, dirt, and grit. Keep hands free of any accumulation of grease.

c. After cleaning, cover or wrap all parts to protect them from dust and dirt. Lightly oil parts which are subject to rust.

WARNING



Compressed air can injure you or others.

Do not aim compressed air at yourself or other personnel. Always wear goggles when working with compressed air. Do not use more pressure than 30 psi (207 kPa) with air nozzles.

3. Blow out tapped (threaded) holes with compressed air to remove dirt and cleaning fluids.

INSPECTION INSTRUCTIONS

All components and parts must be carefully checked to determine:

a. If they are serviceable for reuse.
b. If they can be repaired.
c. If they must be scrapped.

Drilled and Tapped (Threaded Holes)

1. Inspect for wear, distortion, cracks, or any other damage in or around holes.
2. Inspect threaded areas for wear, distortion (stretching), or evidence of crossthreading.
3. Mark all damaged areas for repair or replacement.

Metal Lines, Flexible Lines (Hoses), and Metal Fittings

1. Inspect metal lines for sharp kinks, cracks, bad bends, or dents.
2. Inspect flexible lines for fraying, evidence of leakage, or loose metal fittings or connectors.
3. Check all metal fittings and connectors for thread damage, and check for hex heads that are worn or rounded by poorly fitting wrenches.
4. Mark all damaged material for repair or replacement.

Machined Metal Parts

1. Inspect machined surfaces for nicks, burrs, raised metal, wear, or any other damage.
2. Check all inner and outer surfaces for breaks or cracks.
3. Mark all damaged material for repair or replacement.

REPAIR PARTS, SPECIAL TOOLS; TEST, MEASUREMENT, AND DIAGNOSTIC EQUIPMENT (TMDE); AND SUPPORT EQUIPMENT

0005 00

COMMON TOOLS AND EQUIPMENT

For authorized common tools and equipment, refer to the Modified Table of Organization and Equipment (MTOE) applicable to your unit.

SPECIAL TOOLS, TMDE, AND SUPPORT EQUIPMENT

No special tools or equipment are required to maintain the heater.

REPAIR PARTS

Repair parts are listed and illustrated in WP 0040 00 – 0044 00.

SERVICE UPON RECEIPT OF MATERIAL

Unpacking

When a new or reconditioned heater is received, be aware of any shipping damage to packaging material. Report any damage on SF 364, Report of Discrepancy (ROD), as prescribed in AR 735-11-2. Retain packaging material for future use.

Checking Unpacked Equipment

1. Inspect the equipment for damage incurred during shipment. If the equipment has been damaged, report the damage on SF 361, Transportation Discrepancy Report.

2. Check the equipment against the packing slip to see if the shipment is complete. Report all discrepancies in accordance with applicable service instructions (e.g., for Army instructions, see DA PAM 750-8).

GENERAL INSTRUCTIONS

No service upon receipt is to be performed on the heater, other than bleeding the vehicle fuel system after installation. Once installed, service is to be performed only as required.

PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS) 0007 00

THIS WORK PACKAGE COVERS:

INITIAL SETUP:

Maintenance Level
Unit

Tools and Special Tools
General Mechanic's Tool Kit (WP 0048 00, Item 1)

Materials/Parts
Dry-Cleaning Solvent (WP 0047 00, Item 3)
General Detergent (WP 0047 00, Item 1)
Wiping Rags (WP 0047 00, Item 2)

Personnel Required
Unit Mechanic

References
WP 0015 00
WP 0017 00
WP 0018 00
TM 9-1450-646-10
TM 9-1055-647-13&P

GENERAL

Preventive maintenance means checking the heater on a regular basis to ensure it functions properly. It also means finding things that are going to be bad before they fail completely, as well as damage that might have occurred during transport. This helps avoid repair jobs that may take more time.

All items to be checked by Unit Maintenance appear in the Preventative Maintenance Checks and Services (PMCS) chart in this section. All items are to be checked monthly.

Record all problems noted on DA 2404. Also, record the corrective actions taken to repair the heater. Use the numbers in the item column of the PMCS for the TM number column on DA 2404 report.

SPECIAL INSTRUCTIONS

If the heater does not work after doing everything listed in the Table 1, go to Chapter 3, Troubleshooting.

If you find something wrong with the heater that can be repaired, write it down on the DA 2404 and notify Unit Maintenance. Use item numbers from the PMCS chart for the "TM Number" column on the form.

Always do your PMCS in the same order so it gets to be a habit. With practice, you will spot anything that is wrong.

When you do your PMCS, take along the tools you will need to make all the checks. You will always need wiping rags.

GENERAL INSPECTION

Keep your vehicle clean. Dirt, grease, oil, and debris only get in the way, and may cover up a serious problem. Clean your vehicle as you work and as needed.

WARNING

Solvent fumes and fluid are poisonous and can cause skin irritation.

Solvent may be harmful if swallowed. Avoid skin contact and breathing of fumes. Read solvent warning at the front of this manual

WARNING

Solvent evaporates rapidly and makes fumes that are flammable.

Do not smoke or allow open flames near solvent fumes.

Read solvent warning at the front of this manual.

Use cleaning solvent (WP 0047, Item 3) on metal surfaces. Use scrubbing soap (WP 0047, Item 1) and water when you clean rubber or plastic surfaces.

Bolts, nuts, and screws: Check for looseness and missing, bent, or broken parts. If you find a loose one, tighten it. If you can't tighten it, notify unit maintenance. Look for chipped paint, bare metal, or rust around bolt heads.

Welds: Look for loose or chipped paint, rust, cracks, or gaps where parts are welded together. If you find a bad weld, notify unit maintenance.

Electrical wires and connectors: Look for cracked or broken insulation, bare wires, and loose or broken connectors. Tighten loose connectors. Make sure wires are in good shape. If you find cracked or broken insulation, bare wires, or broken connectors, notify unit maintenance.

Hoses and fluid lines: Look for wear, damage, and leaks. Make sure clamps and fittings are tight. Wet spots show leaks. A stain around a fitting or connector can also mean there is a leak. If a leak comes from a loose fitting or connector, tighten each fitting or connector. If something is broken or worn out, notify unit maintenance.

You need to know how fluid leaks affect your equipment. Definitions of the types and classes of leaks are given below. You need to know them to determine the condition of your equipment. Learn them. REMEMBER: WHEN IN DOUBT, NOTIFY MAINTENANCE.

LEAKAGE DEFINITIONS

It is necessary for you to know how fluid leaks affect the status of your equipment. The following are definitions of the types/classes of leakage you need to know to be able to determine the status of your equipment. Learn, and be familiar with them.

Class I	Seepage of fluid (as indicated by wetness or discoloration) not great enough to form drops.
Class II	Leakage of fluid great enough to form drops but not enough to cause drops to drip from the item being check/inspected.
Class III	Leakage of fluid great enough to form drops that fall from the item being checked/inspected.

EXPLANATION OF PMCS TABLE ENTRIES

(1) **Item Number Column** – Numbers in this column are for reference. When completing DA Form 5988E (Equipment Maintenance Inspection Worksheet), include the item number for the check/service indicating a fault. Item numbers also appear in the order that you must do checks and services for the intervals listed.
(2) **Interval Column** – This column tells you when you must do the procedure in the PROCEDURE column.
(3) **Item To Be Check or Serviced Column** – This column lists the item to be checked or serviced.
(4) **Procedure Column** – This column gives the procedure you must do to check or service the item listed in the ITEM TO BE CHECKED OR SERVICED column to know if the equipment is ready for operation. You must do the procedure at the time stated in the INTERVAL column. Carefully follow these instructions.

If you find something wrong when performing PMCS, fix it if you can by using Troubleshooting Procedures (WP 0013 00) or maintenance procedures.

Table 1. Monthly Preventive Maintenance Checks and Services.

ITEM NO.	INTERVAL	ITEM TO BE CHECKED OR SERVICED	CREWMEMBER PROCEDURE
1	Annual	Mechanical	a. Remove cover (WP 0015 00). b. Check all external parts of heater for tightness. c. Replace any missing or damaged screws or nuts.
2	Annual	Electrical	a. Check for loose electrical connections. b. Check all wires for broken or frayed insulation. c. Tape any damage insulation.
3	Annual	Ignitor Check	a. Remove glow plug (WP 0018 00) and glow spark plug (WP 0017 00) from heater. b. Inspect for signs of damage (mashed, burned, or pitted surfaces). c. Replace glow plug (WP 0018 00) or glow spark plug (WP 0017 00) if damaged.
4	Annual	Fuel Inspection	**NOTE** **Worn clamps vibrate and work loose easily.** a. Check all hoses, clamps, and fuel tubes connectors for leaks. b. Tighten any loose clamps or connectors. c. Replace any leaking hoses or fuel tubes.
5	Annual	Exhaust System Check	**NOTE** **Look for signs of water in the exhaust system. If you find any, remove heater from vehicle and dump water out of heater.** a. Inspect exhaust system of heater. b. Remove any objects that may be blocking the exhaust system.
6	Annual	Operational Check	**CAUTION** **Heater manufacturer has issued new starting procedures. These procedures must be followed for proper heater operation and to prevent ignition system damage.** a. Install cover (WP 0015 00). b. Start heater. See TM 9-1450-646-10 and TM 9-1450-647-10. c. Listen for any unusual noises during heater operation. d. Make sure heater purges properly after shut-down.

DESCRIPTION OF HEATER FUNCTIONS 0008 00

HEATING

Sequence after switch-on.

Switch On

Pilot light ON
Glow filament of the glow plug and ignition spark generator ON.
Blower ON at full speed

After 25 seconds: Fuel metering pump ON
(with fuel delivery for “High” heat flow)

When steady flame has formed, the glow plug will switch off with approximately 10 seconds delay. The heater will continue to operate for at least 30 seconds under positive control with the heat flow on “High.” Regulation of the heat flow can then take place.

Regulation of the Heat Flow

In heating mode, the required heat flow can be adjusted with the control knob on the temperature control.

The heater itself is operated in 2 settings. In the “low” setting, the fuel metering pump runs at low frequency and delivers a small amount of fuel. Accordingly, the solenoid valve for combustion air is switched to “Low.”

In the “High” setting, the fuel metering pump runs at high frequency and the solenoid valve for combustion air is switched to high. This ensures that the correct fuel-air mixture ratio is obtained in both settings with the same blower speed.

According to heat requirement (outside temperature) and the setting of the control knob (desired discharge temperature), the heater switches over at various intervals from “High” to “Low” and vice versa. The length of the intervals at which the heater operates on “High” or “Low” is a function of the actual discharge temperature which is measured by a temperature sensor in the discharge hood and the desired discharge temperature, corresponding to setting of the control knob.

Switch Off

When the heater is turned off, the pilot light will extinguish. The blower motor will continue to run for cooling purposes and cease automatically after 3 minutes.

CONTROL AND SAFETY DEVICES

NOTE

The flame is monitored by the flame sensor to the maximum permissible temperature by the overheating switch. Both these devices influence the control unit which switches the heater off in the event of any malfunction.

1. If the heater does not start up within 90 seconds after fuel delivery has started, then starting is automatically repeated.

   If heater does not start after second attempt (90 seconds after fuel delivery has started), then the heater will initiate a malfunction shutdown.

2. If the flame extinguishes during operation, the restart cycle is started. If the heater does ignite within 90 seconds from the start of fuel delivery or extinguishes again within 10 minutes, malfunction shut-off cycle will start. Malfunction shut-off can be cancelled by switching the heater briefly OFF and ON.

3. In the event of overheating, the overheating switch will respond, the fuel supply will be interrupted, and the malfunction shut-off will take place. If overheating is the cause of malfunction shut-off, the ON pilot light will flash at regular intervals. Additional malfunction signals can be invoked with operational extra equipment. After the cause of overheating has been remedied, the unit can be restarted by switching the heater OFF and ON again.

4. If the voltage drops below approximately 21 volts or rises to over approximately 30 volts, malfunction shut-off will take place after 20 seconds. Brief periods of over and under voltage will have no effect.

5. When the heater is switched on, the blower motor operation is verified. If it does not start to rotate, the heater will switch to fault mode. During operation, the blower motor is monitored cyclically (every 4 minutes). If the motor speed is below the permissible limit, malfunction shut-off will take place.

DESCRIPTION OF HEATER FAULT CODE 0009 00

ASSESSING THE FUNCTION AND MALFUNCTION TEST

1. In cases of a malfunction, make the following checks first:
   a. Is there fuel in the tank?
   b. Are electrical leads and connections OK?
   c. Ensure the air and exhaust ducts are not blocked.
2. Causes for soot that is produced by the heater can be blocked air and/or exhaust ducts. Remove obstruction.
3. Fuel metering pump delivery excessive. Measure fuel delivery; if necessary, replace fuel delivery pump.
4. Precipitation in the heat exchanger. Clean heat exchanger, replace if necessary.

FUNCTION AND MALFUNCTION TESTING OF THE PERSONNEL HEATER INSTALLED IN THE CARRIER

NOTE

The fault code readings can be obtained without the flashing light by using a JE Diagnostic Unit (P/N 97-1865-070) that will display the three digit code.

1. Involving Personnel Heaters Diagnostic Signals:
   a. Start engine.
   b. Move OFF/HEAT switch to HEAT.
   c. Insert a jumper wire in control unit plug B between pins 9 and 11 for 5 seconds.
   d. Note and count out the code being flashed on the personnel heater ON light.
   e. Find your flashing code in table on the next page.

EXPLANATION OF COLUMNS

Column (1) – Diagnostic Signal. This represents the HEATER ON light flashing a fault code.

Column (2) – Fault Code. Represents the digital malfunction (three number equivalent of the flash signal).

Column (3) – Malfunction/Remedy – Description of the fault. Will help in the decision of what needs to be done for repair of the personnel heater.

DESCRIPTION OF HEATER FAULT CODE - Continued 0009 00

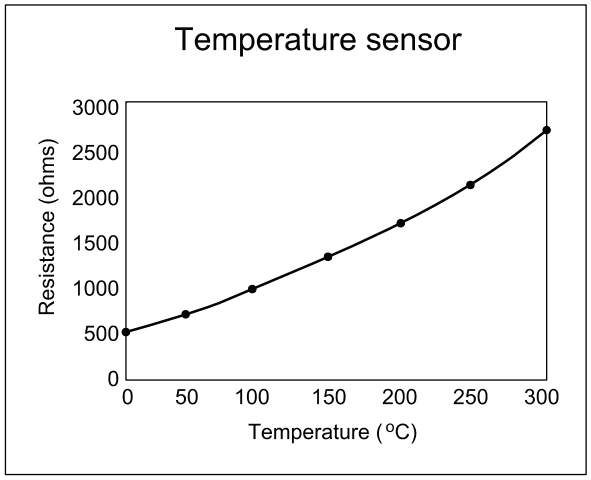
(1) Diagnostic Signal	(2) Fault Code	(3) Malfunction/Remedy
	000	None/Heater operational/No fault
	001, 002	Advance warning signal: Over/under voltage. OVER between A3 and A4 at control unit is 28 volts, UNDER at control panel between A3 and A4 is 22 volts.
	010	Over voltage signal: Shutoff/Voltage between A3 and A4 at control unit is 29.4 volts. Voltage to get fault must be present for 20 seconds. Perform starting charging system troubleshooting (regulator and/or leads)
	011	Under voltage signal: Shut off/Voltage between A3 and A4 at control unit is 21 volts. Voltage to get fault must be present for 20 seconds. Perform starting charging system troubleshooting (regulator and/or leads)
	020	Glow plug break (A1) signal: Check connection control unit A1 to ignition spark generator and to glow plug Break in glow plug filament alone will not be detected on account of parallel connected ignition spark generator. Replace glow plug if necessary.
	029–033, 036	Burner motor defective/Speed deviation longer than 240 seconds: Speed <40% relative to set point (motor not turning). Measure voltage with blower running with analog voltmeter, if voltage is present, burner motor not running. Replace motor. Also for this fault check air solenoid control unit B6 to relay connections for short circuit to positive. If OK replace relay.
	052	No start safety period exceed: No flame was detected within starting phase. Flame sensor value (100°C (1380Ω)). Check fuel supply. Check exhaust and combustion air ducts. Check flame sensor and flame sensor values.
	012	Over heating or metering pump break (B12) signal: Switching value 70°C and 90°C. Check connection control unit to metering pump for continuity. Check heating air lines for obstruction: Clear obstruction if necessary.

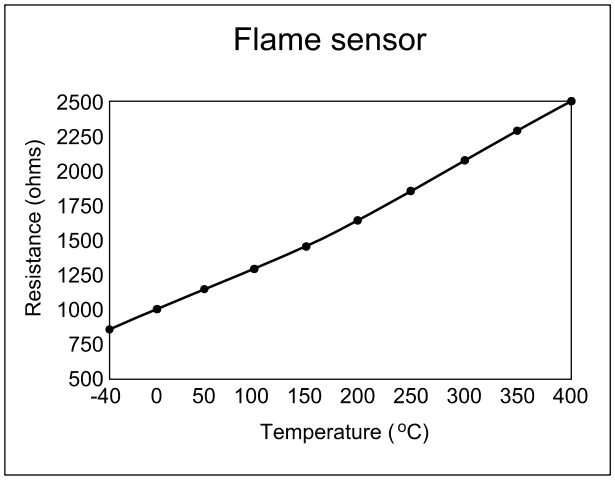
DESCRIPTION OF HEATER FAULT CODE - Continued **0009 00**

(1) Diagnostic Signal	(2) Fault Code	(3) Malfunction/Remedy
	047	Metering pump short circuit (B12): Check connection control unit B12 to metering pump for short-circuit. Check metering pump function. No short-circuit replace metering pump.
	060–063	Temperature sensor break or short circuit (B3), set point POT break or short circuit (B8): Temperature sensor signals temperature valve outside control range. Check connection leads. Temperature sensor values as follows: Resistance value between B2 and B3 >3000Ω (IF BREAK). IF shorted resistance value between B2 and B3 will be <260Ω and Set-point Potentiometer B8 Standard values: 680Ωand 1150Ω. For open, repair break and for short replace temperature sensor or setpoint POT.
	064, 065	Flame sensor break or short circuit (B10): Flame sensor values outside measuring range. Resistance values between B2 and B10 are (if break in line) 3200Ω and if short-circuit 200Ω. If break in line fix the open and if shorted replace flame sensor.
	056	Flame cutout, LOW setting: Heater has ignited (flame detected) and signals flame cutout in one setting. Check fuel flow rate, blower speed, and fuel supply. Also check exhaust and combustion air ducts. If combustion is OK check flame sensor. Replace if necessary and the same with the flame sensor valves.
	054	Flame cutout, HIGH setting: Heater has ignited (flame detected) and signals flame cutout in one setting. Check fuel flow rate, blower speed, and fuel supply. Also check exhaust and combustion air ducts. If combustion is OK check flame sensor. Replace if necessary and the same with the flame sensor valves.
	090, 092–094	Control unit defective: Internal error in microprocessor. Could be (Internal fault/reset), (ROM error), (RAM error), (EEPROM error). Replace control unit.

DESCRIPTION OF HEATER FAULT CODE - Continued **0009 00**

(1) Diagnostic Signal	(2) Fault Code	(3) Malfunction/Remedy
0 — 8 sec.		
	091	Control unit fault memory erased: The fault memory has been overwritten due to interference voltages. Eliminate interference voltages.





CHAPTER 3

DIRECT SUPPORT TROUBLESHOOTING PROCEDURES

WORK PACKAGE INDEX

REPAIR PARTS, SPECIAL TOOLS; TEST, MEASUREMENT, AND DIAGNOSTIC EQUIPMENT (TMDE); AND SUPPORT EQUIPMENT

0010 00

COMMON TOOLS AND EQUIPMENT

For authorized common tools and equipment, refer to the Modified Table of Organization and Equipment (MTOE) applicable to your unit.

SPECIAL TOOLS, TMDE, AND SUPPORT EQUIPMENT

No special tools or equipment are required to maintain the heater.

REPAIR PARTS

Repair parts are listed and illustrated in WP 0040 00 – 0044 00.

INTRODUCTION TO TROUBLESHOOTING 0011 00

GENERAL

The troubleshooting table lists common malfunctions found while operating or servicing the ESPAR V7S Vehicular Compartment Heater. The troubleshooting table is divided into sections. Each section covers malfunctions common to the different components of the heater.

The troubleshooting table has three divisions: malfunction, test or inspection, and corrective action. The malfunctions are numbered in sequence through the troubleshooting table. The malfunction is what will bring you to the troubleshooting table.

Test or inspection is a step you take to isolate the malfunction. You should perform the test or inspection and corrective action in the order listed.

The troubleshooting symptom index is in WP 0012 00.

TROUBLESHOOTING SYMPTOM INDEX **0012 00**

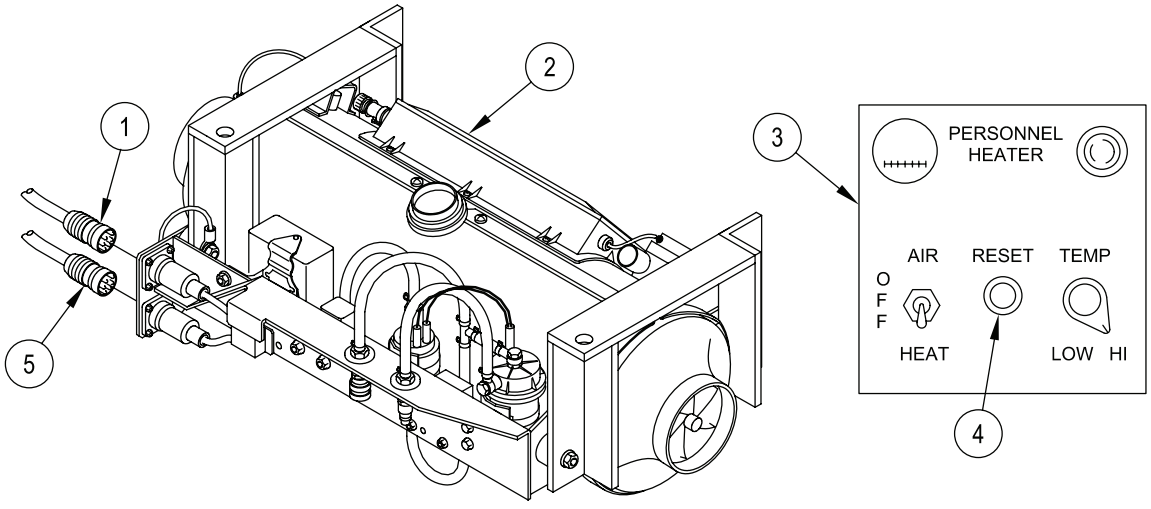
TROUBLESHOOTING PROCEDURES **0013 00**

INITIAL SETUP:

Maintenance Level

Unit

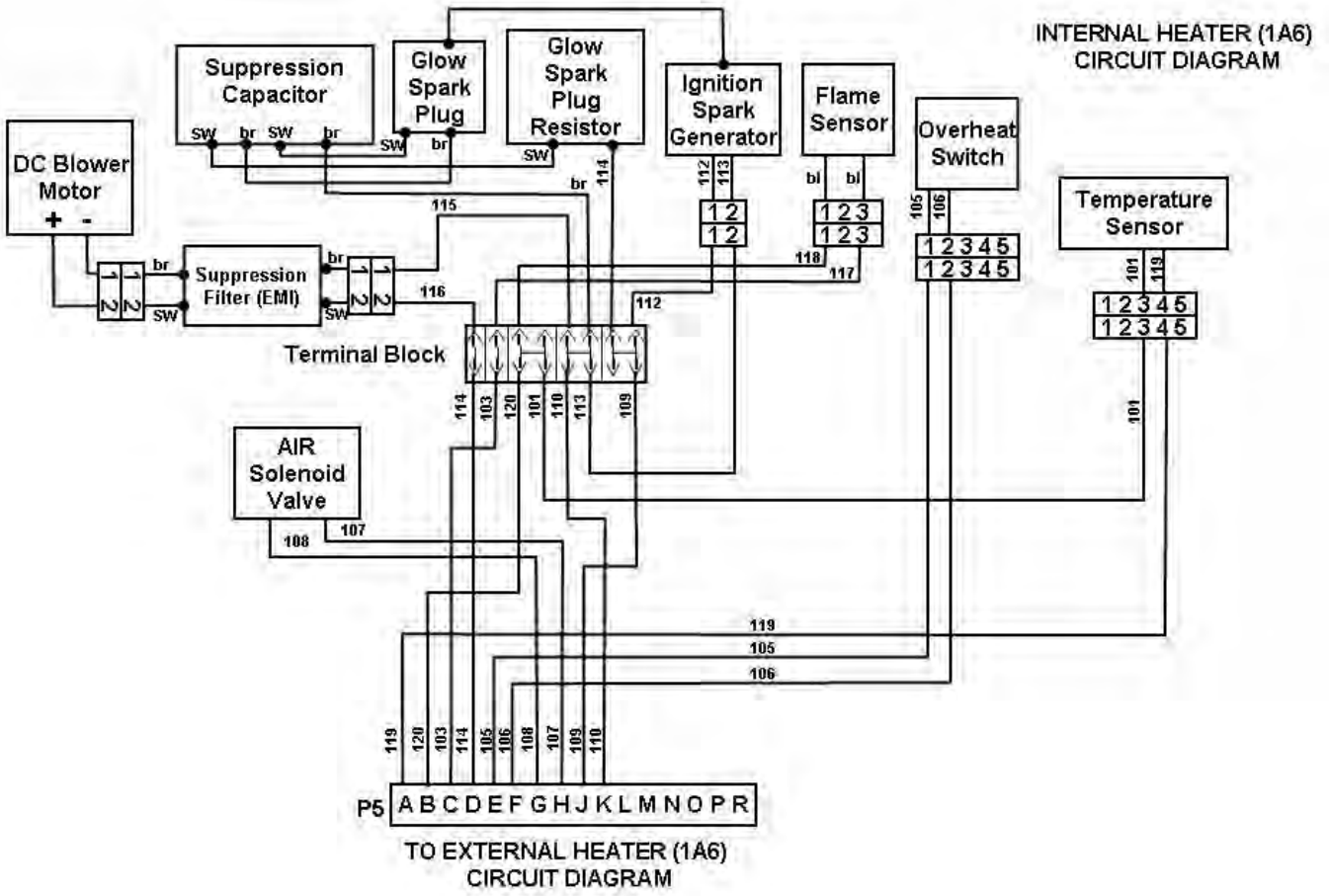
MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
1. HEATER DOES NOT START	1. Check for proper voltage requirements as follows: a. Disconnect switchbox cable (1) to heater (2). b. Using multimeter set to read DC voltage, put red probe on terminal 30 and black probe on terminal 31 of switchbox cable (1).	If multimeter reads anything other than 21-28 volts, troubleshoot vehicle electrical system (refer to applicable vehicle technical manuals).
	2. Check overheat reset button (4) on the switchbox (3).	None, the overheat reset button is not connected.
	3. Check Air/Heat switch on switchbox.	Replace Air/Heat switch on switchbox (refer to applicable vehicle technical manuals).
	4. Disconnect switchbox cables (1) and (5) from heater (2) and check for broken, corroded, or missing terminals.	Clean or replace corroded, broken, or missing terminals (refer to applicable vehicle technical manuals).
	5. Check combustion air relay.	Replace combustion air relay (WP 0032 00).



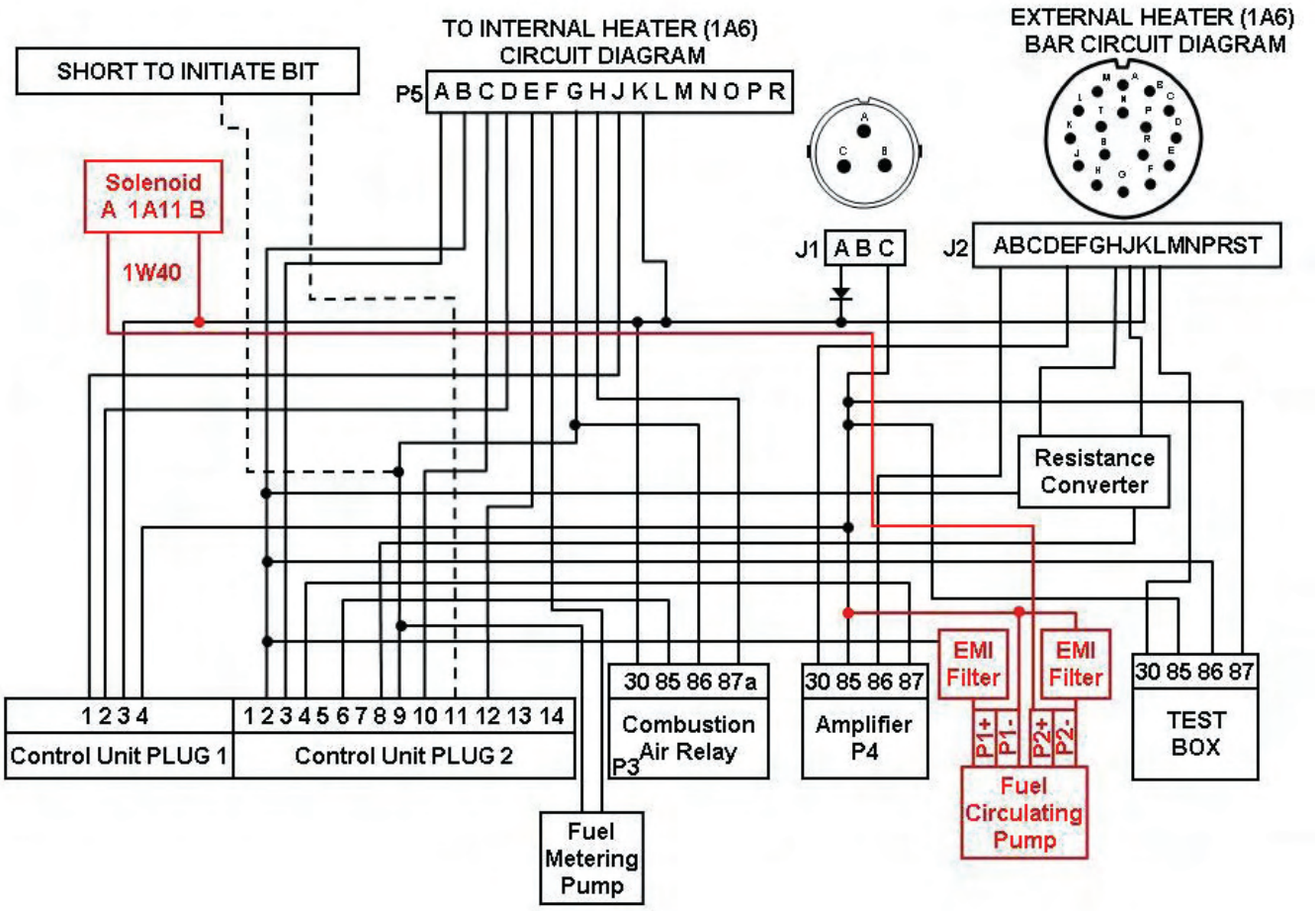
HEATER SCHEMATIC 0014 00

DESCRIPTION

Use the schematic below as an aid for performing system troubleshooting procedures.



HEATER SCHEMATIC 0014 00



CHAPTER 4

DIRECT SUPPORT MAINTENANCE INSTRUCTIONS

WORK PACKAGE INDEX

REMOVE/INSTALL COVER **0015 00**

THIS WORK PACKAGE COVERS:

INITIAL SETUP:

Maintenance Level
Unit

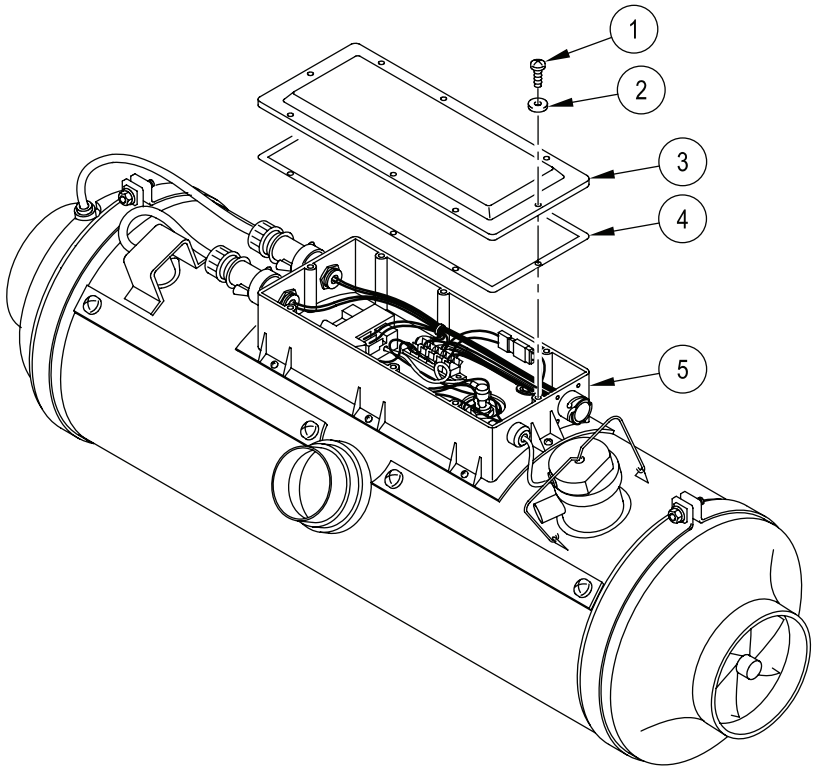
Personnel Required
Unit Mechanic

Tools and Special Tools
General Mechanic's Tool Kit (WP 0048 00, Item 1)

Equipment Condition
Heater removed from vehicle (applicable vehicle technical manual)

REMOVAL

1. Remove eight screws (1), washers (2), cover (3), and gasket (4) from the heater box (5). Use screwdriver.

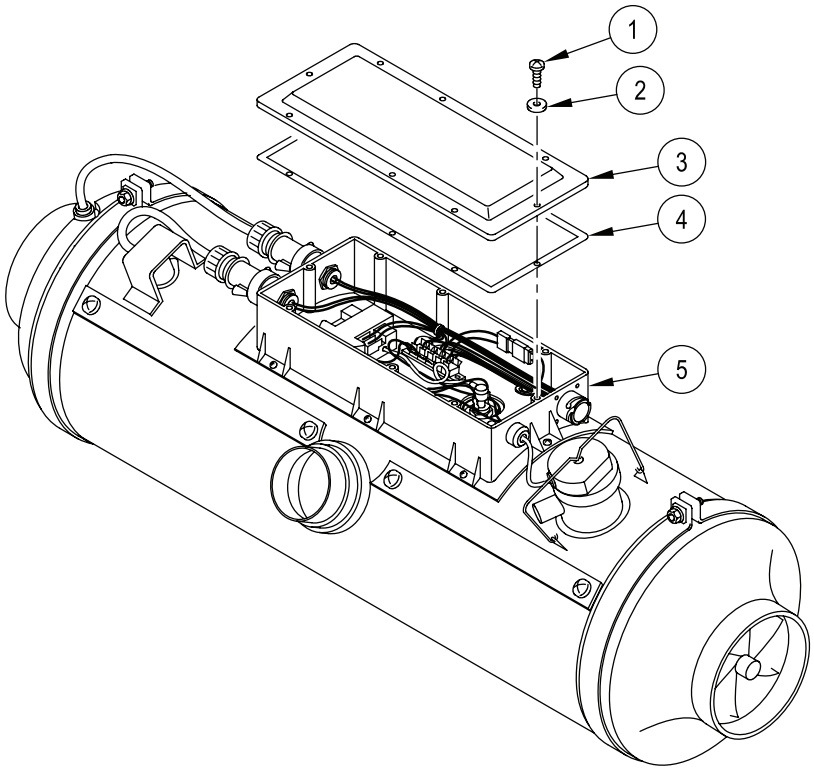


INSTALLATION

NOTE

Inspect cover and gasket for damage and cracks. Replace if damaged, prior to installation.

1. Position gasket (4) and cover (3) on heater box (5).
2. Install eight screws (1), washers (2), and cover (3) to the heater box (5).



END OF TASK

REPLACE HEATER IGNITER (IGNITION SPARK GENERATOR) 0016 00

THIS WORK PACKAGE COVERS:

INITIAL SETUP:

Maintenance Level
Unit

Personnel Required
Unit Mechanic

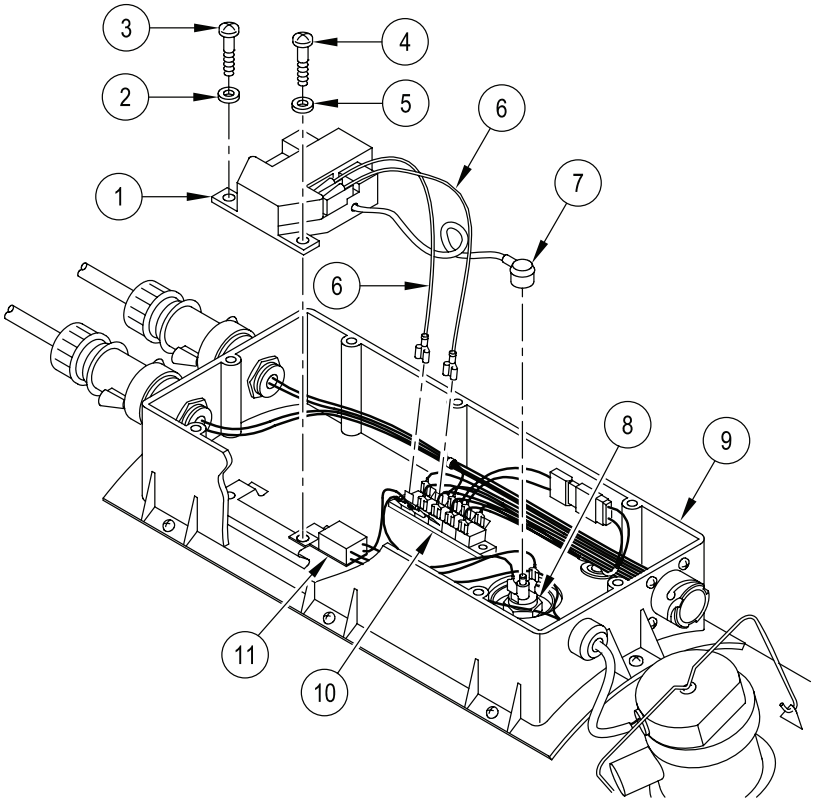
Tools and Special Tools
General Mechanic's Tool Kit (WP 0048 00, Item 1)

Equipment Condition
Heater removed from vehicle (applicable vehicle technical manual)
Cover removed (WP 0015 00)

Materials/Parts
Marking Tags (WP 0047 00, Item 4)
Lockwasher (2)

REMOVAL

1. Remove cable connector (7) from glow spark plug (8).
2. Remove two electrical leads (6) from the terminal board (10). Tag leads and terminals.
3. Remove screws (3) and lockwashers (2) from spark generator (1) on heater box (9). Discard lockwashers.
4. Remove screw (4), lockwasher (5), and spark generator (1) from heater box (9) and capacitor (11). Discard lockwasher.

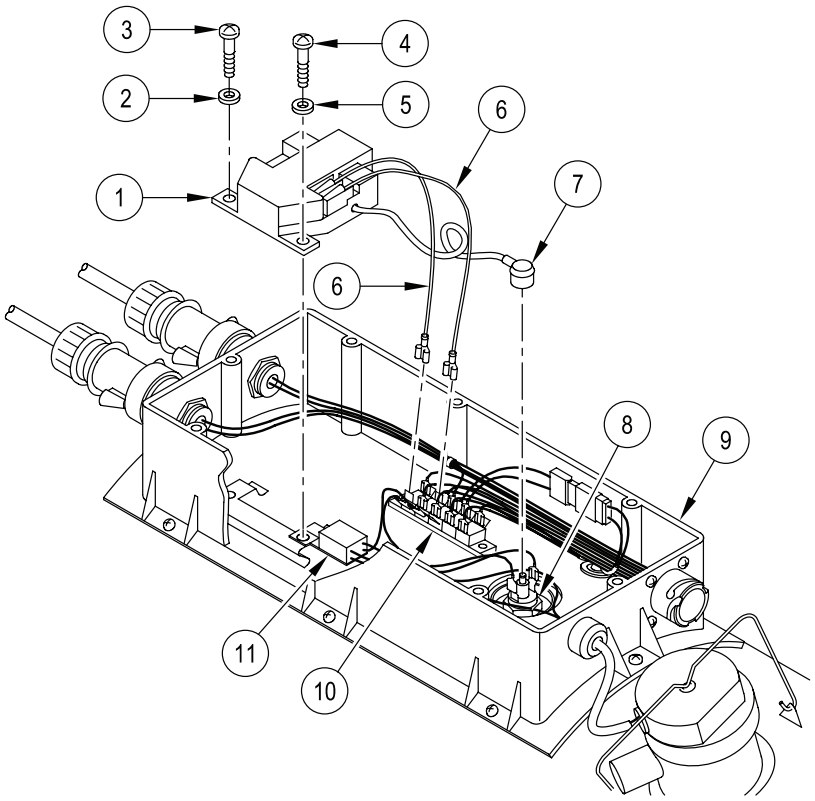


INSTALLATION

NOTE

Inspect spark generator for cracks and broken terminal. Replace prior to installation.

1. Install screw (4), new lockwasher (5), and spark generator (1) on heater box (9) and capacitor (11).
2. Install screw (3) and new lockwasher (2) in spark generator (1) on heater box (9).
3. Install two leads (6) on their assigned terminal on terminal board (10).
4. Install cable (7) on glow plug spark plug (8).



FOLLOW-THROUGH STEPS

1. Install cover (WP 0015 00).

END OF TASK

REPLACE GLOW SPARK PLUG 0017 00

THIS WORK PACKAGE COVERS:

INITIAL SETUP:

Maintenance Level
Unit

Personnel Required
Unit Mechanic

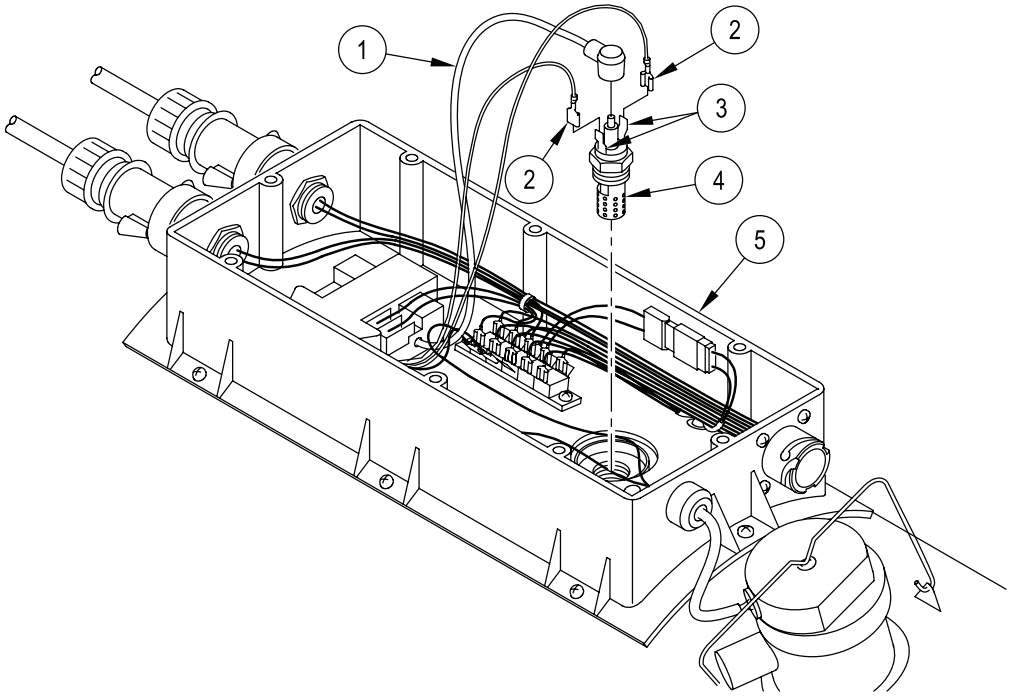
Tools and Special Tools
General Mechanic's Tool Kit (WP 0048 00, Item 1)
Socket, 7/8" deep (WP 0048 00, Item 2)

Equipment Condition
Heater removed from vehicle (applicable vehicle technical manual)
Cover removed (WP 0015 00)

Materials/Parts
Marking Tags (WP 0047 00, Item 4)

REMOVAL

1. Remove two leads (2) from glow spark plug terminals (3). Tag leads.
2. Remove cable (1) from glow spark plug (4).
3. Using deep socket, socket wrench, and handle, remove glow spark plug (4) from heater box (5).

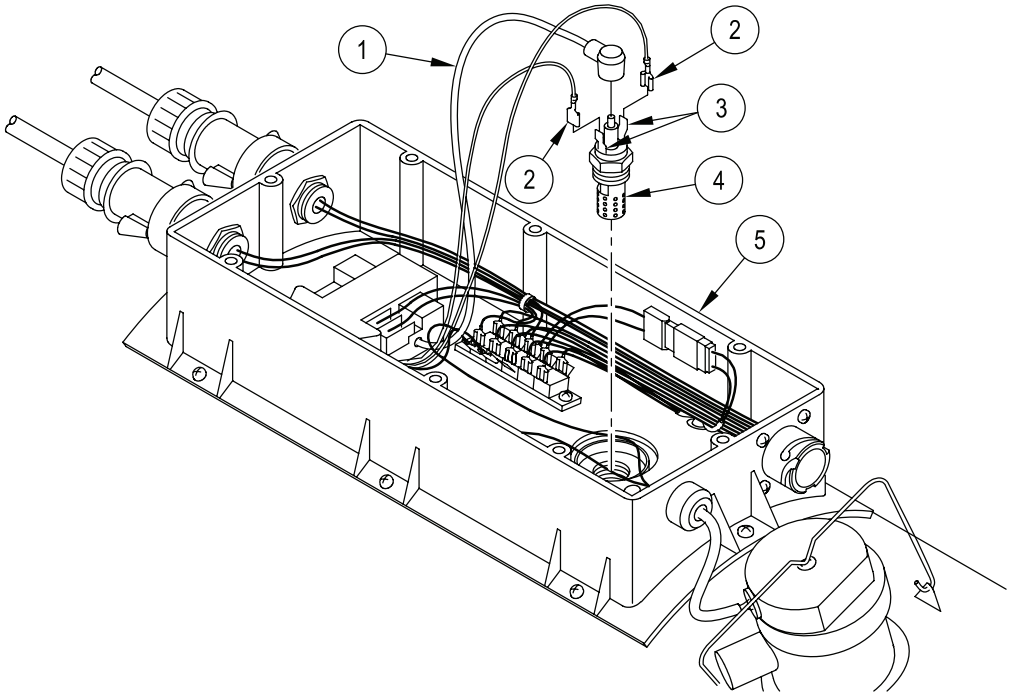


INSTALLATION

NOTE

Inspect glow spark plug for broken wire and cracked electrode. Replace prior to installation.

1. Install glow spark plug (4) on heater box (5). Use socket wrench and handle.
2. Install cable (1) on glow spark plug (4).
3. Install two leads (2) on glow spark plug terminals (3).



FOLLOW-THROUGH STEPS

1. Install cover (WP 0015 00).

END OF TASK

REPLACE GLOW PLUG **0018 00**

THIS WORK PACKAGE COVERS:

INITIAL SETUP:

Maintenance Level
Unit

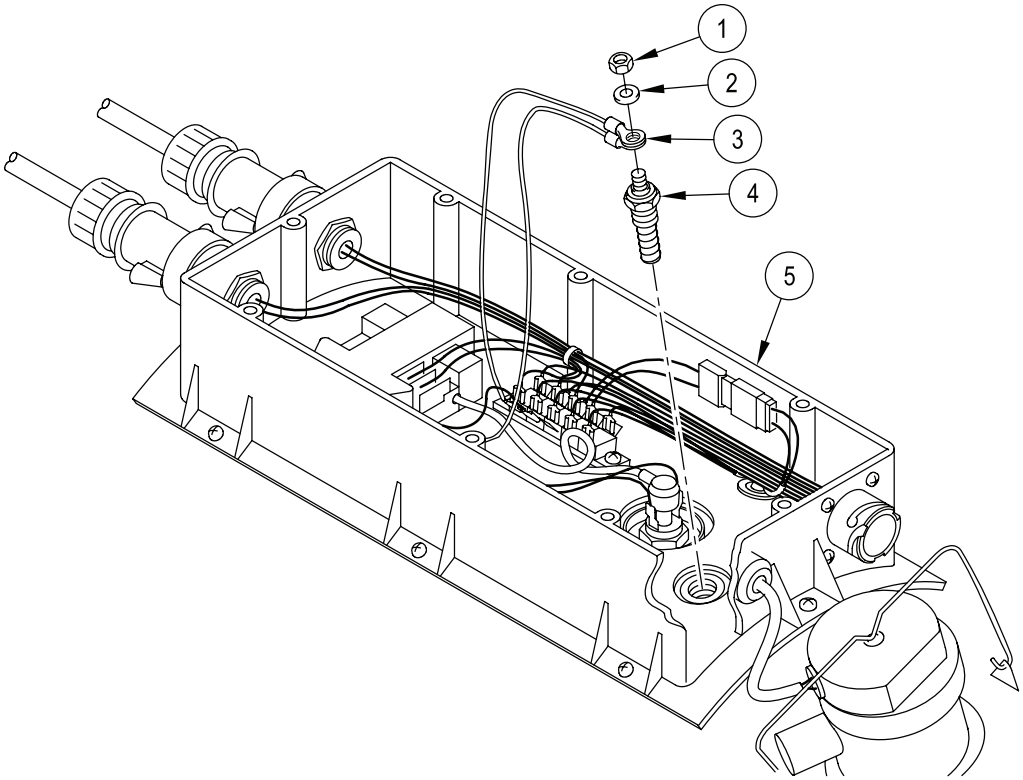
Personnel Required
Unit Mechanic

Tools and Special Tools
General Mechanic's Tool Kit (WP 0048 00, Item 1)
Socket, 3/4" deep (WP 0048 00, Item 3)

Equipment Condition
Heater removed from vehicle (applicable vehicle technical manual)
Cover removed (WP 0015 00)

REMOVAL

1. Remove nut (1), washer (2), and electrical leads (3) from glow plug (4).
2. Remove glow plug (4) from heater box (5). Use socket wrench.

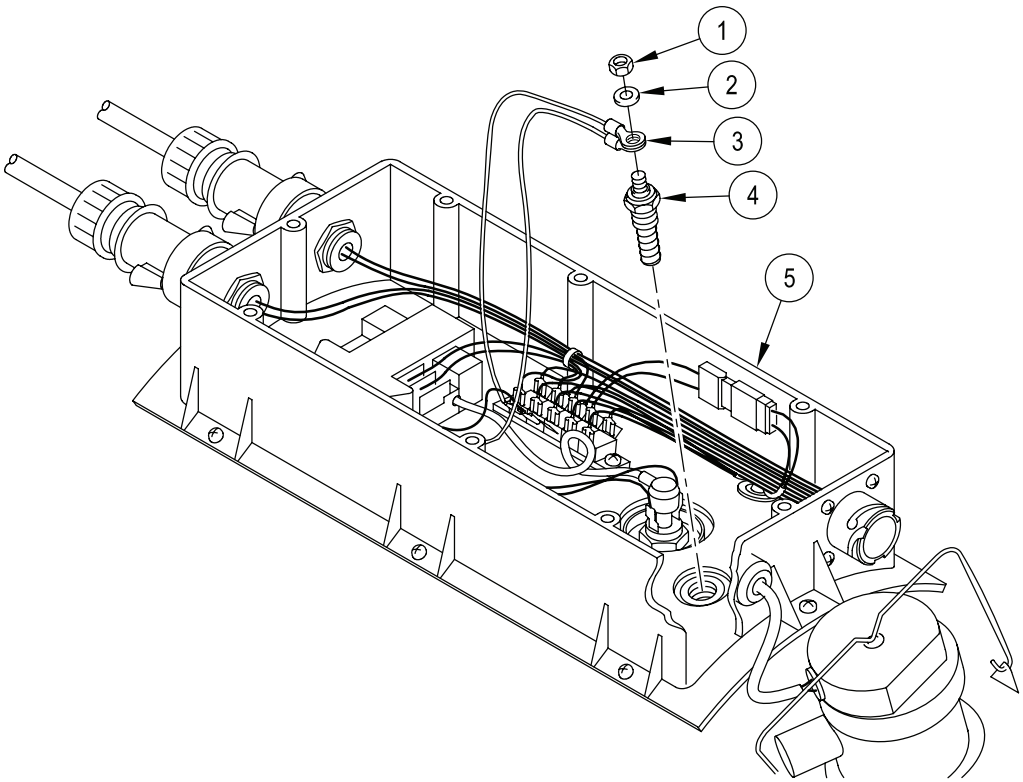


INSTALLATION

NOTE

Inspect glow plug for broken wire and burn. Replace prior to installation.

1. Install glow plug (4) on heater box (5). Use socket wrench.
2. Install electrical leads (3), washer (2), and nut (1) on glow plug (4).



FOLLOW-THROUGH STEPS

1. Install cover (WP 0015 00).

END OF TASK

REPLACE TERMINAL BOARD 0019 00

THIS WORK PACKAGE COVERS:

INITIAL SETUP:

Maintenance Level
Unit

Personnel Required
Unit Mechanic

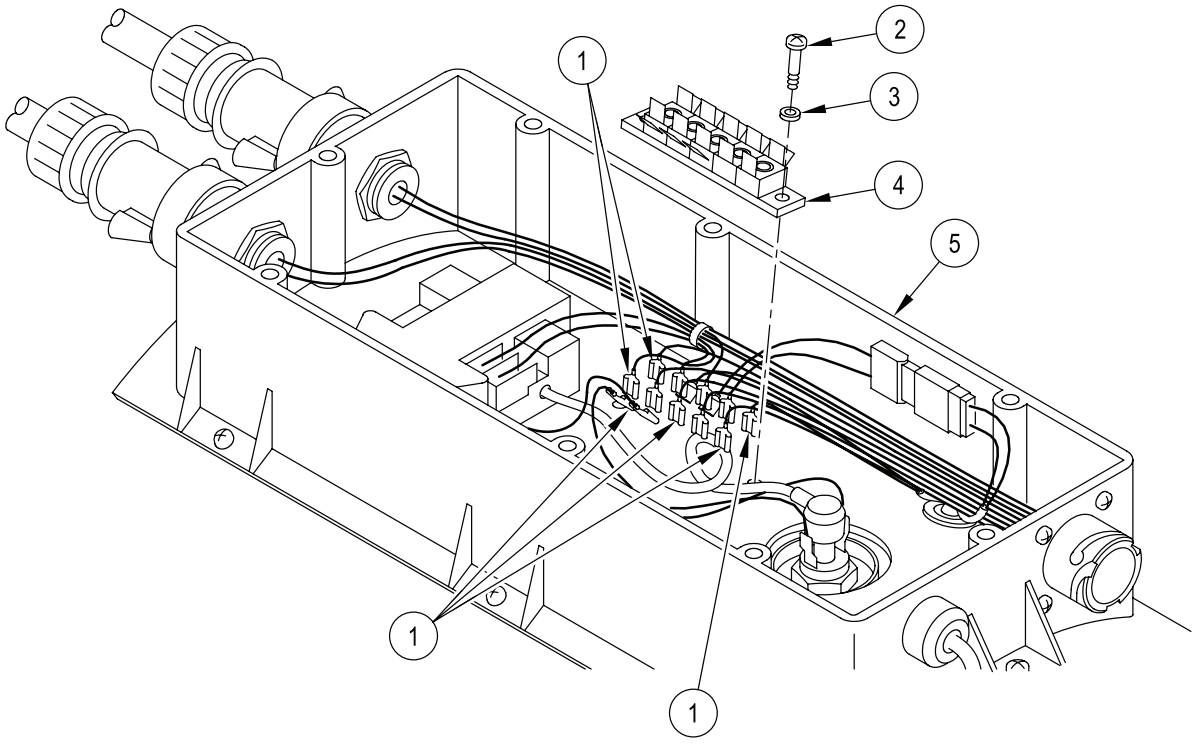
Tools and Special Tools
General Mechanic's Tool Kit (WP 0048 00, Item 1)

Equipment Condition
Heater removed from vehicle (applicable vehicle technical manual)
Cover removed (WP 0015 00)

Materials/Parts
Marking Tags (WP 0047 00, Item 4)

REMOVAL

1. Remove electrical leads (1) from terminal board (4). Tag leads and terminals.
2. Remove two screws (2), washers (3), and terminal board (4) from heater box (5).

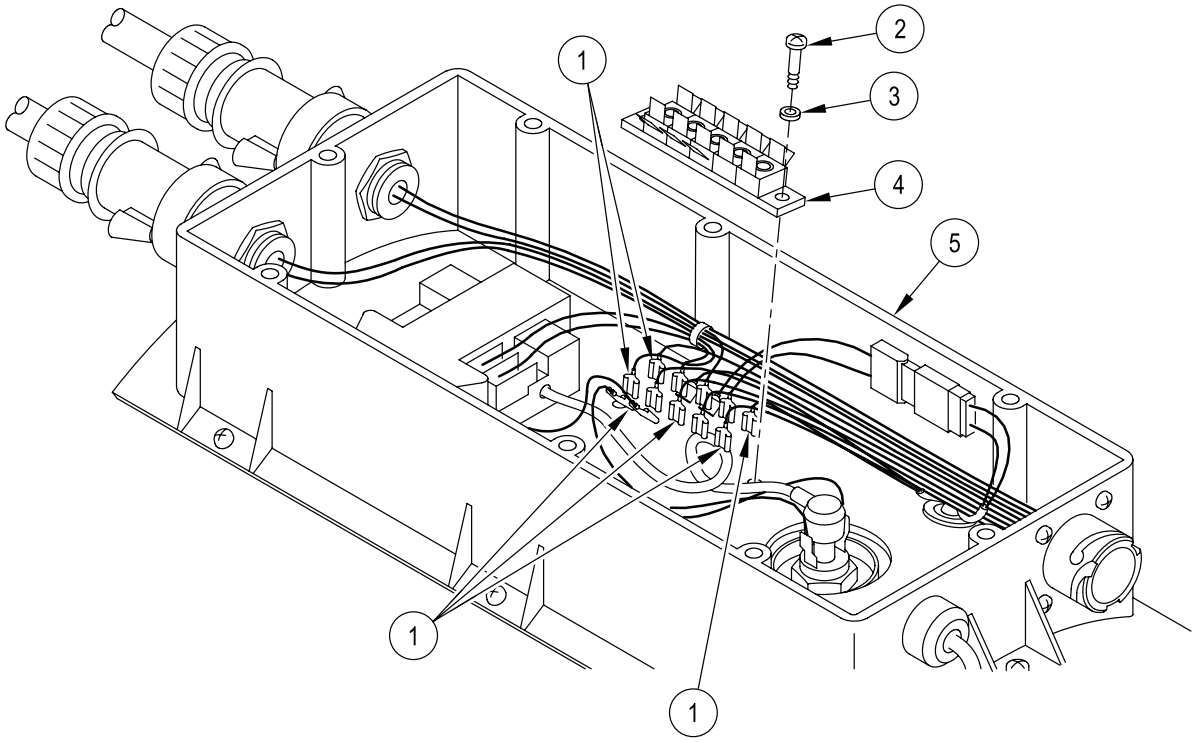


INSTALLATION

NOTE

Inspect terminal board for cracks and burn. Replace prior to installation.

1. Install two screws (2), washers (3), and terminal board (4) on heater box (5).
2. Install electrical leads (1) on their assigned terminals on terminal board (4).



FOLLOW-THROUGH STEPS

1. Install cover (WP 0015 00).

END OF TASK

REPLACE CABLE CONNECTOR/SOCKET HOUSING 0020 00

THIS WORK PACKAGE COVERS:

INITIAL SETUP:

Maintenance Level
Unit

Personnel Required
Unit Mechanic

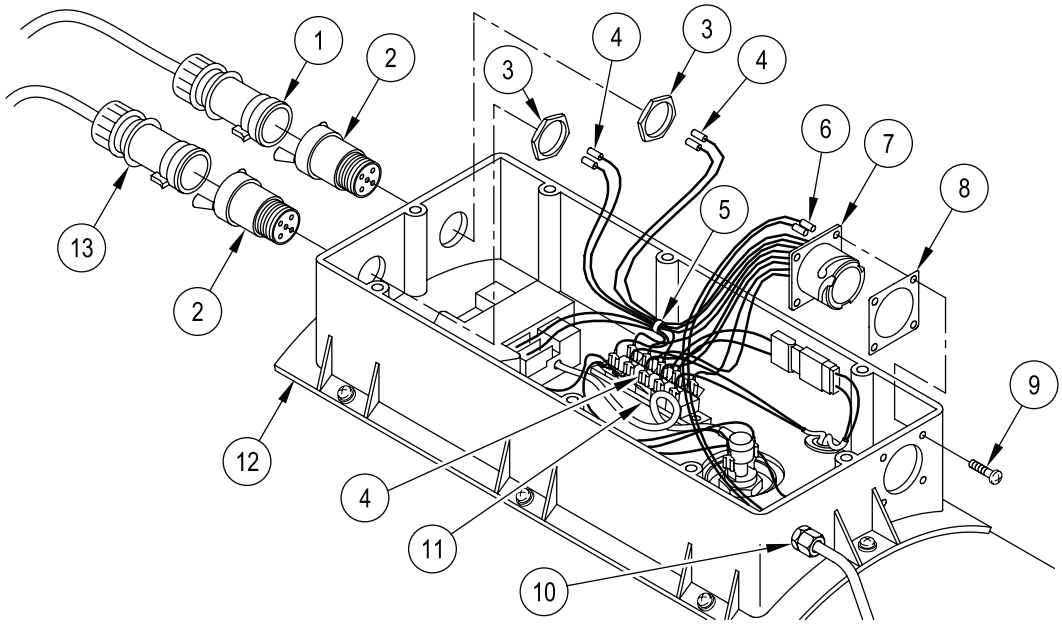
Tools and Special Tools
General Mechanic's Tool Kit (WP 0048 00, Item 1)
Pin Removal Tool (WP 0048 00, Item 4)

Equipment Condition
Heater removed from vehicle (applicable vehicle technical manual)
Cover removed (WP 0015 00)

Materials/Parts
Marking Tags (WP 0047 00, Item 4)
Tie Strap (as required)

REMOVAL

1. Cut and remove tie strap (5) from leads (4).
2. Disconnect leads (4) from terminal board (11) and socket housings (2). Tag leads, terminals, and locations of socket housings.
3. Unlatch and remove overheat switch cable (13) from socket housing (2).
4. Unlatch and remove temperature sensor cable (1) from socket housing (2).
5. Remove two counter nuts (3) and socket housings (2) from heater box (12). Use open end wrench.
6. Remove four screws (9), sealing (8), and cable connector (7) from heater box (12).
7. Disassemble strain relief (10) and disconnect leads (6) from cable connector (7). Label leads (6) and mark location in connector housing (7).

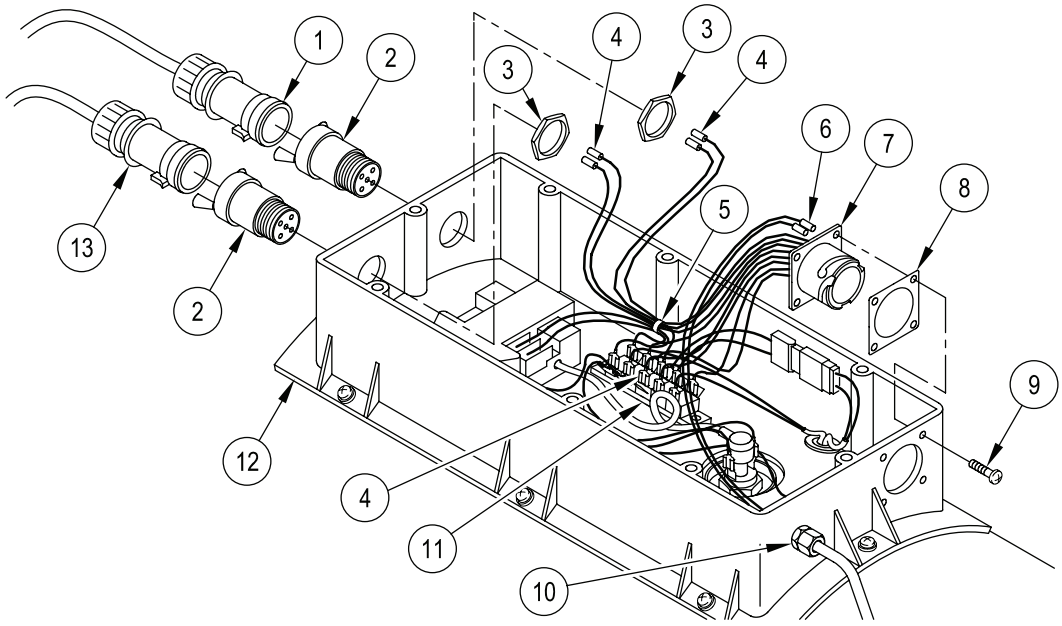


INSTALLATION

NOTE

Inspect connector and housing for cracks. Replace prior to installation.

1. Install leads (6) into original locations in cable connector (7).
2. Install four screws (9), sealing (8), and cable connector (7) on heater box (12).
3. Assemble strain relief (10).
4. Install two counter nuts (3) and socket housings (2) on heater box (12).
5. Install and latch temperature sensor cable (1) on socket housing (2).
6. Install and latch overheat switch cable (13) on socket housing (2).
7. Install leads (4) on their assigned terminals on terminal board (11) and socket housings (2).
8. Secure leads (4) with new tie strap (5).



FOLLOW-THROUGH STEPS

1. Install cover (WP 0015 00).

END OF TASK

REPLACE FIXED CAPACITOR (SUPPRESSION CAPACITOR) 0021 00

THIS WORK PACKAGE COVERS:

INITIAL SETUP:

Maintenance Level
Unit

Tools and Special Tools
General Mechanic's Tool Kit (WP 0048 00, Item 1)

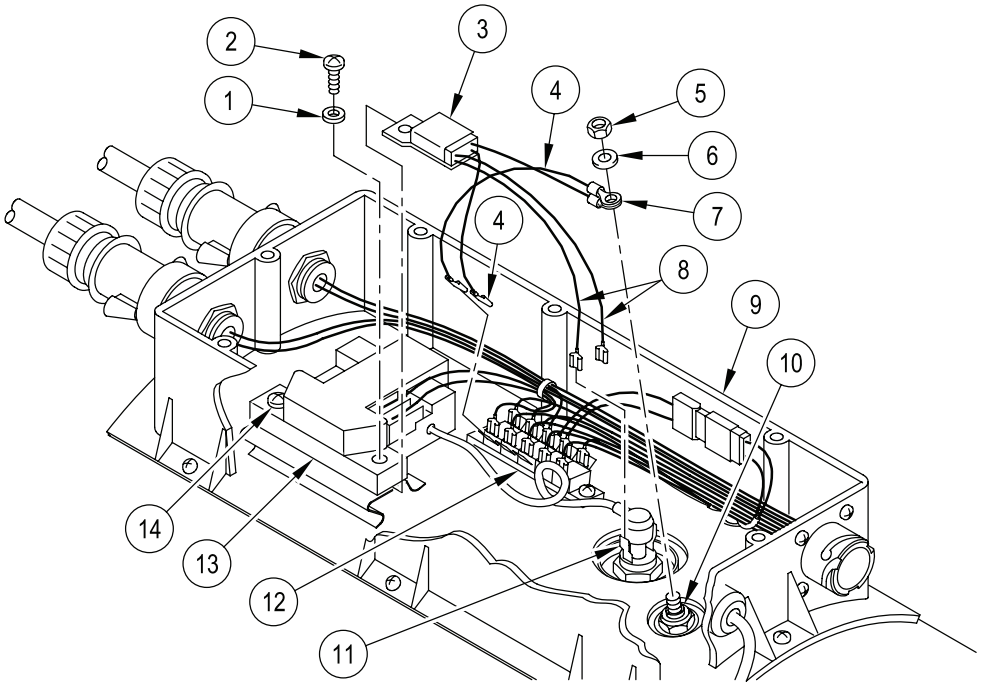
Materials/Parts
Marking Tags (WP 0047 00, Item 4)

Personnel Required
Unit Mechanic

Equipment Condition
Heater removed from vehicle (applicable vehicle technical manual)
Cover removed (WP 0015 00)

REMOVAL

1. Remove two leads (8) from glow spark plug terminals (11). Tag leads.
2. Remove nut (5), washer (6), and electrical leads (7) from glow plug (10).
3. Disconnect two leads (4) from terminal board (12). Tag leads and terminals.
4. Loosen screw (14) on the right side of ignition spark generator (13).
5. Remove screw (2), washer (1), and capacitor (3) from heater box (9).

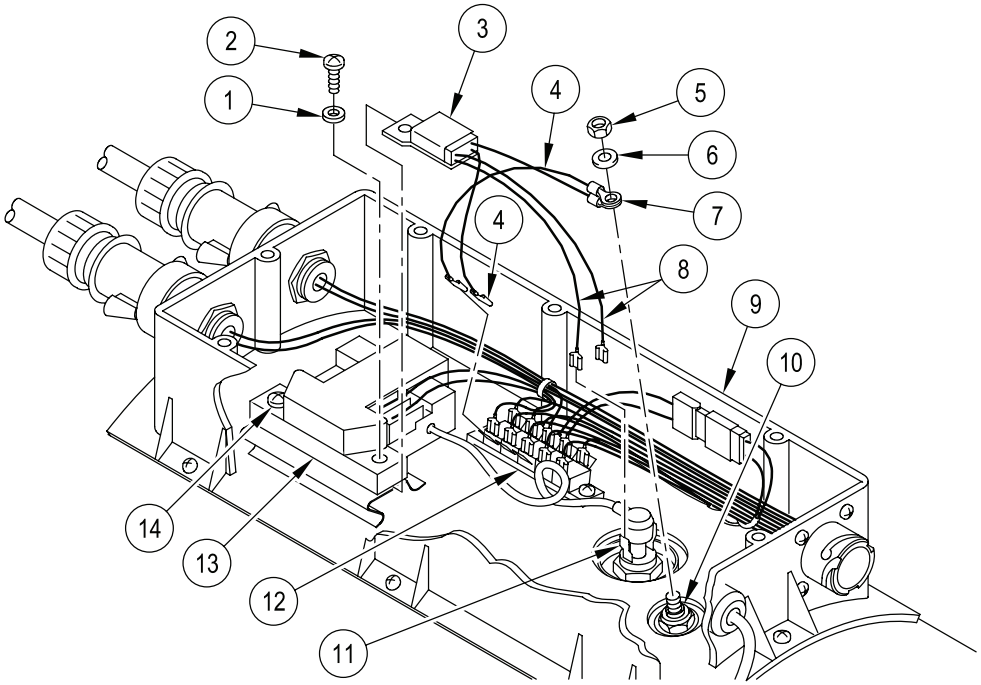


INSTALLATION

NOTE

Inspect capacitor for burn and cracks. Replace prior to installation.

1. Insert capacitor mounting plate (3) between the heater box (9) and ignition spark generator (13).
2. Install screw (2) and washer (1) to secure capacitor (3) and ignition spark generator (13) on heater box (9).
3. Tighten screw (14) on right side of ignition spark generator (13).
4. Connect two leads (4) on terminal board (12).
5. Install two leads (8) on glow spark plug terminals (11).
6. Install nut (5), washer (6), and electrical leads (7) on glow plug (10).



FOLLOW-THROUGH STEPS

1. Install cover (WP 0015 00).

END OF TASK

REPLACE TEMPERATURE TRANSMITTER (TEMPERATURE SENSOR) 0022 00

THIS WORK PACKAGE COVERS:

INITIAL SETUP:

Maintenance Level
Unit

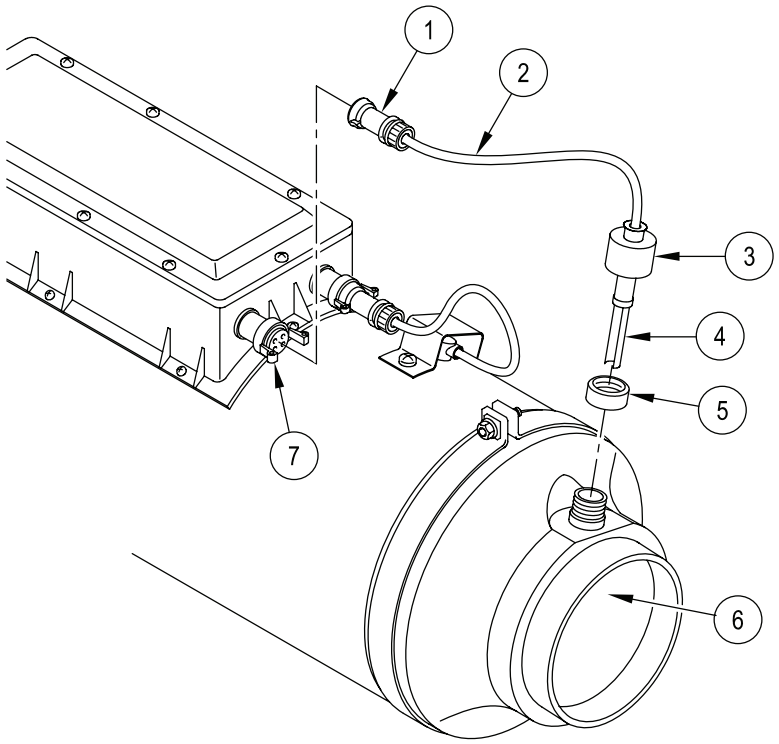
Personnel Required
Unit Mechanic

Tools and Special Tools
General Mechanic's Tool Kit (WP 0048 00, Item 1)

Equipment Condition
Heater removed from vehicle (applicable vehicle technical manual)

REMOVAL

1. Lift the rubber boot (3) upward.
2. Turn round nut (5) in counter-clockwise direction until it is completely off the sensor (4). Use slip joint pliers.
3. From inside of the housing (6), push sensor (4) upward. Pull cable (2) gently until sensor is out of the housing.
4. Unlatch and pull the sensor cable connector (1) from socket housing (7).

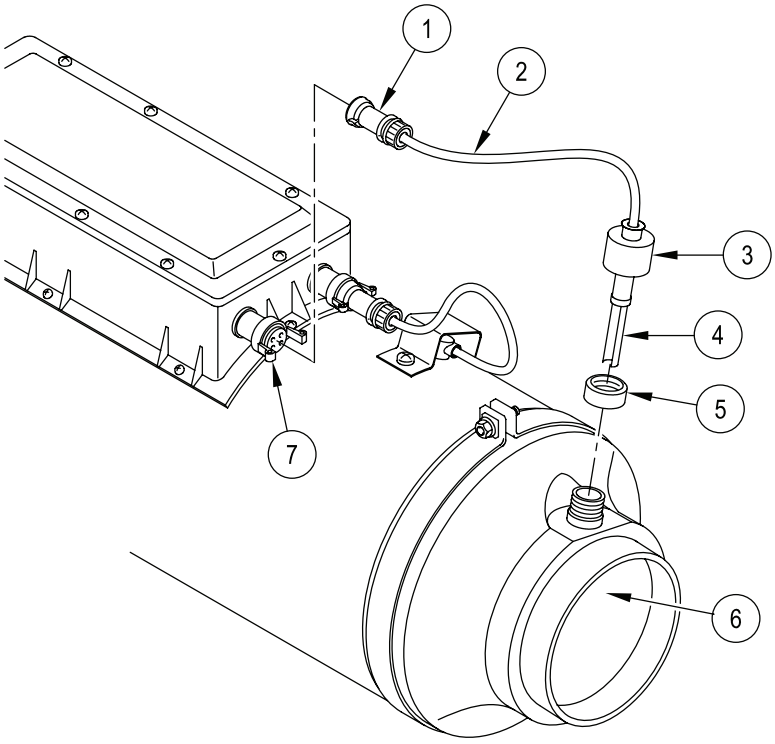


INSTALLATION

NOTE

Inspect temperature sensor for cracks and burn. Replace prior to installation.

1. Insert and latch cable connector (1) to socket housing (7).
2. Position sensor (4) and gently push all the way down in hole on housing.
3. Install round nut (5) to secure the sensor (4) in place.
4. Push the rubber boot (3) down to cover the sensor (4).



END OF TASK

REPLACE TEMPERATURE TRANSMITTER (OVERHEAT SWITCH) 0023 00

THIS WORK PACKAGE COVERS:

INITIAL SETUP:

Maintenance Level
Unit

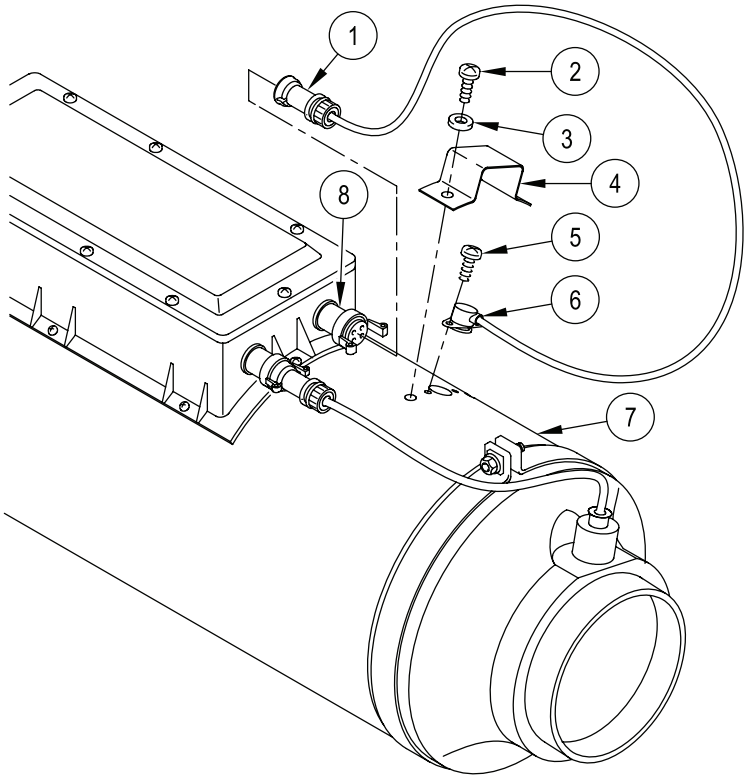
Personnel Required
Unit Mechanic

Tools and Special Tools
General Mechanic's Tool Kit (WP 0048 00, Item 1)

Equipment Condition
Heater removed from vehicle (applicable vehicle technical manual)

REMOVAL

1. Remove two screws (2), washer (3), and access cover (4) from heater housing (7).
2. Remove two screws (5) and overheat switch (6) from heater housing (7).
3. Unlatch and remove overheat switch cable (1) from socket housing (8).



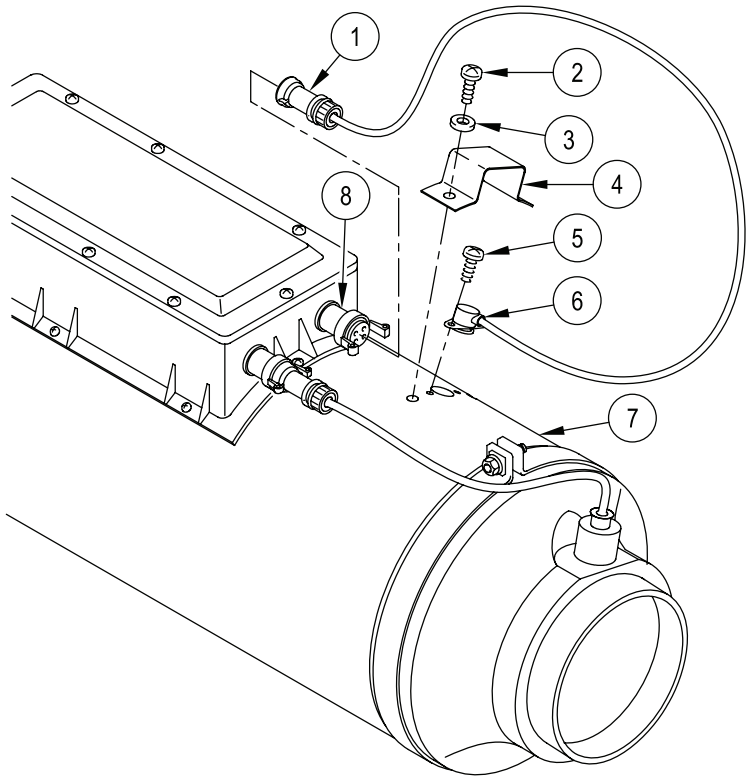
REPLACE TEMPERATURE TRANSMITTER (OVERHEAT SWITCH) - Continued **0023 00**

INSTALLATION

NOTE

Inspect overheat switch for burn. Replace prior to installation.

1. Position overheat switch cable (1) and install to the socket housing (8).
2. Install two screws (5) to secure overheat switch (6) to the heater housing (7).
3. Install two screws (2), washers (3), and access cover (4) to heater housing (7).



END OF TASK

REPLACE SOLENOID VALVE 0024 00

THIS WORK PACKAGE COVERS:

INITIAL SETUP:

Maintenance Level
Unit

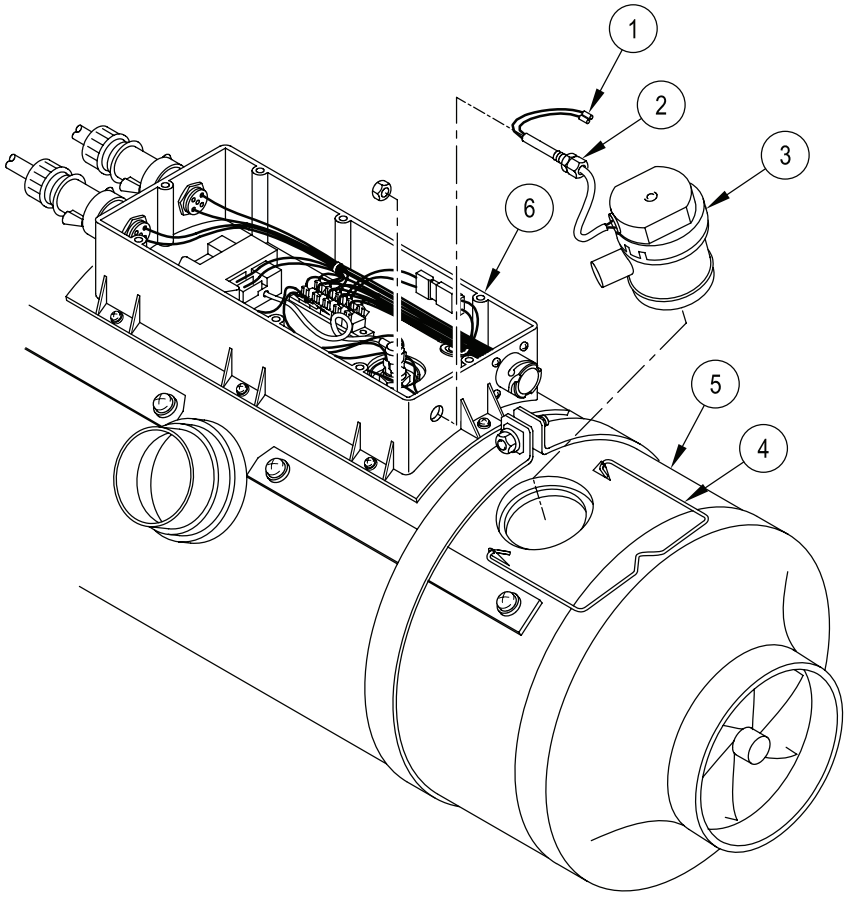
Personnel Required
Unit Mechanic

Tools and Special Tools
General Mechanic's Tool Kit (WP 0048 00, Item 1)
Pin Removal Tool (WP 0048 00, Item 4)

Equipment Condition
Heater removed from vehicle (applicable vehicle technical manual)
Cover removed (WP 0015 00)

REMOVAL

1. Loosen spring tension clip (4) and remove solenoid (3) from heater housing (5).
2. Disassemble pass through connector (2) and slide up wire (1) to allow some slack.
3. Use pin removal tool to disconnect two wires (1) from connector housing (6). Label wires (1) and location in connector housing (6).

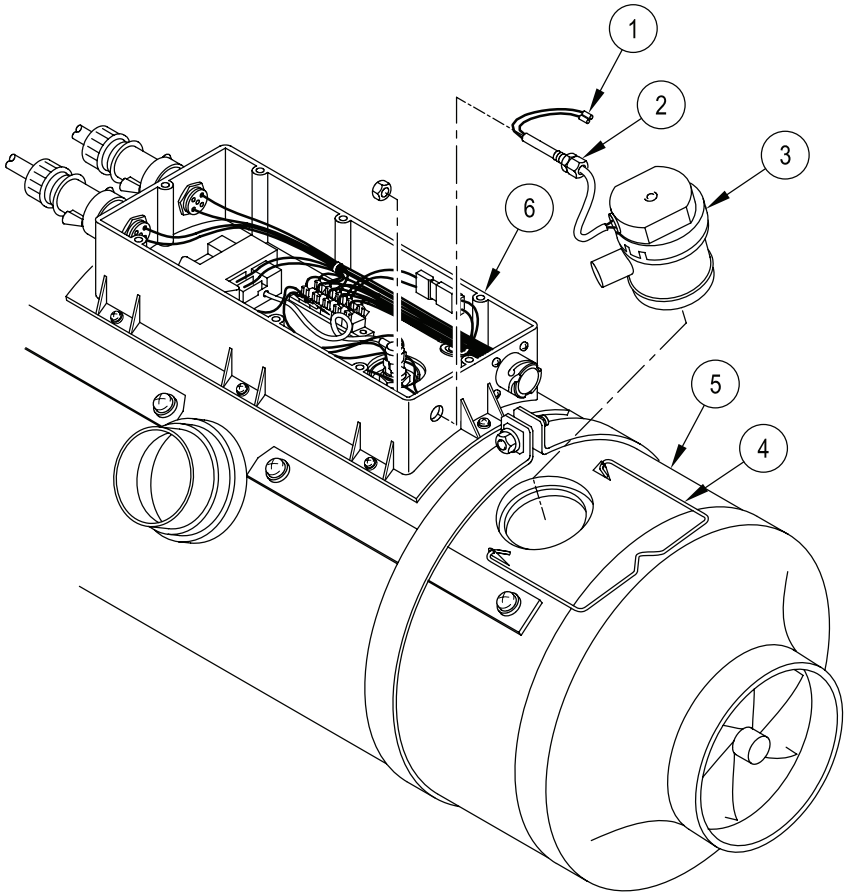


INSTALLATION

NOTE

Inspect solenoid valve for burn and cracks. Replace prior to installation.

1. Place strain relief on wire (1).
2. Install two leads (1) into original position in connector housing (6).
3. Position solenoid (3) on heater housing (5). Secure with spring tension clip (4).
4. Tighten pass-through connector (2) on wire (1) allowing a slight amount of slack in wire.



FOLLOW-THROUGH STEPS

1. Install cover (WP 0015 00).

END OF TASK

REPLACE HOUSING 0025 00

THIS WORK PACKAGE COVERS:

INITIAL SETUP:

Maintenance Level
Unit

Tools and Special Tools
General Mechanic's Tool Kit (WP 0048 00, Item 1)

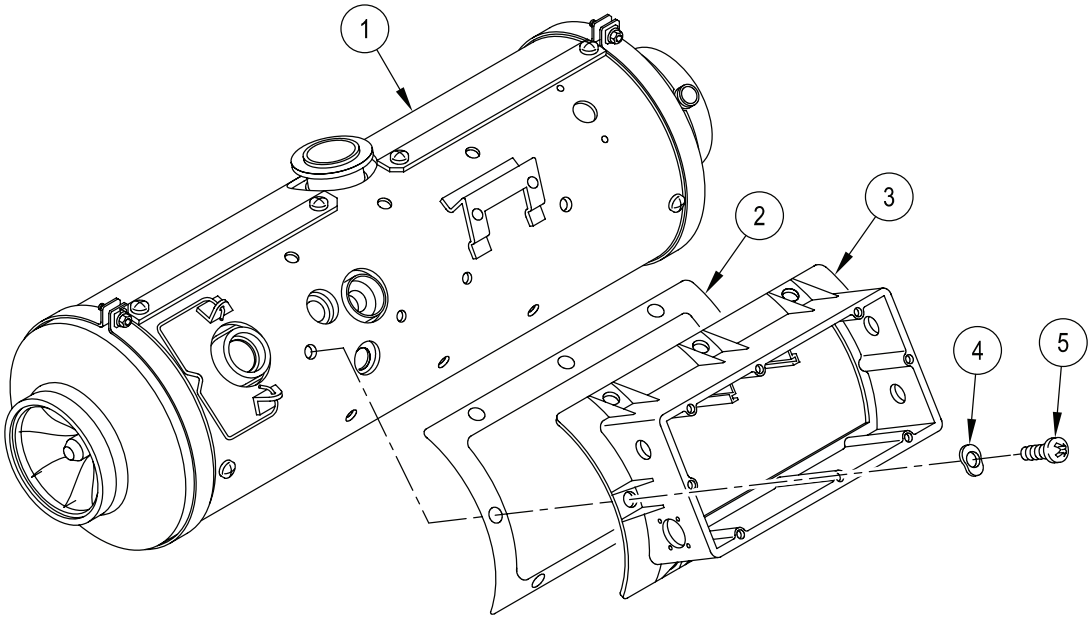
Materials/Parts
Gasket
Lockwasher (8)
Lockwasher (4)

Personnel Required
Unit Mechanic

Equipment Condition
Heater removed from vehicle (applicable vehicle technical manual)
Cover removed (WP 0015 00)
Solenoid valve removed (WP 0024 00)
Heater igniter removed (WP 0016 00)
Fixed capacitor removed (WP 0021 00)
Glow spark plug removed (WP 0017 00)
Glow plug removed (WP 0018 00)
Terminal board removed (WP 0019 00)

REMOVAL

1. Disconnect temperature sensor connector (WP 0022 00) and overheat switch connector (WP 0023 00).
2. Using cross tip screwdriver, remove eight screws (5), washers (4), box (3), and gasket (2) from housing (1). Discard gasket.

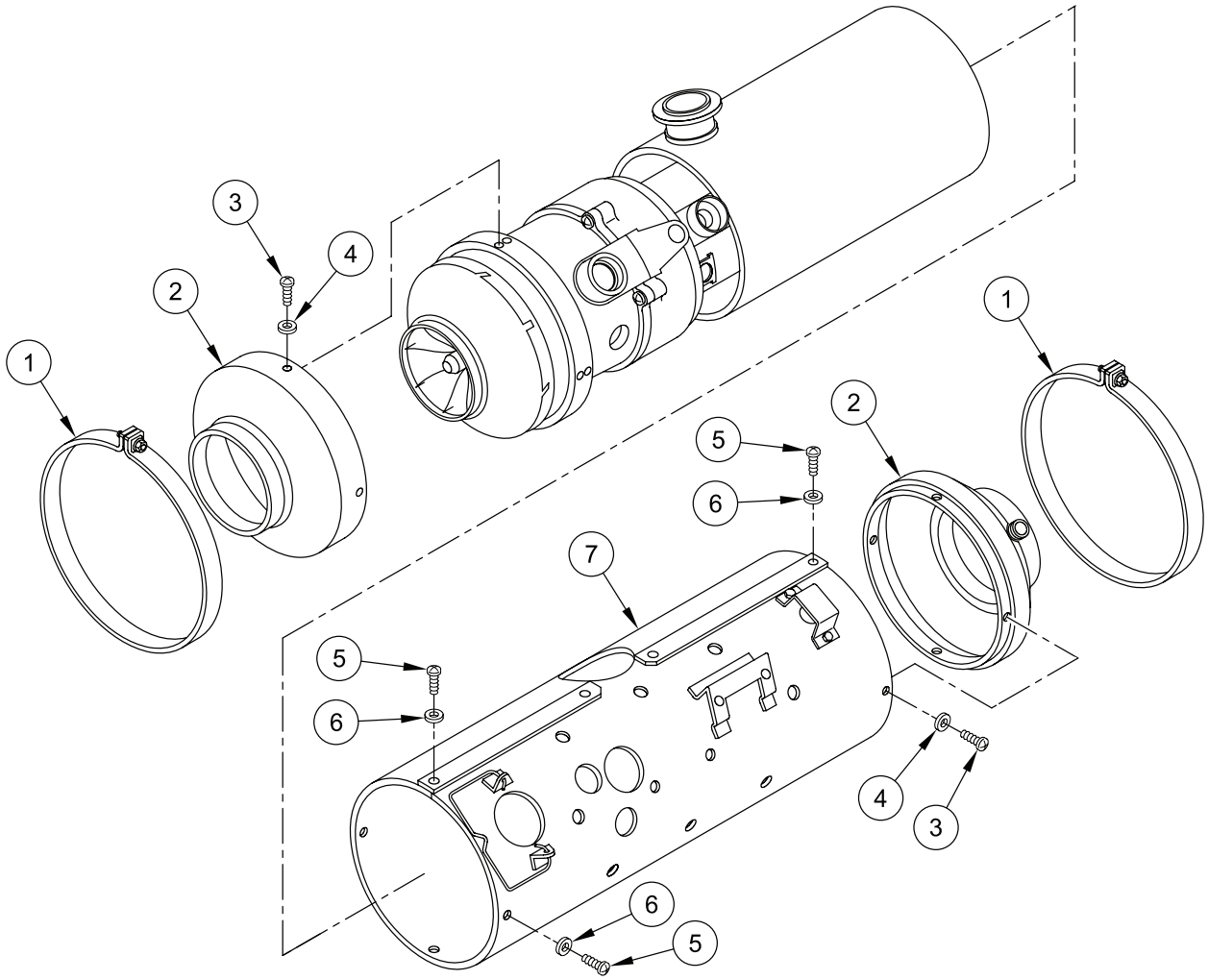


REPLACE HOUSING - Continued **0025 00**

3. Using cross tip screwdriver, remove eight screws (3), lockwashers (4), and hoods (2) from housing (7). Discard lockwashers.

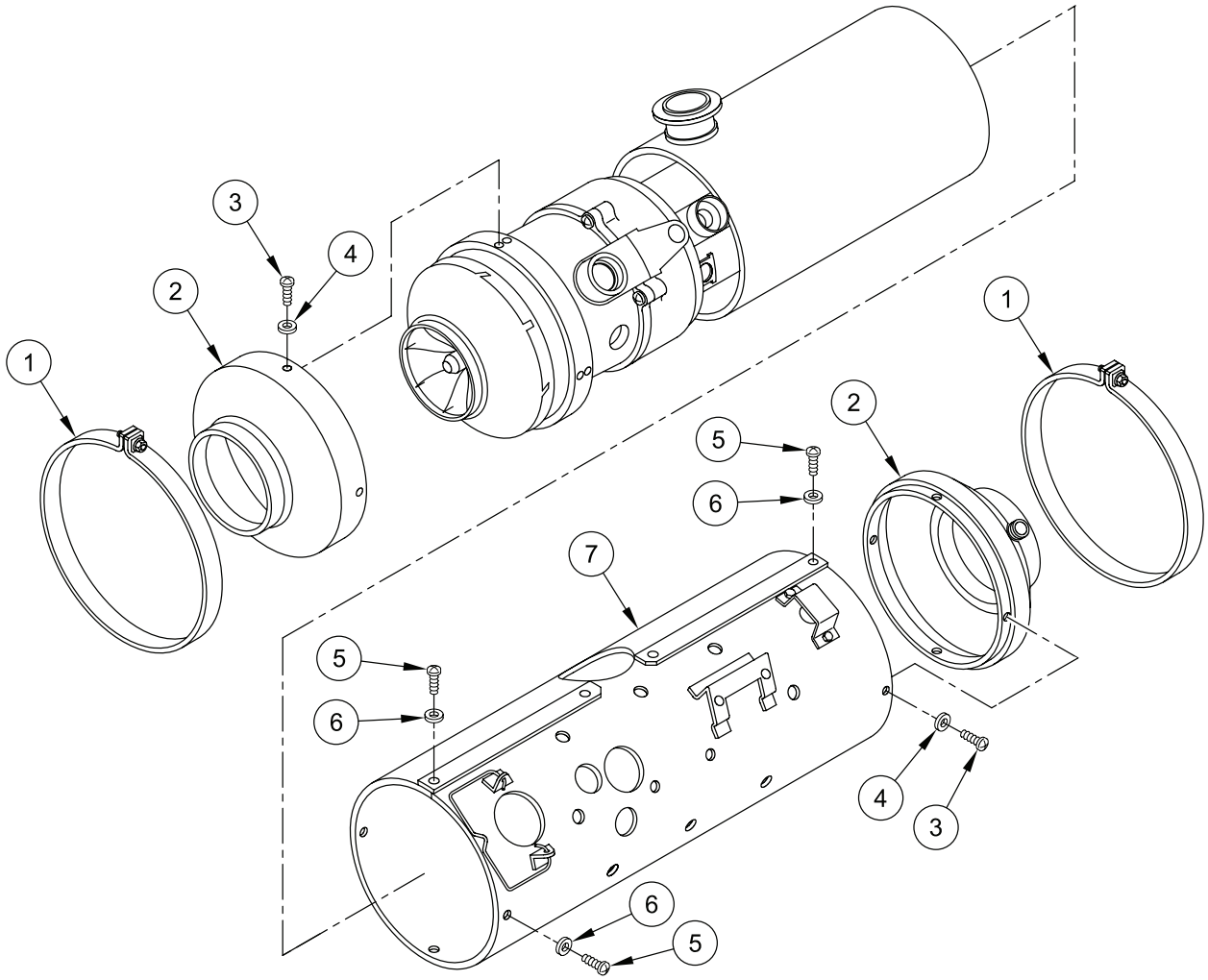
4. Slightly loosen and remove loop clamps (1).

5. Remove six screws (5), lockwashers (6), and housing (7) from heater assembly. Discard lockwashers.

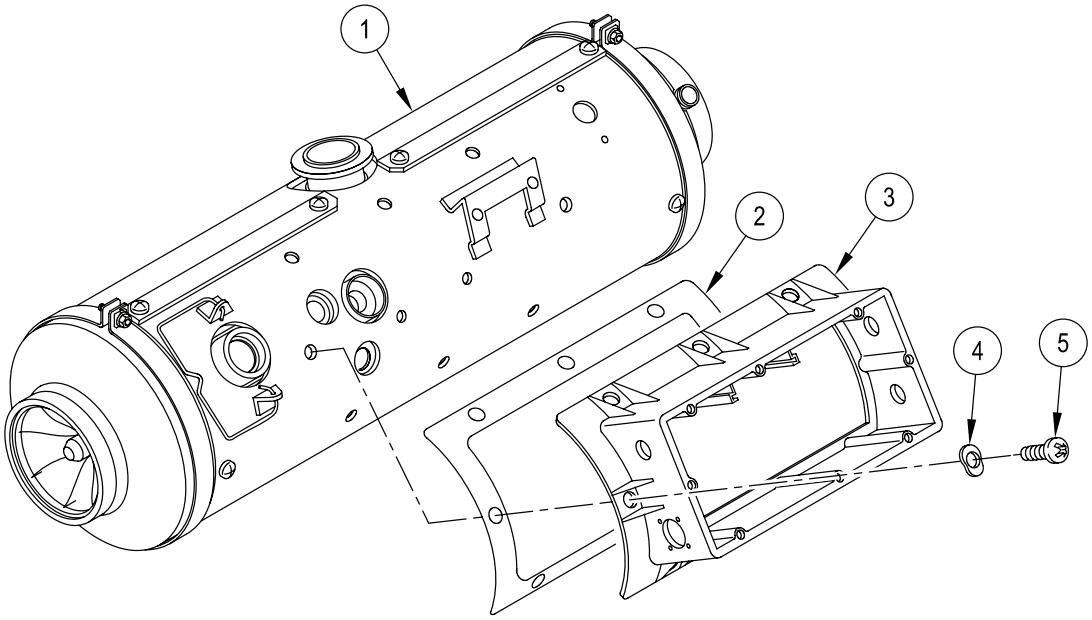


INSTALLATION

1. Install the housing (7) onto the heater assembly and secure loosely with loop clamps (1).
2. Install six screws (5) and new lockwashers (6) onto housing (7).
3. Install hoods (2) onto housing with eight screws (3) and new lockwashers (4).



4. Install new gasket (2) and box (3) onto housing (1) with eight screws (5) and washers (4).



FOLLOW-THROUGH STEPS

1. Connect overheat switch (WP 0023 00).
2. Connect temperature sensor (WP 0022 00).
3. Install terminal board (WP 0019 00).
4. Install glow plug (WP 0018 00).
5. Install glow spark plug (WP 0017 00).
6. Install fixed capacitor (WP 0021 00).
7. Install heater igniter (WP 0016 00).
8. Install solenoid valve (WP 0024 00).
9. Install cover (WP 0015 00).

END OF TASK

REPLACE BLOWER MOTOR AND IMPELLER 0026 00

THIS WORK PACKAGE COVERS:

INITIAL SETUP:

Maintenance Level
Unit

Tools and Special Tools
General Mechanic's Tool Kit (WP 0048 00, Item 1)

Materials/Parts
Lockwasher (4)

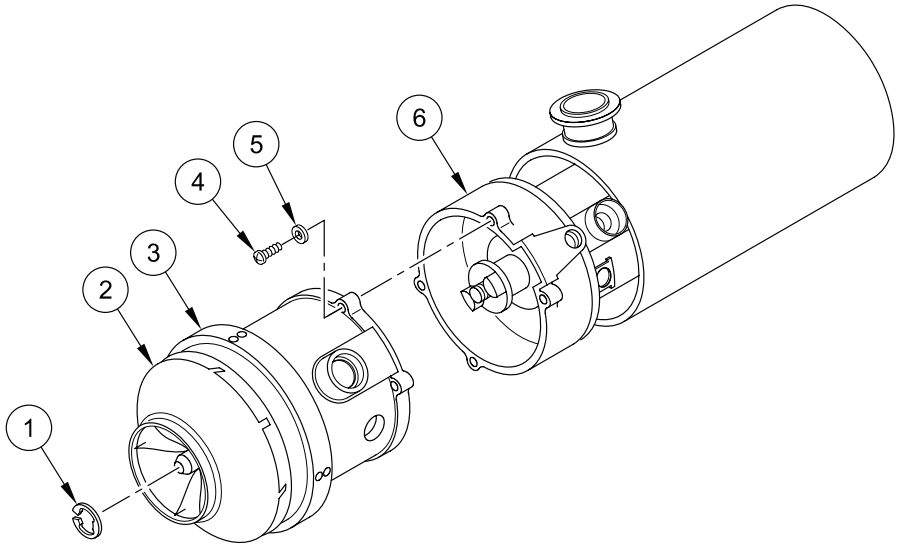
Personnel Required
Unit Mechanic

Equipment Condition
Heater removed from vehicle (applicable vehicle technical manual)
Cover removed (WP 0015 00)
Solenoid valve removed (WP 0024 00)
Heater igniter removed (WP 0016 00)
Fixed capacitor removed (WP 0021 00)
Glow spark plug removed (WP 0017 00)
Glow plug removed (WP 0018 00)
Terminal board removed (WP 0019 00)
Housing removed (WP 0025 00)

REMOVAL

1. Using flat tip screwdriver, remove retaining ring (1) from impeller (2).

2. Using a cross tip screw driver, remove four screws (4), nylon washers (5), and blower motor (3) from diffuser/heat exchanger assembly (6).

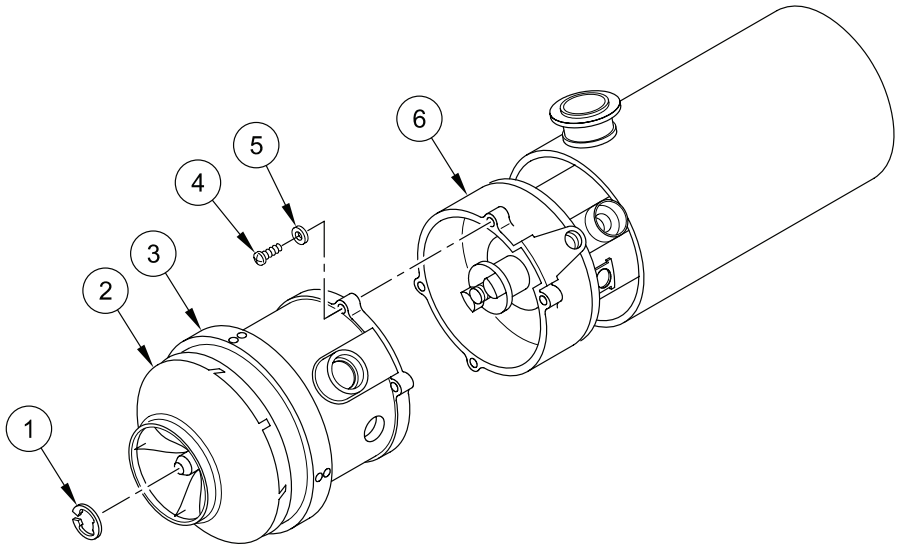


INSTALLATION

NOTE

Inspect motor for burns and the impeller for cracks. Replace prior to installation.

1. Install four screws (4), nylon washers (5), and blower motor (3) onto diffuser/heat exchanger assembly (6).
2. Install impeller (2) onto blower motor (3) and secure with retaining ring (1).



FOLLOW-THROUGH STEPS

1. Install housing (WP 0025 00).
2. Connect overheat switch (WP 0023 00).
3. Connect temperature sensor (WP 0022 00).
4. Install terminal board (WP 0019 00).
5. Install glow plug (WP 0018 00).
6. Install glow spark plug (WP 0017 00).
7. Install fixed capacitor (WP 0021 00).
8. Install heater igniter (WP 0016 00).
9. Install solenoid valve (WP 0024 00).
10. Install cover (WP 0015 00).

END OF TASK

REPLACE ROTATING DIFFUSER AND HEAT EXCHANGER 0027 00

THIS WORK PACKAGE COVERS:

INITIAL SETUP:

Maintenance Level
Unit

Tools and Special Tools
General Mechanic's Tool Kit (WP 0048 00, Item 1)

Materials/Parts
Gasket
Lockwasher (6)

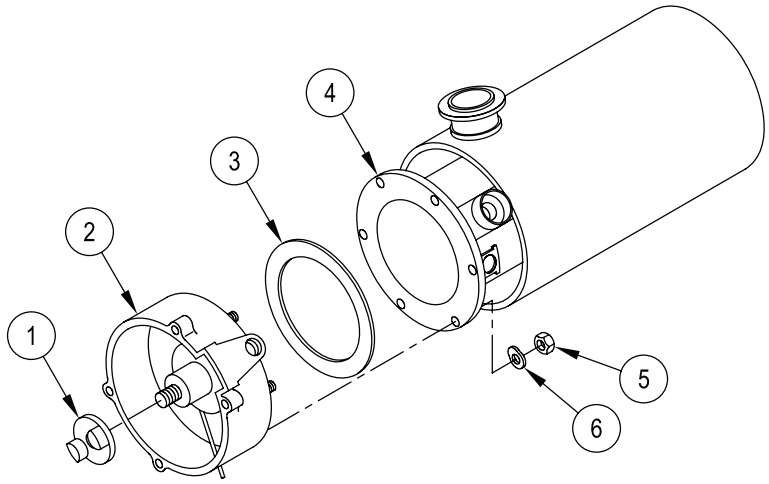
Personnel Required
Unit Mechanic

Equipment Condition
Heater removed from vehicle (applicable vehicle technical manual)
Blower motor and impeller removed (WP 0026 00)
Flame sensor removed (WP 0028 00)
Housing removed (WP 0025 00)

REMOVAL

1. Using 8mm open end wrench, remove six nuts (5), lockwashers (6), gasket (3), and rotating diffuser (2) from heat exchanger (4). Discard gasket and lockwashers.

2. Remove coupling (1) from rotating diffuser (2).

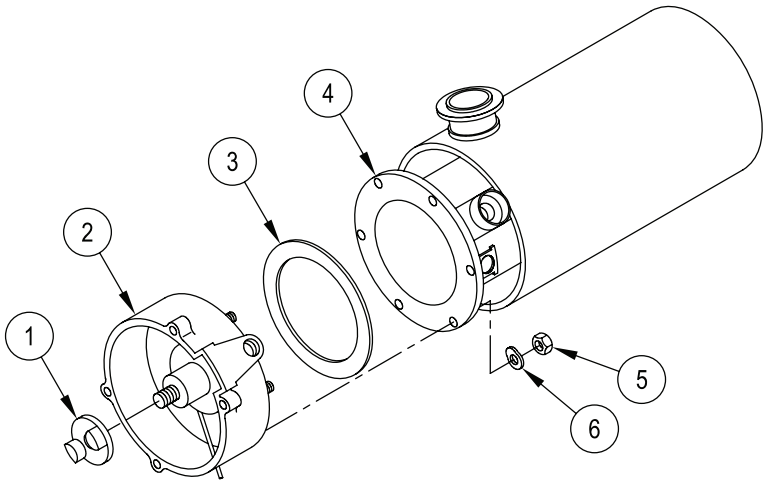


INSTALLATION

NOTE

Inspect rotating diffuser and heat exchanger for cracks. Replace prior to installation.

1. Install coupling (1) on rotating diffuser (2).
2. Install new gasket (3) on rotating diffuser (2).
3. Install six nuts (5), new lockwashers (6), and rotating diffuser (2) on heat exchanger (4).



FOLLOW-THROUGH STEPS

1. Install flame sensor (WP 0028 00).
2. Install blower motor and impeller (WP 0026 00).
3. Install housing (WP 0025 00).

END OF TASK

REPLACE FLAME SENSOR 0028 00

THIS WORK PACKAGE COVERS:

INITIAL SETUP:

Maintenance Level
Unit

Tools and Special Tools
General Mechanic's Tool Kit (WP 0048 00, Item 1)

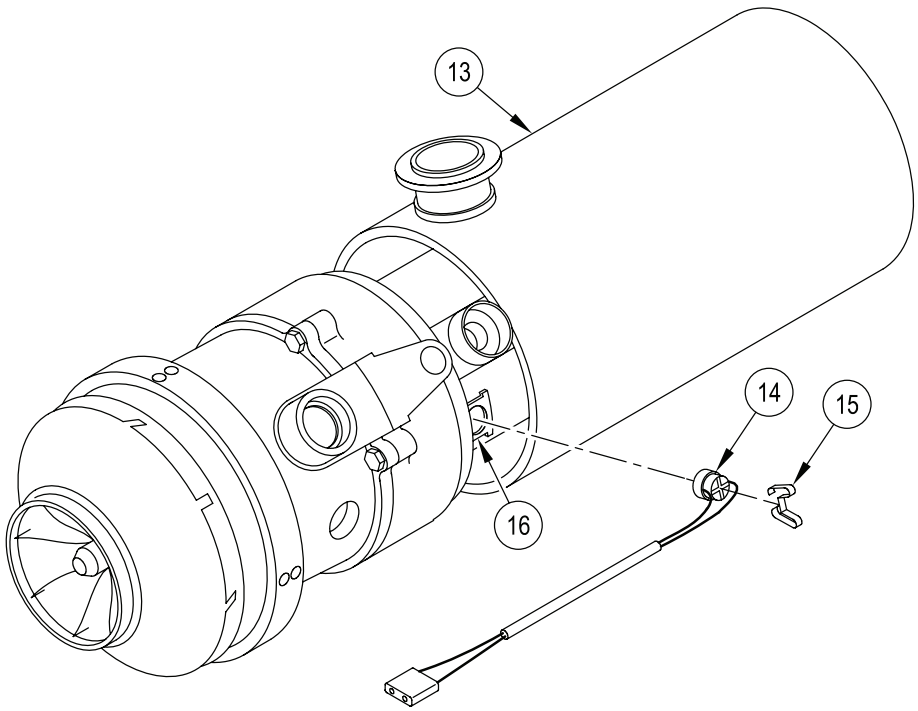
Materials/Parts
Gasket
Lockwasher (6)
Lockwasher (4)

Personnel Required
Unit Mechanic

Equipment Condition
Heater removed from vehicle (applicable vehicle technical manual)
Cover removed (WP 0015 00)
Solenoid valve removed (WP 0024 00)
Fixed capacitor removed (WP 0021 00)
Heater igniter removed (WP 0016 00)
Glow spark plug removed (WP 0017 00)
Glow plug removed (WP 0018 00)
Terminal board removed (WP 0019 00)
Temperature sensor removed (WP 0022 00)
Overheat switch removed (WP 0023 00)
Housing removed (WP 0025 00)

REMOVAL

1. Remove spring tension clip (15) from flame sensor (14) and heat exchanger (13).
2. Remove flame sensor (14) from plug (16) in heat exchanger (13).

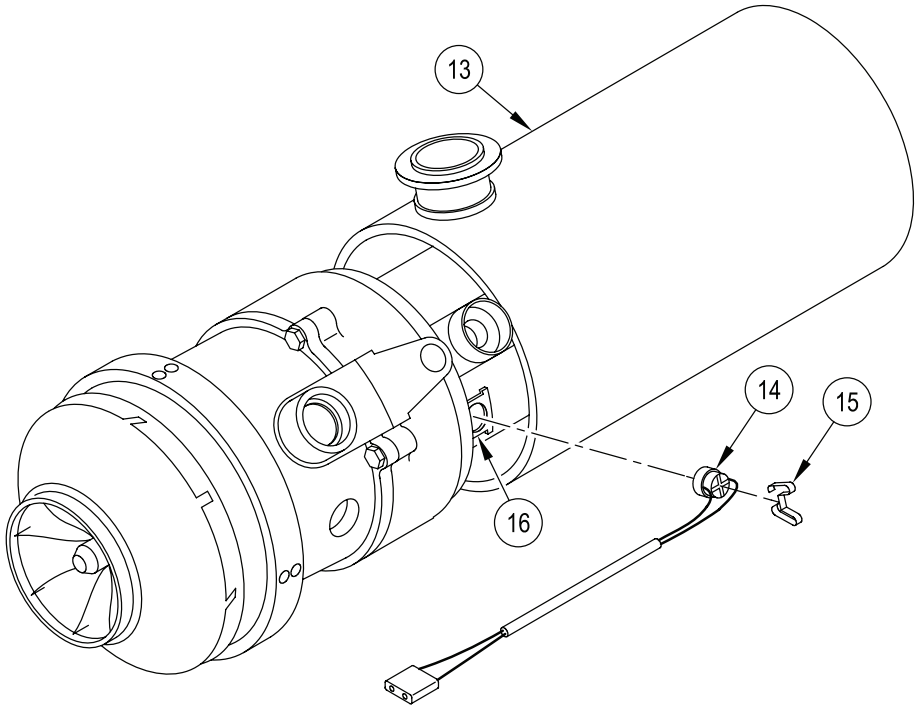


INSTALLATION

NOTE

Inspect flame sensor for cracks and burn. Replace prior to installation.

1. Install flame sensor (14) onto plug (16) in heat exchanger (13).
2. Install spring tension clip (15) on flame sensor (14) and heat exchanger (13).



FOLLOW-THROUGH STEPS

1. Install housing (WP 0025 00).
2. Install overheat switch (WP 0023 00).
3. Install temperature sensor (WP 0022 00).
4. Install terminal board (WP 0019 00).
5. Install glow plug (WP 0018 00).
6. Install glow spark plug (WP 0017 00).
7. Install fixed capacitor (WP 0021 00).
8. Install heater igniter (WP 0016 00).
9. Install solenoid valve (WP 0024 00).
10. Install cover (WP 0015 00).

END OF TASK

REPLACE FUEL CIRCULATING PUMP 0029 00

THIS WORK PACKAGE COVERS:

INITIAL SETUP:

Maintenance Level
Unit

Personnel Required
Unit Mechanic

Tools and Special Tools
General Mechanic's Tool Kit (WP 0048 00, Item 1)

Equipment Condition
Heater removed from vehicle (applicable vehicle technical manual)

Materials/Parts
Marking Tags (WP 0047 00, Item 4)

REMOVAL

WARNING

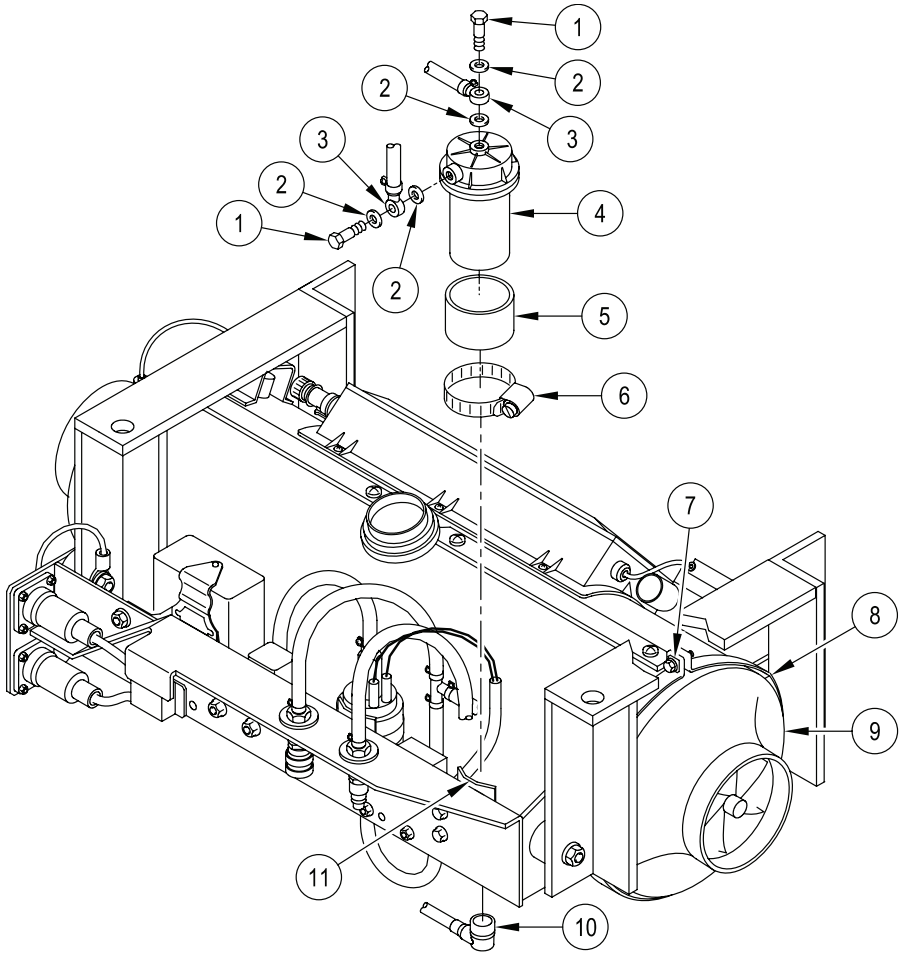
Diesel fuel can catch fire and seriously injure or kill personnel and damage or destroy equipment.

Empty fuel from heater and disassembled fuel system components. Wipe up fuel spills immediately. Do not smoke or allow sparks and flame near fuel or fuel system components when working on fuel system.

NOTE

Tag all hoses to aid during installation.

1. Loosen screw (7) and clamp (8) on heater housing (9).
2. Remove two fuel passage bolts (1), rings (3), and four washers (2) from top and side of fuel circulating pump (4).
3. Loosen clamp (6) and remove fuel circulating pump (4) and cushion (5).
4. Remove electrical connector (10) from the bottom of the fuel circulating pump (4).
5. Remove clamp (6) from control mounting bracket (11).



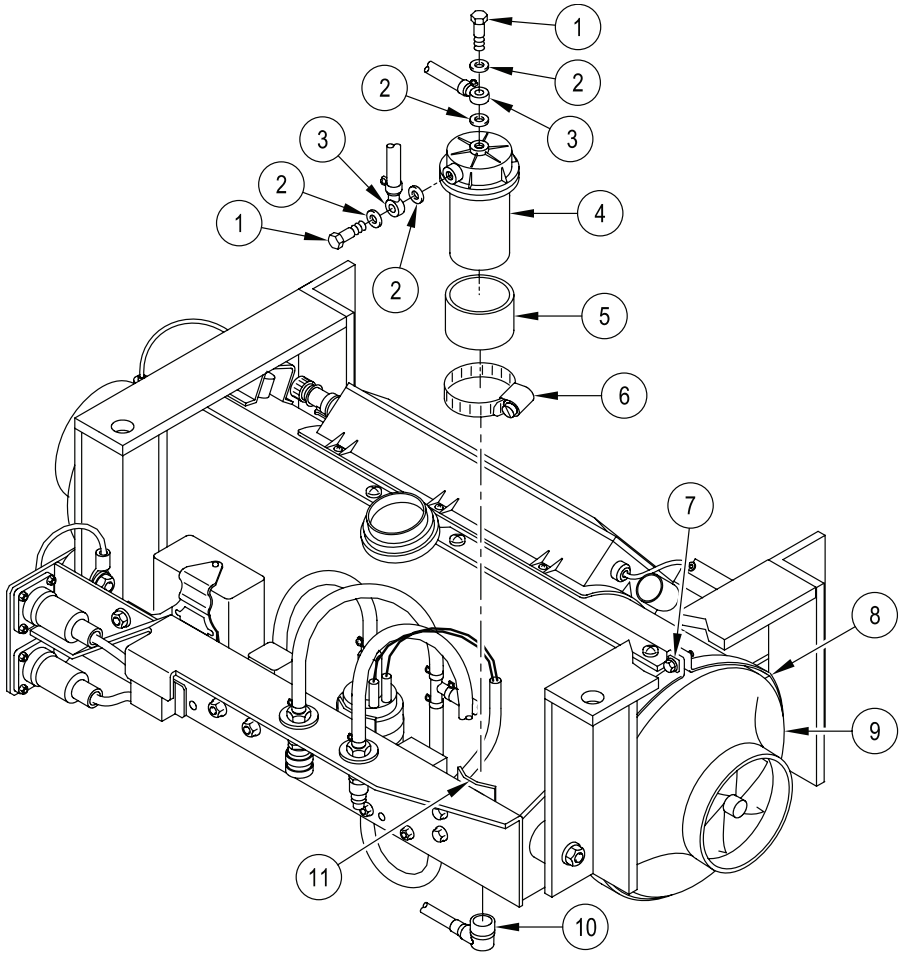
INSTALLATION

NOTE

Inspect fuel pump for leaks and cracks. Replace prior to installation.

If hose clamp was replaced, the new hose clamp will have to be unscrewed completely.

1. Install clamp (6) onto control mounting bracket (11).
2. Install electrical connector (10) on the bottom of the fuel circulating pump (4).
3. Install cushion (5) on fuel circulating pump (4).
4. Position fuel circulating pump (4) on the control mounting bracket (11). Tighten clamp (6) to secure pump in place.
5. Install two fuel passage bolts (1), rings (3), and four washers (2) on top and side of fuel circulating pump (4).
6. Tighten screw (7) and clamp (8) on heater housing (9).



END OF TASK

REPLACE FUEL METERING PUMP 0030 00

THIS WORK PACKAGE COVERS:

INITIAL SETUP:

Maintenance Level
Unit

Personnel Required
Unit Mechanic

Tools and Special Tools
General Mechanic's Tool Kit (WP 0048 00, Item 1)

Equipment Condition
Heater removed from vehicle (applicable vehicle technical manual)

Materials/Parts
Marking Tags (WP 0047 00, Item 4)

REMOVAL

WARNING

Diesel fuel can catch fire and seriously injure or kill personnel and damage or destroy equipment.

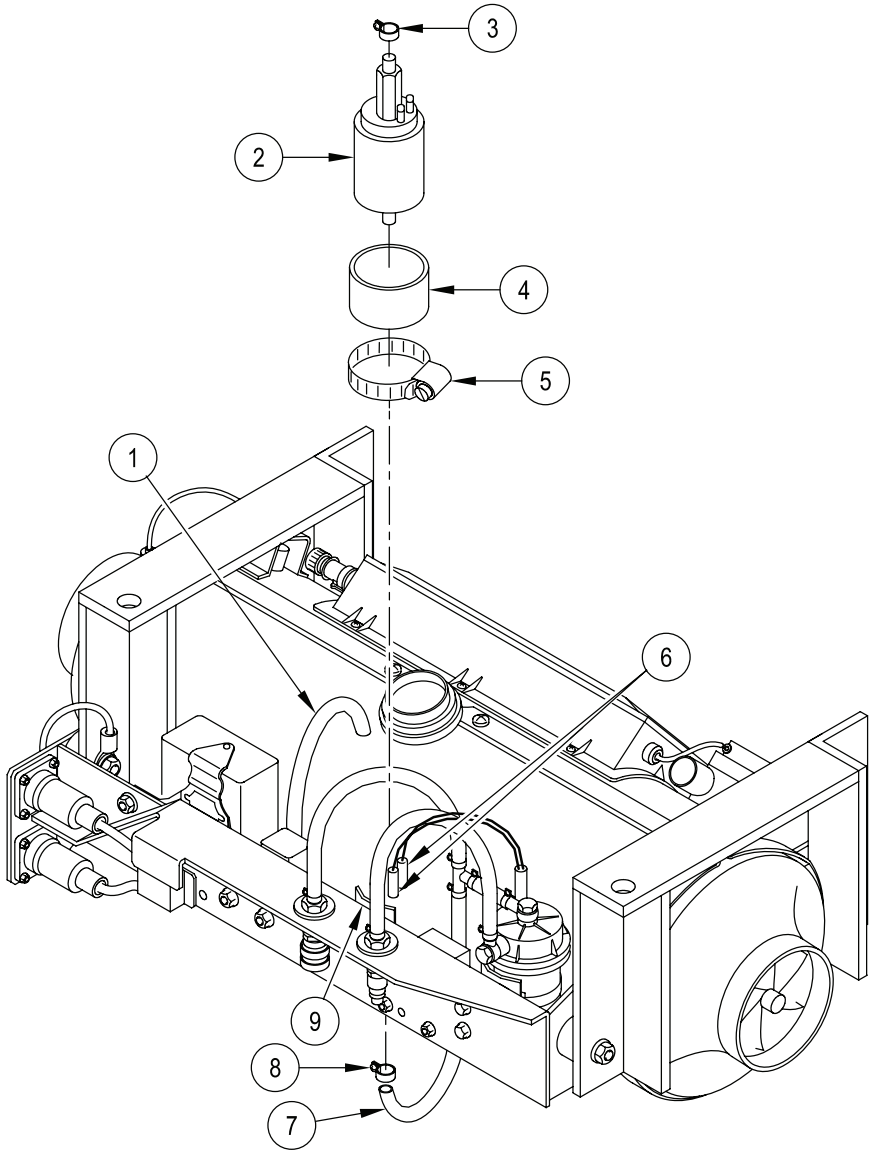
Empty fuel from heater and disassembled fuel system components. Wipe up fuel spills immediately. Do not smoke or allow sparks and flame near fuel or fuel system components when working on fuel system.

REPLACE FUEL METERING PUMP - Continued **0030 00**

NOTE

Tag all hoses to aid during installation.

1. Loosen clamp (3) and remove hose (1) from the top of the fuel metering pump (2).
2. Loosen clamp (8) and remove hose (7) from the bottom of the fuel metering pump (2).
3. Remove two electrical connectors (6) from the top of the fuel metering pump (2).
4. Loosen clamp (5) and remove cushion (4) and fuel metering pump (2) from control mounting bracket (9).

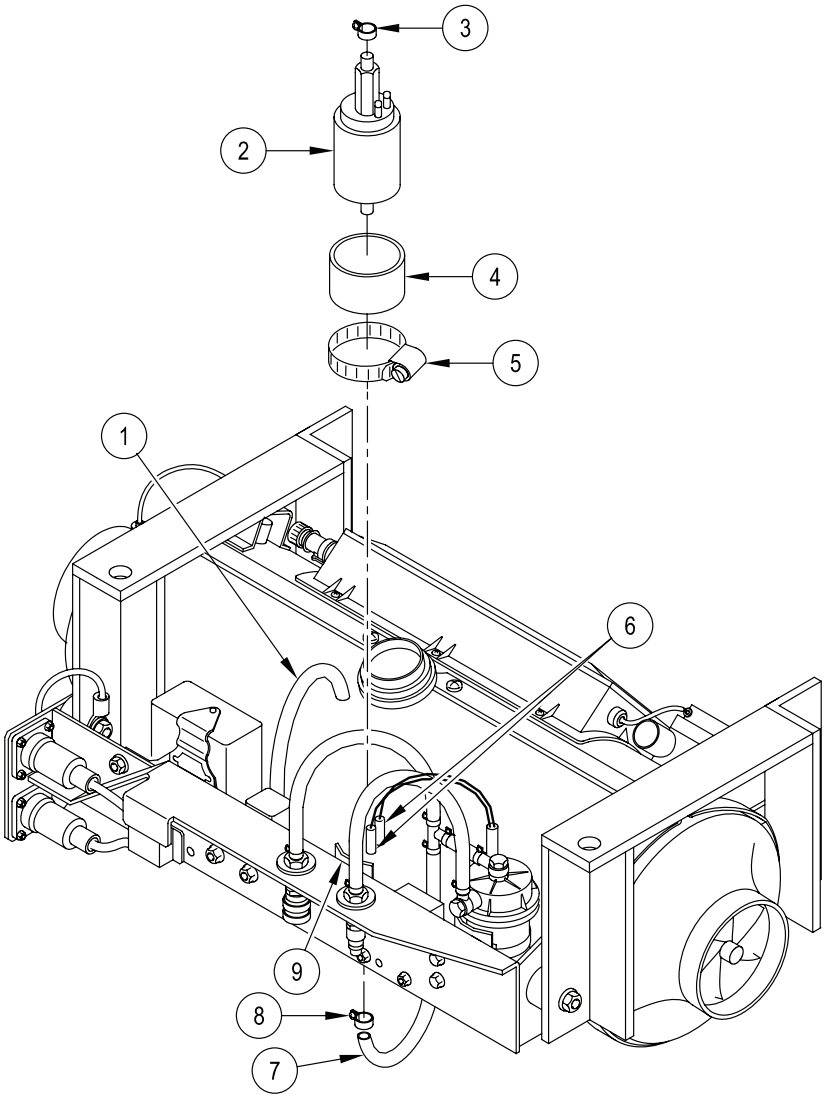


INSTALLATION

NOTE

Inspect metering pump for cracks and leaks. Inspect plug for broken pins. Replace prior to installation

1. Install cushion (4) on fuel metering pump (2).
2. Position fuel metering pump (2) on the control mounting bracket (9). Tighten clamp (5) to secure fuel metering pump.
3. Connect two electrical connectors (6) on top side of fuel metering pump (2).
4. Install hose (7) to the bottom of fuel metering pump (2). Tighten clamp (8) to secure hose.
5. Install hose (1) to the top of fuel metering pump (2). Tighten clamp (3) to secure hose.



END OF TASK

REPLACE CONTROL UNIT **0031 00**

THIS WORK PACKAGE COVERS:

INITIAL SETUP:

Maintenance Level
Unit

Personnel Required
Unit Mechanic

Tools and Special Tools
General Mechanic's Tool Kit (WP 0048 00, Item 1)

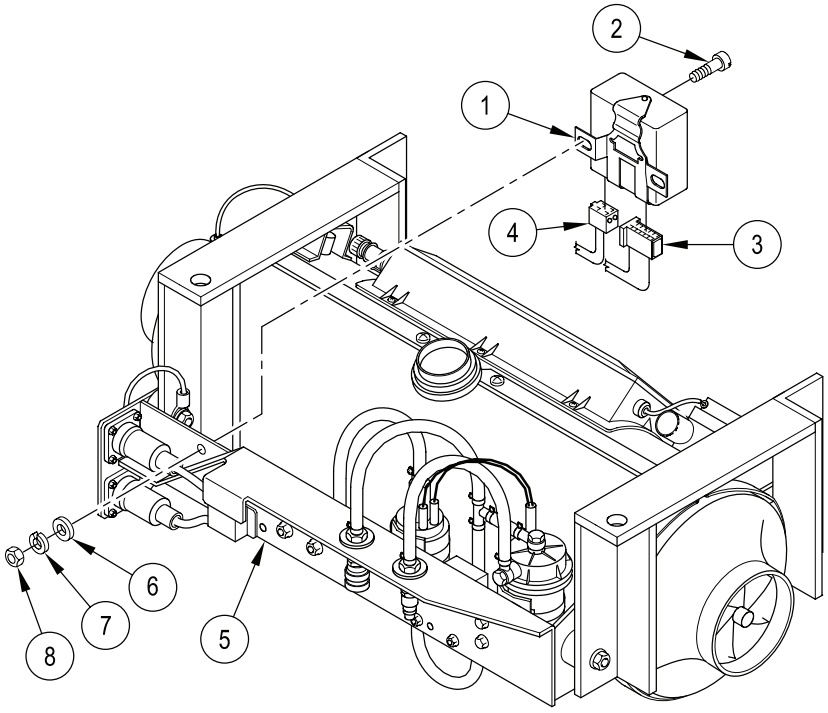
Equipment Condition
Heater removed from vehicle (applicable vehicle technical manual)

Materials/Parts
Lockwasher (2)

REMOVAL

1. Disconnect electrical connectors (3) and (4) from plug on the bottom of control unit with support bracket (1).

2. Remove two nuts (8), two lockwashers (7), two washers (6), and two screws (2) from control unit with support bracket (1) and control mounting bracket (5). Discard lockwasher.



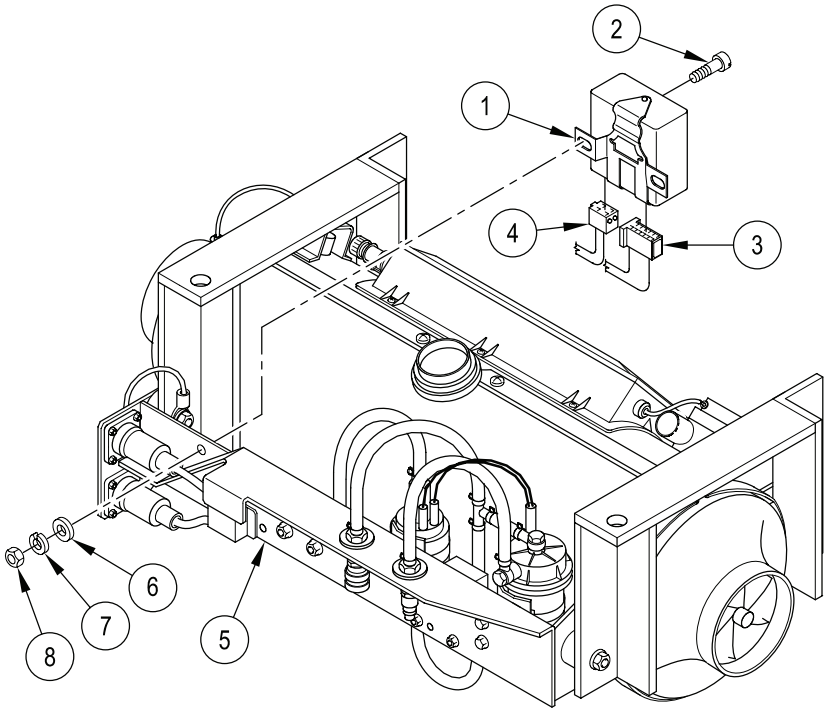
INSTALLATION

NOTE

Inspect control unit plug for broken pins. Replace prior to installation.

1. Install control unit with support bracket (1) onto control mounting bracket (5) and secure with two screws (2), two washers (6), two new lockwashers (7), and two nuts (8).

2. Install electrical connectors (3) and (4) on plugs at the bottom of the control unit with support bracket (1).



END OF TASK

REPLACE AIR SOLENOID VALVE RELAY/AMPLIFIER/VEHICLE PURGE RELAY 0032 00

THIS WORK PACKAGE COVERS:

INITIAL SETUP:

Maintenance Level
Unit

Personnel Required
Unit Mechanic

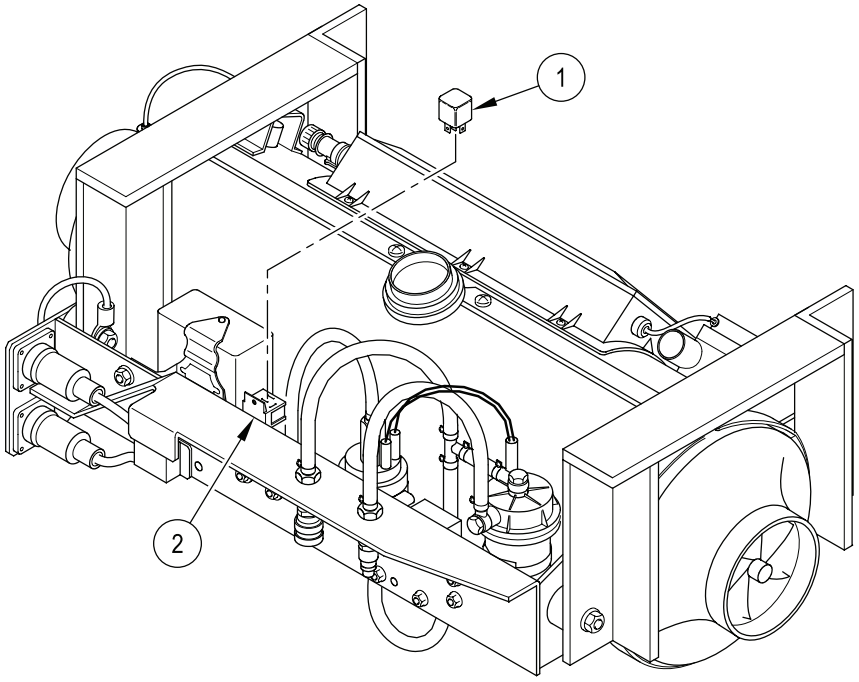
Equipment Condition
Heater removed from vehicle (applicable vehicle technical manual)

REMOVAL

NOTE

Removal and installation of the combustion air relay, amplifier, or vehicle purge relay are done the same way. Only the combustion air relay is shown.

1. Grasp relay (1) firmly with hand and work back and forth to release the relay form the mounting socket (2).
2. Pull relay (1) straight up to remove it from the relay socket (2).



INSTALLATION

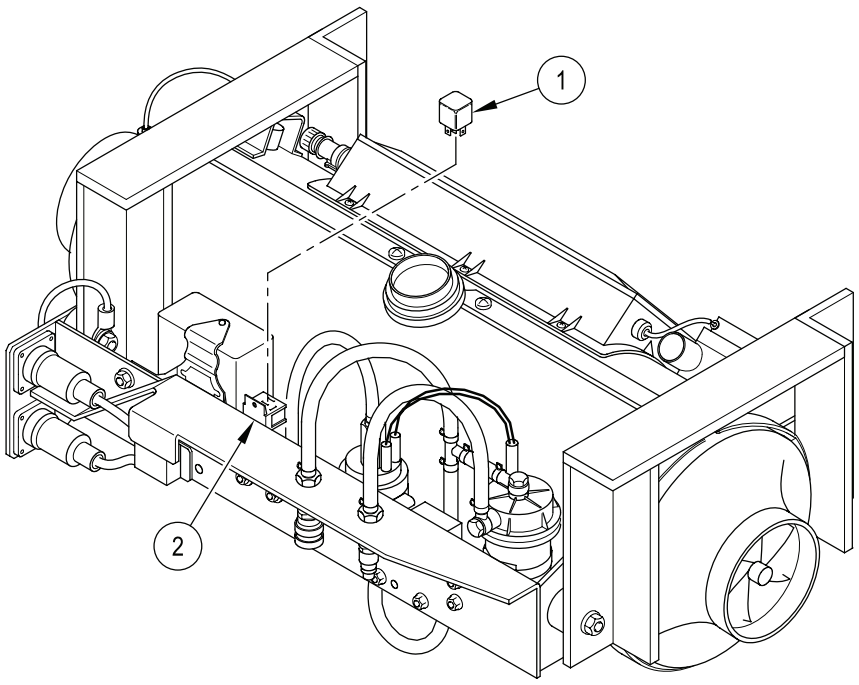
NOTE

Removal and installation of the combustion air relay, amplifier, or vehicle purge relay are done the same way. Only the combustion air relay is shown.

NOTE

Inspect the relay and relay socket for broken or missing contacts and dirt prior to installing the relay. Use electrical contact cleaner or replace as needed.

1. Note the orientation of the relay socket (2) and relay contacts (1).
2. Align the relay (1) with the relay socket (2).
3. Press the relay (1) into the relay socket (2) until the relay (1) is fully seated.



END OF TASK

REPLACE FCP EMI (RADIO FILTER) 0033 00

THIS WORK PACKAGE COVERS:

INITIAL SETUP:

Maintenance Level
Unit

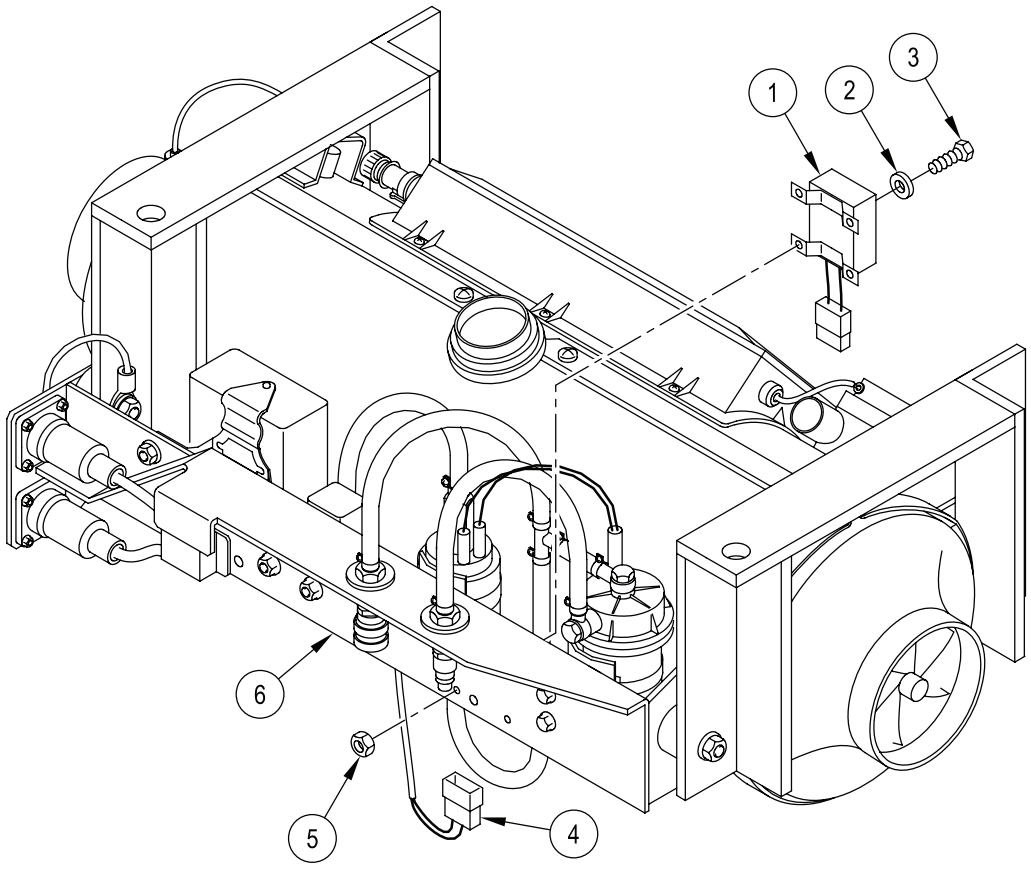
Personnel Required
Unit Mechanic

Tools and Special Tools
General Mechanic's Tool Kit (WP 0048 00, Item 1)

Equipment Condition
Heater removed from vehicle (applicable vehicle technical manual)

REMOVAL

1. Remove four nuts (5), washers (2), screws (3), and FCP EMI (1) from control mounting bracket (6).
2. Disconnect electrical connector (4) from plug on the side of the FCP EMI (1).

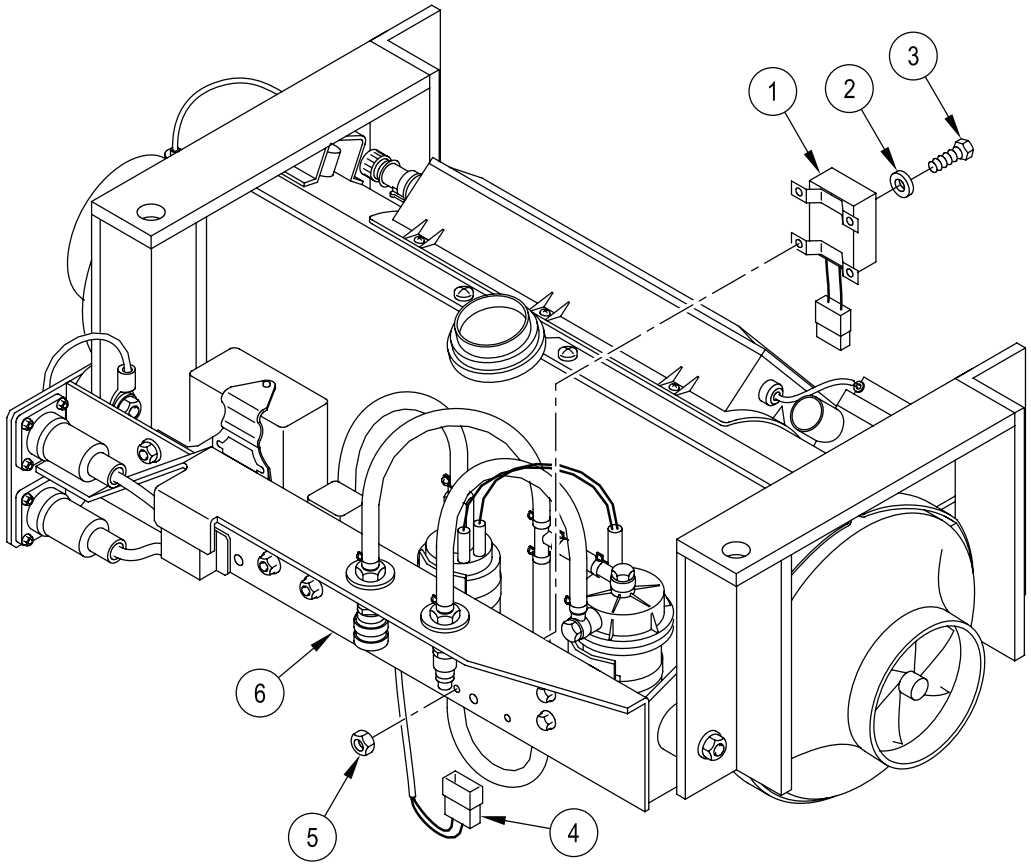


INSTALLATION

NOTE

Inspect electrical plug for broken pins. Replace prior to installation.

1. Install electrical connector (4) onto plug at the side of the FCP EMI (1).
2. Install four screws (3), washers (2), nuts (5), and FCP EMI (1) to control mounting bracket (6).



END OF TASK

REPLACE WIRING HARNESS 0034 00

THIS WORK PACKAGE COVERS:

INITIAL SETUP:

Maintenance Level
Unit

Personnel Required
Unit Mechanic

Tools and Special Tools
General Mechanic's Tool Kit (WP 0048 00, Item 1)

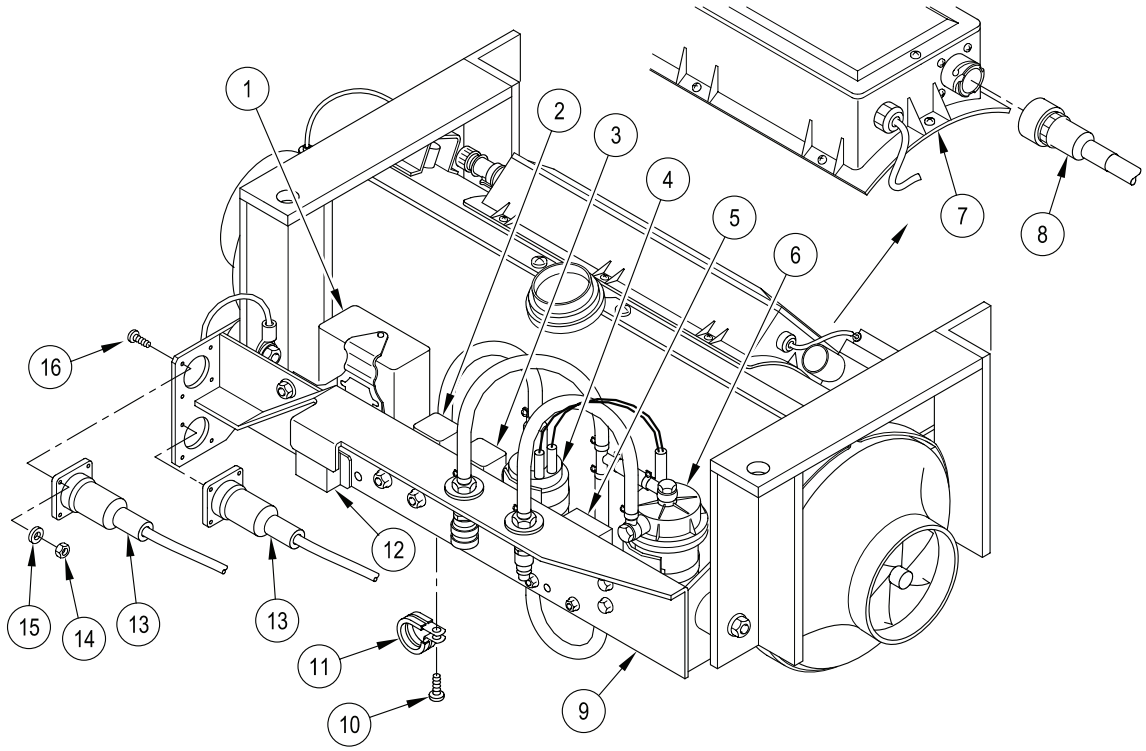
Equipment Condition
Heater removed from vehicle (applicable vehicle technical manual)

REMOVAL

NOTE

Tag all connectors to aid installation.

1. Remove eight nuts (14), washers (15), screws (16) and two cable connectors (13) from control mounting bracket (9).
2. Remove three screws (10) and cable clamps (11) from underside of heater (not shown).
3. Disconnect all electrical connectors from control unit with support bracket (1), purge relay (12), relays (2), (3), fuel metering pump (4), FCP EMI (5), and fuel circulating pump (6).
4. Disconnect other end of wiring harness cable (8) from heater box (7).
5. Remove wiring harness from heater assembly.

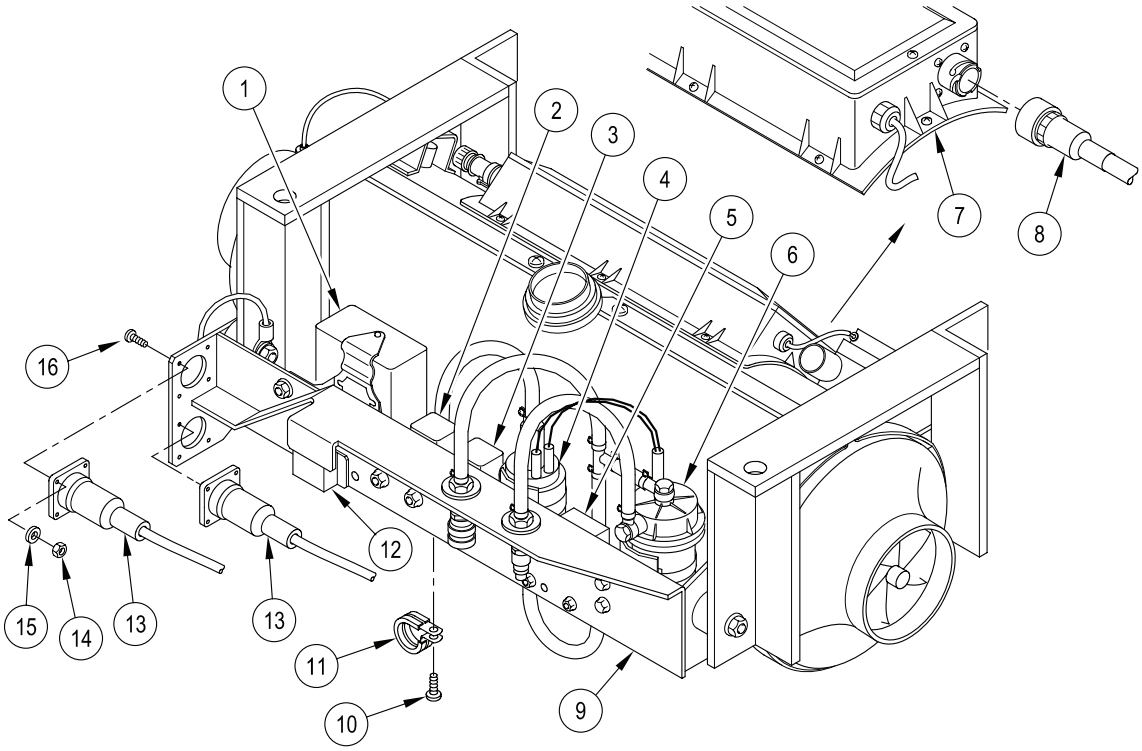


INSTALLATION

NOTE

Inspect cable connectors for broken pins. Replace prior to installation.

1. Connect wiring harness cable (8) on the heater box (7).
2. Route harness and connect all electrical connectors on control unit with support bracket (1), purge relay (12), relays (2), (3), fuel metering pump (4), FCP EMI (5), and fuel circulating pump (6).
3. Install eight screws (16), washers (15), nuts (14), and two cable connectors (13) on control mounting bracket (9).
4. Install three screws (10) and cable clamps (11) on underside of heater (not shown).



END OF TASK

REPLACE MOUNTING ASSEMBLY 0035 00

THIS WORK PACKAGE COVERS:

INITIAL SETUP:

Maintenance Level
Unit

Tools and Special Tools
General Mechanic's Tool Kit (WP 0048 00, Item 1)

Materials/Parts
Marking tags (WP 0047 00, Item 4)
Lockwasher (4)

Personnel Required
Unit Mechanic

Reference
WP 0034 00

Equipment Condition
Heater removed from vehicle (applicable vehicle technical manual)
Fuel circulating pump removed (WP 0029 00)
Fuel metering pump removed (WP 0030 00)
Control unit removed (WP 0031 00)
Combustion air relay removed (WP 0032 00)
FCP EMI removed (WP 0033 00)

REMOVAL

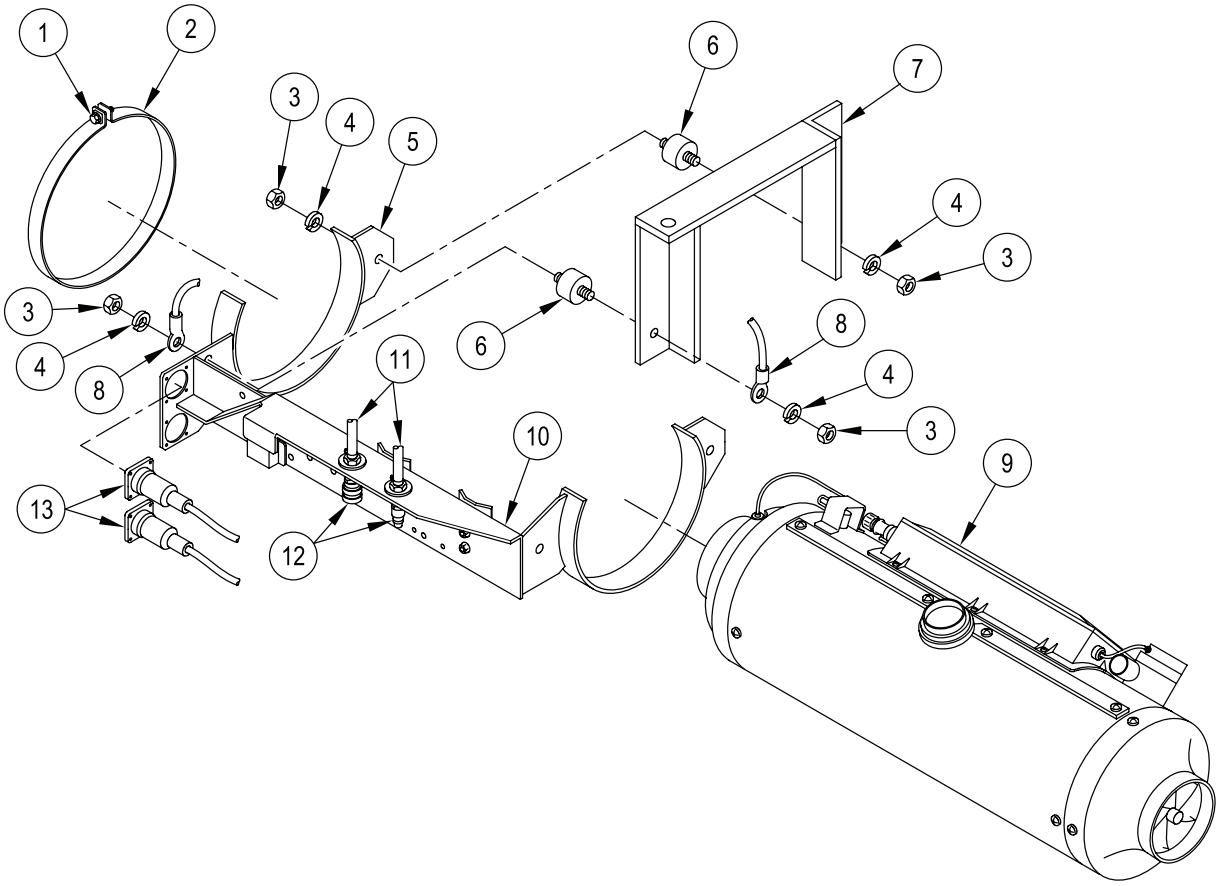
NOTE

Removal and installation of left and right side mounting is the same. Left side mounting is shown.

Tag all hoses and electrical connectors to aid installation.

REPLACE MOUNTING ASSEMBLY - Continued **0035 00**

1. Remove two fuel hoses (11) and fuel quick disconnect (12) from control mounting bracket (10).
2. Remove two cable connectors (13) from control mounting bracket (10) (WP 0034 00).
3. Loosen screw (1) and remove clamp (2) from angle bracket (5) and heater (9).
4. Remove two nuts (3), lockwashers (4), angle bracket (5), and mount resilient (6) from square bracket (7).
5. Remove two nuts (3), lockwashers (4), ground lead (8), mount resilient (6), and square bracket (7) from the other side of the control mounting bracket (10).

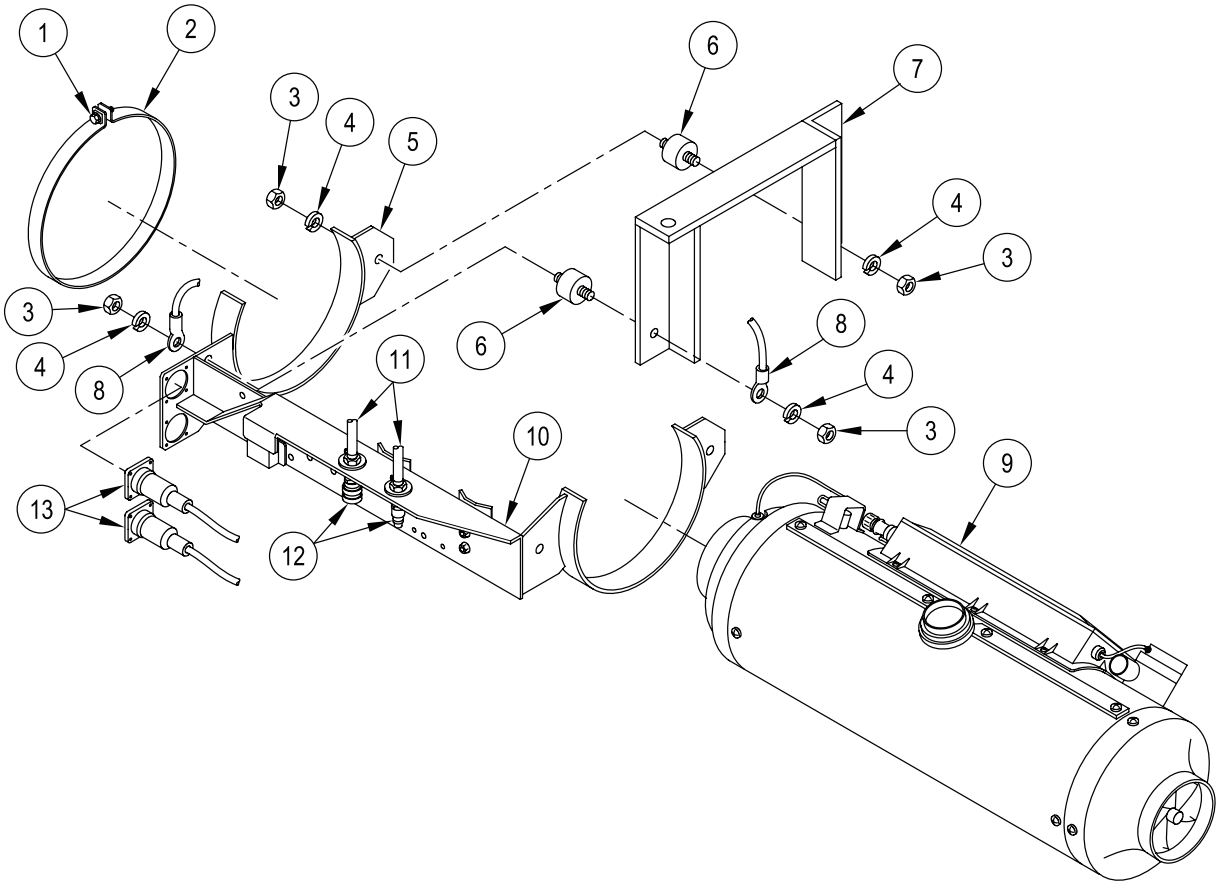


INSTALLATION

NOTE

Removal and installation of left and right side mounting is the same. Left side mounting is shown.

1. Align square bracket (7), mount resilient (6), and ground lead (8) on control mounting bracket (10). Secure with two new lockwashers (4) and nuts (3).
2. Install mount resilient (6) to other side of square bracket (7).
3. Install angle bracket (5), two new lockwashers (4), and nuts (3) on mount resilient (6).
4. Install clamp (2) on angle bracket (5) and heater (9). Tighten screw (1) on clamp to secure heater in place.
5. Install two cable connectors (13) on control mounting bracket (10) (WP 0034 00).
6. Install two fuel lines (11) and fuel quick disconnect (12) on control mounting bracket (10).



FOLLOW-THROUGH STEPS

1. Install FCP EMI (WP 0033 00).
2. Install combustion air relay (WP 0032 00).
3. Install control unit (WP 0031 00).
4. Install fuel metering pump (WP 0030 00).
5. Install fuel circulating pump (WP 0029 00).

END OF TASK

REPLACE FUEL LINES AND FITTINGS 0036 00

THIS WORK PACKAGE COVERS:

INITIAL SETUP:

Maintenance Level
Unit

Personnel Required
Unit Mechanic

Tools and Special Tools
General Mechanic's Tool Kit (WP 0048 00, Item 1)

Equipment Condition
Heater removed from vehicle (applicable vehicle technical manual)

Materials/Parts
Marking tags (WP 0047 00, Item 4)

REMOVAL

WARNING

Diesel fuel can catch fire and seriously injure or kill personnel and damage or destroy equipment.

Empty fuel from heater and disassembled fuel system components. Wipe up fuel spills immediately. Do not smoke or allow sparks and flame near fuel or fuel system components when working on fuel system.

NOTE

Tag all hoses to aid during installation.

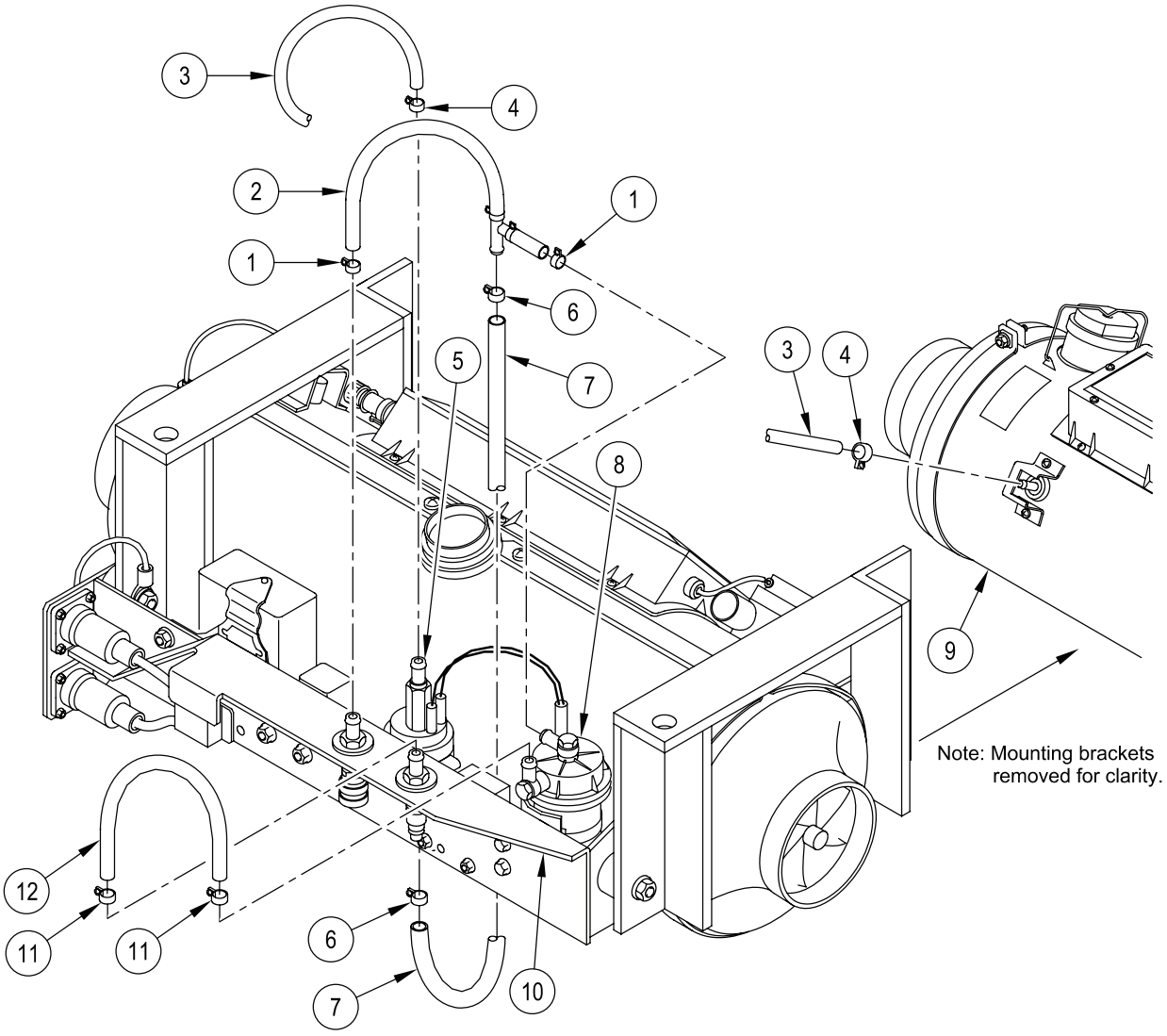
REPLACE FUEL LINES AND FITTINGS - Continued **0036 00**

1. Loosen two clamps (11) and remove supply hose (12) from side of fuel circulating pump (8) and control mounting bracket (10). Use cross tip screwdriver.

2. Loosen two clamps (1) and remove return hose (2) from top of fuel circulating pump (8) and control mounting bracket (10).

3. Loosen two clamps (6) and remove hose (7) from the bottom of fuel metering pump (5).

4. Loosen two clamps (4) and remove hose (3) from heater (9) and top of fuel metering pump (5).



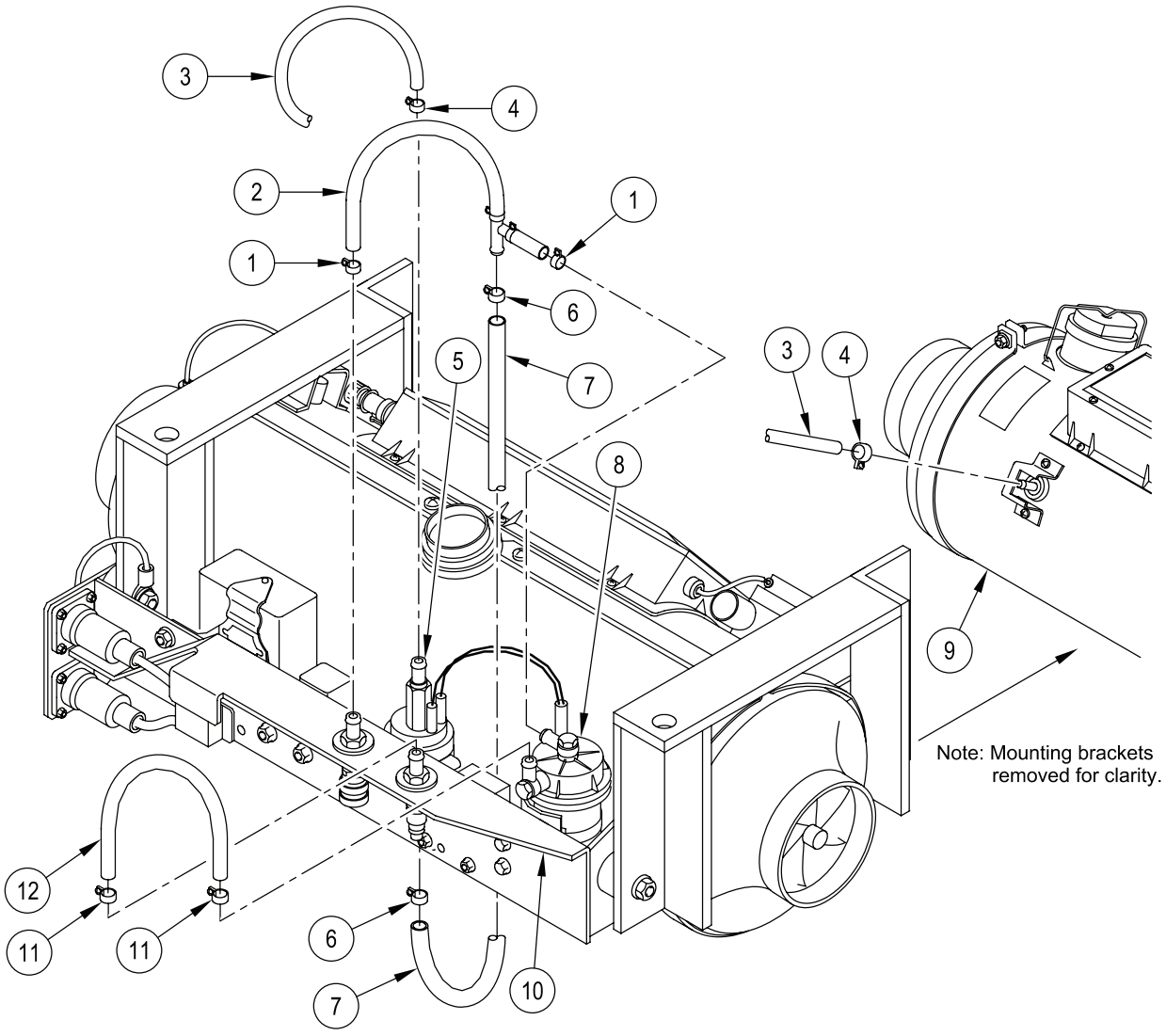
INSTALLATION

1. Install hose (3) on heater (9) and top of fuel metering pump (5). Tighten two clamps (4) to secure hose in place.

2. Install supply hose (7) on the bottom of the metering pump (5). Tighten two clamps (6).

3. Install fuel return hose (2) on control mounting bracket (10) and on top of fuel circulating pump (8). Tighten two clamps (1) to secure hose in place.

4. Install fuel supply hose (12) on control mounting bracket (10) and on the side of fuel circulating pump (8). Tighten two clamps (11) to secure hose in place.



END OF TASK

CHAPTER 5

SUPPORTING INFORMATION

WORK PACKAGE INDEX

REFERENCES 0037 00

SCOPE

This work package lists all field manuals, forms, technical manuals, and miscellaneous publications referenced in this manual.

FORMS

Equipment Maintenance Inspection Worksheet	DA 5988E
Quality Deficiency Report	SF 368
Recommended Changes to Equipment Technical Publications	DA Form 2028
Report of Discrepancy (ROD)	SF 364
Transportation Discrepancy Report	SF 361

FIELD MANUALS

First Aid for Soldiers	FM 4-25.11

TECHNICAL MANUALS

Interactive Electronic Manual (ETM) for the Multiple Launch Rocket System (MLRS) M270A1 Launcher and M993/M993A1 Carrier	TM 9-1055-647-13&P
Operator's Manual for Carrier, Multiple Launch Rocket System, M993	TM 9-1450-646-10
Procedures for Destruction of Equipment in Federal Supply Classifications 1000, 1005, 1015, 1020, 1025, 1030, 1055, 1090, and 1095 to Prevent Enemy Use	TM 750-244-7
Procedures for Destruction of Tank-Automotive Equipment to Prevent Enemy Use	TM 750-244-6
Unit Maintenance Manual for Carrier, Multiple Launch Rocket System, M993	TM 9-1450-646-20-1

MISCELLANEOUS PUBLICATIONS

Army Material Maintenance Policy	AR 750-1
Army Medical Department Expendable/Durable Items	CTA 8-100
Expendable/Durable Items (Except Medical, Class V, Repair Parts and Heraldic Items)	CTA 50-970
Report of Supply Discrepancies	AR 735-11-2
The Army Maintenance Management System (TAMMS) User’s Manual	DA PAM 750-8

END OF WORK PACKAGE

MAINTENANCE ALLOCATION CHART 0038 00

GENERAL

The Army Maintenance System MAC

This introduction provides a general explanation of all maintenance and repair functions authorized at the two maintenance levels under the Two-Level Maintenance system concept.

The MAC (immediately following this introduction) designates overall authority and responsibility for the performance of maintenance functions on the identified end item or component. The application of the maintenance functions to the end item or component shall be consistent with the capacities and capabilities of the designated maintenance levels, which are shown on the MAC in column (4) as:

Field – includes two subcolumns, Unit (C (operator/crew) and O (unit)) maintenance and Direct support (F) maintenance.

Sustainment – includes two subcolumns, General Support (H) and Depot (D).

The tools and test equipment requirements (immediately following the MAC) list the tools and test equipment (both special tools and common tool sets) required for each maintenance function as referenced from the MAC.

The remarks (immediately following the tools and test equipment requirements) contain supplemental instructions and explanatory notes for a particular maintenance function.

Maintenance Functions

Maintenance functions are limited to and defined as follows:

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

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

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

(4) *Adjust.* To maintain or regulate, within prescribed limits, by bringing into proper or exact position or by setting the operating characteristics to specified parameters.

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

(6) *Calibrate.* To determine and cause corrections to be made or to be adjusted on instruments of test, measuring, and diagnostic equipment used in precision measurement. Consists of comparisons of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

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

(8) *Replace.* To remove an unserviceable item and install a serviceable counterpart in its place. “Replace” is authorized by the MAC and assigned maintenance level is shown as the third position code of the Source Maintenance and Recoverability (SMR) code.

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

NOTE

The following definitions are applicable to the "repair" maintenance function:

- **Services – Inspect, test, service, adjust, align, calibrate, and/or replace.**
- **Fault location/troubleshooting – The process of investigating and detecting the cause of equipment malfunctioning; the act of isolating a fault within a system or Unit Under Test (UUT).**
- **Disassembly/assembly – The step-by-step breakdown (taking apart) of a spare/functional group coded item to the level of its least component, that is assigned an SMR code for the level of maintenance under consideration (i.e., identified as maintenance significant).**
- **Actions – Welding, grinding riveting, straightening, facing, machining, and/or surfacing.**

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

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

Explanation of Columns in the MAC, Section II

(1) *Column (1), Group Number.* Column (1) lists Functional Group Code (FGC) numbers, the purpose of which is to identify maintenance significant components, assemblies, subassemblies, and modules with the Next Higher Assembly (NHA). End item group number shall be "00."

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

(3) *Column (3), Maintenance Function.* Column (3) lists the functions to be performed on the item listed in column (2). For detailed explanation of these functions, see Maintenance Functions, above.

(4) *Column (4), Maintenance Level.* Column (4) specifies each level of maintenance authorized to perform each function listed in column (3), by indicating work time required (expressed as man-hours in whole hours or decimals) in the appropriate subcolumn. This work time figure represents the active time required to perform that maintenance function at the indicated level of maintenance. If the number or complexity of the tasks within the listed maintenance function varies at different maintenance levels, appropriate work time figures are shown for each level. The work time figure represents the average time required to restore an item (assembly, subassembly, component, module, end item, or system) to a serviceable condition under typical field operating conditions. This time includes preparation time (including any necessary disassembly/assembly time), trouble-shooting/fault location time, and quality assurance time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the MAC. The symbol designations for the various maintenance levels are as follows.

Field

C — Operator or Crew Maintenance

O — Unit Maintenance

F — Direct Support Maintenance

Sustainment

H — General Support Maintenance

D — Depot Maintenance

NOTE

The "L" maintenance level is not included in column (4) of the MAC. Functions to this level of maintenance are identified by a work time figure in the "H" column of column (4), and an associated reference code is used in the REMARKS column (6). This code is keyed to the remarks and the SRA complete repair application is explained there.

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

(6) *Column (6), Remarks.* When applicable , this column contains a letter code, in alphabetic order, which is keyed to the remarks table entries.

Explanation of Columns in Tool and Test Equipment Requirements

Column (1), Reference Code. The tool and test equipment reference code correlates with a code used in column (5) of the MAC.

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

Column (3), Nomenclature. Name or identification of the tool or test equipment.

Column (4), National Stock Number (NSN). The NSN of the tool or test equipment.

Column (5), Tool Number. The manufacturer's part number, model number, or type numbers.

Table 1. MAINTENANCE ALLOCATION CHART, SECTION II

(1)	(2)	(3)	(4) MAINTENANCE LEVEL					(5)	(6)
GROUP NUMBER	COMPONENT/ ASSEMBLY	MAINTENANCE FUNCTION	FIELD			SUSTAINMENT		TOOLS AND EQUIPMENT REF CODE	REMARKS CODE
			UNIT		DIRECT SUPPORT	GENERAL SUPPORT	DEPOT		
			C	O	F	H	D		
22	BODY CHASSIS AND HULL ACCESSORY ITEMS								
2202	MOTOR, DIRECT CURRENT	Replace			0.5			1	
	BURNER ASSEMBLY	Replace			1.0			1	
	MOUNTING ASSEMBLY	Replace			1.0			1	
	SPARK GENERATOR, IGNITION	Replace			0.3			1	
	PLUG, GLOW TEMPERATURE SENSOR	Replace			0.4			1	
	PLUG, GLOW SPARK	Replace			0.5			1	
	CAPACITOR, FIXED	Replace			0.3			1	
	VALVE, SOLENOID	Replace			0.5			1	
	WIRING HARNESS	Replace			0.4			1	
	FUEL METERING PUMP	Replace			0.6			1	
	PUMP, CIRCULATING	Replace			0.6			1	

Table 2. TOOLS AND TEST REQUIREMENTS, SECTION III

EQUIPMENT REF CODE	MAINTENANCE LEVEL	NOMENCLATURE	NATIONAL STOCK NUMBER	TOOL NUMBER
1	O, F	TOOL KIT, GENERAL MECHANIC'S	5180-00-177-7033	10942647

INTRODUCTION TO UNIT, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE REPAIR PARTS AND SPECIAL TOOLS LIST 0039 00

SCOPE

This RPSTL lists and authorizes spares and repair parts; special tools; special test, measurement, and diagnostic equipment (TMDE); and other special support equipment required for performance of Unit, Direct Support, and General Support maintenance of the ESPAR V7 Vehicle Compartment Heater. It authorizes the requisitioning, issue, and disposition of spares, repair parts, and special tools as indicated by the source, maintenance, and recoverability (SMR) codes.

GENERAL

In addition to the Introduction work package, this RPSTL is divided into the following work packages:

1. Repair Parts List Work Packages. Work packages containing lists of spares and repair parts authorized by this RPSTL for use in the performance of maintenance. These work packages also include 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. Sending units, brackets, filters, and bolts are listed with the component they mount on. Bulk materials are listed by item name in FIG. BULK at the end of the work packages. Repair parts kits are listed separately in their own functional group and work package. Repair parts for reparable special tools are also listed in a separate work package. Items listed are shown on the associated illustrations.

2. Special Tools List Work Packages. Work packages containing lists of special tools, special TMDE, and special support equipment authorized by this RPSTL (as indicated by Basis of Issue (BOI) information in the DESCRIPTION AND USABLE ON CODE (UOC) column). Tools that are components of common tool sets and/or Class VII are not listed.

3. Cross-Reference Indexes Work Packages. There are two cross-reference index work packages in this RPSTL: the National Stock Number (NSN) Index work package and the Part Number (P/N) Index work package. Both of the work packages refer you to the figure and item number.

EXPLANATION OF COLUMNS IN THE REPAIR PARTS LIST AND SPECIAL TOOLS LIST WORK PACKAGES

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

SMR CODE (Column (2)). The SMR code containing supply/requisitioning information, maintenance level authorization criteria, and disposition instruction, as shown in the following breakout:

Source Code	**Maintenance Code**		**Recoverability Code**
XXxxx	xx**X**xx	xxx**X**x	xxxx**X**
1st two positions: How to get an item.	3rd position: Who can install, replace, or use the item	4th position: Who can do complete repair* on the item	5th position: Who determines disposition action on unserviceable items.

*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.

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 follow:

Source Code	Application Explanation
PA PB PC PD PE PF PG	Stock items; use the applicable NSN to requisition/request items with these source codes. They are authorized to the level indicated by the code entered in the 3rd position of the SMR code. NOTE: Items coded PC are subject to deterioration.
KD KF KB	Items with these codes are not to be requested/requisitioned individually. They are part of a kit which is authorized to the maintenance level indicated in the 3rd position of the SMR code. The complete kit must be requisitioned and applied.
MO – Made at unit/ AVUM level MF – Made at DS/ AVIM level MH – Made at GS/ level ML – Made at SRA MD – Made at depot	Items with these codes are not to be requisitioned/requested individually. They must be made from bulk material which is identified by the P/N in the DESCRIPTION AND USABLE ON CODE (UOC) column and listed in the bulk material group work package of the RPSTL. If the item is authorized to you by the 3rd position code of the SMR code, but the source code indicates it is made at higher level, order the item from the higher level of maintenance.
AO – Assembled by unit/AVUM level AF – Assembled by DS/AVIM level AH – Assembled by GS level AL – Assembled by SRA AD – Assembled by depot.	Items with these codes are not to be requested/requisitioned individually. The parts that make up the assembled item must be requisitioned or fabricated and assembled at the level of maintenance indicated by the source code. If the 3rd position code of the SMR code authorizes you to replace the item, but the source code indicates the item is assembled at a higher level, order the item from the higher level of maintenance.
XA	Do not requisition an XA-coded item. Order the next higher assembly (Refer to NOTE next page.)
XB	If an item is not available from salvage, order it using the CAGEC and P/N.
XC	Installation drawings, diagrams, instruction sheets, field service drawings; identified by manufacturer's P/N.
XD	Item is not stocked, Order an XD-coded item through normal supply channels using the CAGEC and P/N giver, if no NSN is available.

NOTE

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

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:

Third Position. 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 the following levels of maintenance:

Maintenance Code	Application/Explanation
C	Crew or operator maintenance done within unit/AVUM maintenance.
O	Unit level/AVUM maintenance can remove, replace, and use the item.
F	Direct support/AVIM maintenance can remove, replace, and use the item.
H	General support maintenance can remove, replace, and use the item.
L	Specialized repair activity can remove, replace, and use the item.
D	Depot can remove, replace, and use the item.

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

NOTE

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

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

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 Code	Application/Explanation
Z	Non-repairable item. When unserviceable, condemn and dispose of the item at the level of maintenance shown in the third position of the SMR code.
O	Repairable item. When uneconomically repairable, condemn and dispose of the item at the unit level.
F	Repairable item. When uneconomically repairable, condemn and dispose of the item at the direct support 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 are 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 (such as precious metal content, high dollar value, critical material, or hazardous material). Refer to appropriate manuals/directives for specific instructions.

NSN (Column (3)). The NSN for the item is listed in this column.

CAGEC (Column (4)). The Commercial and Government Entity Code (CAGEC) is a five-digit code which is used to identify the manufacturer, distributor, or Government agency/activity that supplies the item.

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

NOTE

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

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

1. The federal item name and, when required, a minimum description to identify the item.

2. P/Ns of bulk material are referenced in this column in the line entry to be manufactured or fabricated.

3. Hardness Critical Item (HCI). A support item that provides the equipment with special protection from electromagnetic pulse (EMP) damage during a nuclear attack.

4. The state END OF FIGURE appears just below the last item description in column (6) for a given figure in both the repair parts list and special tools list work packages.

QTY (Column (7)). The QTY (quantity per figure) column indicates the quantity of the item used in the breakout shown on the illustration/figure, which is prepared for a functional group, sub functional group, or an assembly. A “V” appearing in this column instead of a quantity indicates that the quantity is variable and quantity may change from application to application. Shims are a good example.

EXPLANATION OF CROSS-REFERENCE INDEXES WORK PACKAGE FORMAT AND COLUMNS

1. National Stock Number (NSN) Index Work Package.

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.

NSN
(e.g., 5385-01-574-1476)
NIIN

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

FIG. Column. This column lists the number of the figure where the item is identified/located. The figures are in numerical order in the repair parts list and special tools list work packages.

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.

2. Part Number (P/N) Index Work Package. P/Ns in this index are listed in ascending alphanumeric sequence (vertical arrangement of letter and number combinations 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).

PART NUMBER Column. Indicates the P/N assigned to the item.

FIG. Column. This column lists the number of the figure where the item is identified/located in the repair parts list and special tools list work packages.

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

SPECIAL INFORMATION

UOC. The UOC 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 first line under the applicable item/nomenclature. Uncoded items are applicable to all models. Identification of the UOCs used in the RPSTL are:

Code	Used on
TBD	ESPAR V7S Vehicular Compartment Heater

Fabrication Instructions. Bulk materials required to manufacture items are listed in the bulk material functional group of this RPSTL. Part numbers for bulk materials are also referenced in the Description Column of the line item entry for the item to be manufactured/fabricated. Detailed fabrication instructions for items source coded to be manufactured or fabricated are found in the appropriate maintenance work packages of this manual.

Index Numbers. Items which have the word BULK in the figure column will have an index number shown in the item number column. This index number is a cross-reference between the NSN / P/N work packages and the bulk material list in the repair parts list work package.

Illustrations List. The illustrations in this RPSTL contain unit authorization items. Illustrations published in the maintenance portion of this manual that contain unit authorized items also appear in this RPSTL.

HOW TO LOCATE REPAIR PARTS

1. When NSN or P/Ns Are Not Known.

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

Second. Find the figure covering the functional group to which the item belongs.

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

Fourth. Look in the repair parts list work package for the figure and item numbers. The NSNs and part numbers are on the same line as the associated item numbers.

2. When NSN Is Known.

First. If you have the NSN, look in the STOCK NUMBER column of the NSN index. The NSN is arranged in NIIN sequence. Note the figure and item number next to the NSN.

Second. Turn to the figure and locate the item number. Verify that the item is the one you are looking for.

3. When P/N Is Known.

First. If you have the P/N and not the NSN, look in the PART NUMBER column of the P/N index work package. Identify the figure and item number.

Second. Look up the item on the figure in the repair parts list work package.

END OF WORK PACKAGE

ESPAR V7S VEHICULAR COMPARTMENT HEATER

INTERNAL COMPONENTS

REPAIR PARTS LIST

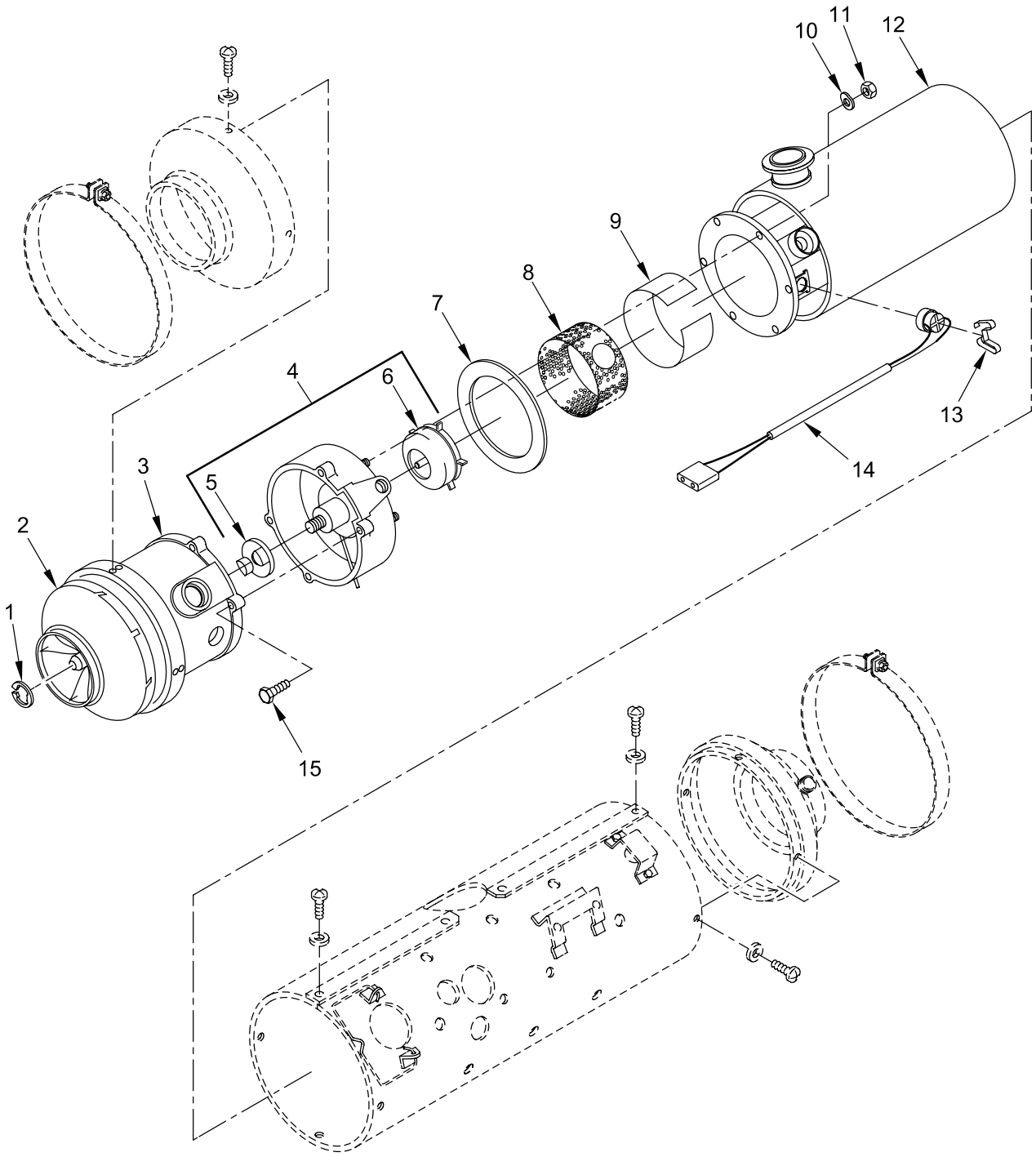


Figure 1. ESPAR V7S Vehicular Compartment Heater Internal Components

SECTION II

(1) ITEM NO	(2) SMR	(3) NSN	(4) CAGE	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODE (UOC)	(7) QTY
					GROUP BIA FIG. 1 INTERNAL COMPONENTS 12476638	
1	PAOZZ	5325-12-192-2886	D9909	AS6ZN12	RING,RETAINING.....	1
2	PAOZZ	2540-12-346-1916	D8435	251728201500	EXHAUST,FAN,VEHICLE.....	1
3	PAOZZ	6105-20-002-6758	38453	25 2239 20 00 00	FAN AND BLOWER MOTOR ASSEMBLY.....	1
4	PAOZZ	4530-12-346-2939	D8435	25 1728 15 00 00	ROTATING DIFFUSER ASSEMBLY.....	1
5	PAOZZ	3010-12-346-3282	D8435	25 1728 15 05 00	.COUPLING.....	1
6	PAOZZ	4530-12-346-2940	D8435	25 1728 15 01 00	.ROTATING DIFFUSER.....	1
7	PAFZZ	5330-12-171-2725	D8435	25 1226 01 00 04	GASKET.....	1
8	PAOZZ	5335-12-346-2042	D8435	25 1728 06 00 02	BELTING.....	1
9	PAOZZ	2540-12-346-1918	D8435	25 1244 07 00 03	INSULATION.....	1
10	PAOZZ	5310-20-002-3039	38453	CA3 00 306	WASHER,LOCK.....	6
11	PAOZZ	5310-20-002-3042	38453	CA3 00 206	NUT,PLAIN,HEXAGON.....	6
12	PAOZZ	2540-12-346-1917	D8435	25 1728 06 00 00	HEAT EXCHANGER.....	1
13	PAOZZ	5340-12-346-2423	D8435	251728010010	CLIP,SPRING TENSION.....	1
14	PAOZZ	6685-12-346-1975	D8435	251766360000	TRANSMITTER,TEMPERATURE.....	1
15	PAOZZ	5306-20-002-3046	D8435	CA3 00 108	BOLT, MACHINE, M5X16MM.....	4

END OF FIGURE 1

ESPAR V7S VEHICULAR COMPARTMENT HEATER

IGNITION COMPONENTS

REPAIR PARTS LIST

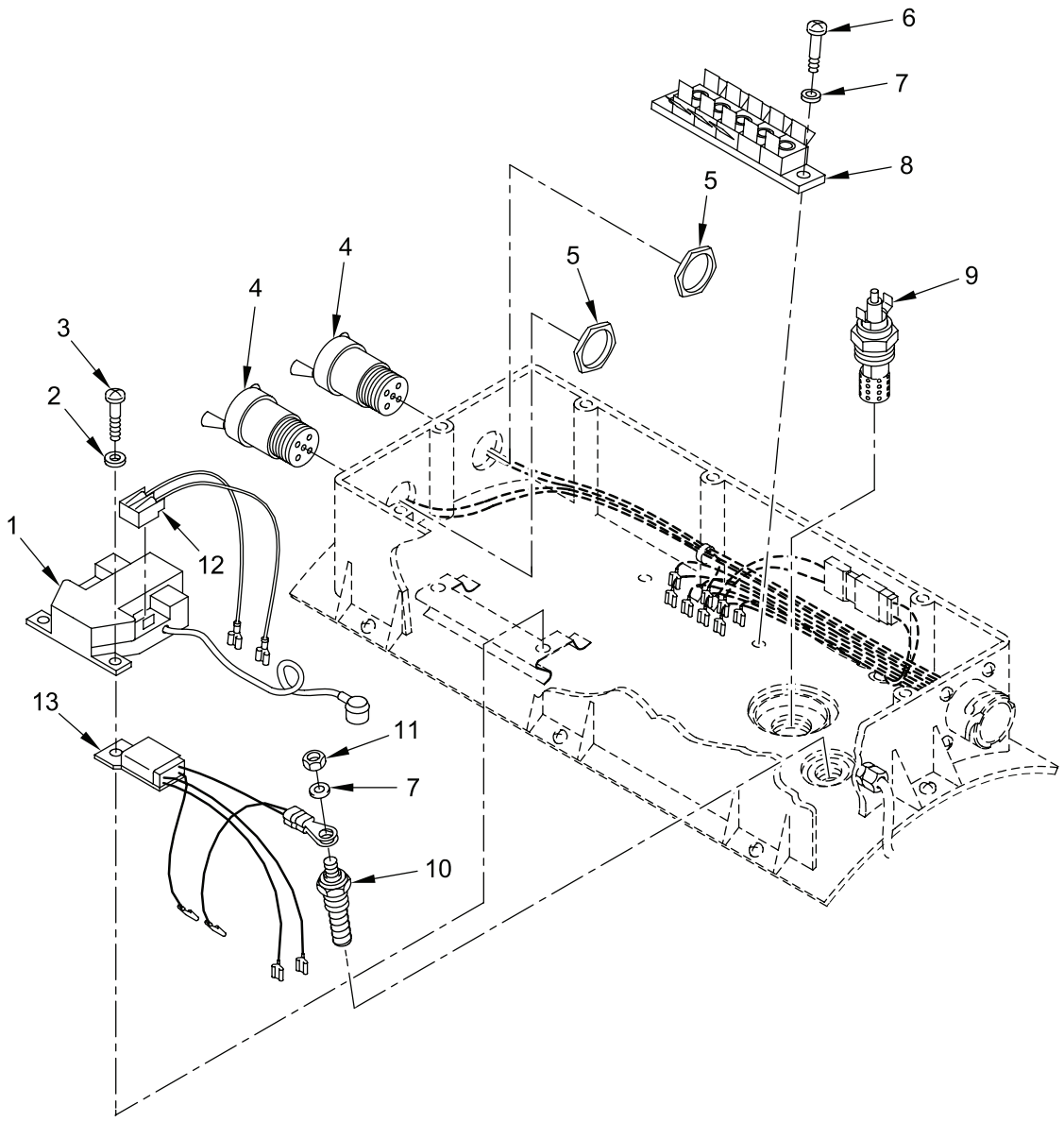


Figure 2. ESPAR V7S Vehicular Compartment Heater Ignition Components

SECTION II

(1) ITEM NO	(2) SMR	(3) NSN	(4) CAGE	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODE (UOC)	(7) QTY
					GROUP BIA FIG. 2 IGNITION COMPONENTS 12476638	
1	PAOZZ	4520-12-335-3261	D8977	EZB12/2-18	IGNITER,HEATER.....	1
2	PAOZZ	5310-20-002-3039	38453	CA3 00 306	WASHER,LOCK.....	2
3	PAOZZ		D8046	109 10 53	SCREW,MACHINE.....	2
4	PAOZZ	5935-12-332-5263	D8435	206 31 060	CONNECTOR, PLUG, ELECTRICAL.....	2
5	PAOZZ	5310-12-351-0795	D8435	206 31 061	COUNTER-NUT.....	2
6	PAOZZ		38453	CA3 00 104	PHILLIPS HEAD SCREW M4 X 16MM.....	2
7	PAOZZ	5310-20-002-3041	38453	CA3 00 313	WASHER, LOCK.....	3
8	PAOZZ	5940-12-351-1955	D8435	251728010900	TERMINAL BOARD.....	1
9	PAOZZ	5905-12-346-2744	D8435	25 1728 01 05 00	GLOW SPARK PLUG.....	1
10	PAOZZ	2920-12-334-7439	D8435	25 1731 01 00 06	GLOW PLUG.....	1
11	PAOZZ		38453	CA3 00 210	M4 NUT.....	1
12	PAOZZ	6150-12-351-0792	D8435	251728010400	LEAD ASSEMBLY,ELECT.....	1
13	PAOZZ	5910-12-346-2742	D8435	251728010700	CAPACITOR,FIXED,MET.....	1

END OF FIGURE 2

ESPAR V7S VEHICULAR COMPARTMENT HEATER

MOUNTING ASSEMBLY

REPAIR PARTS LIST

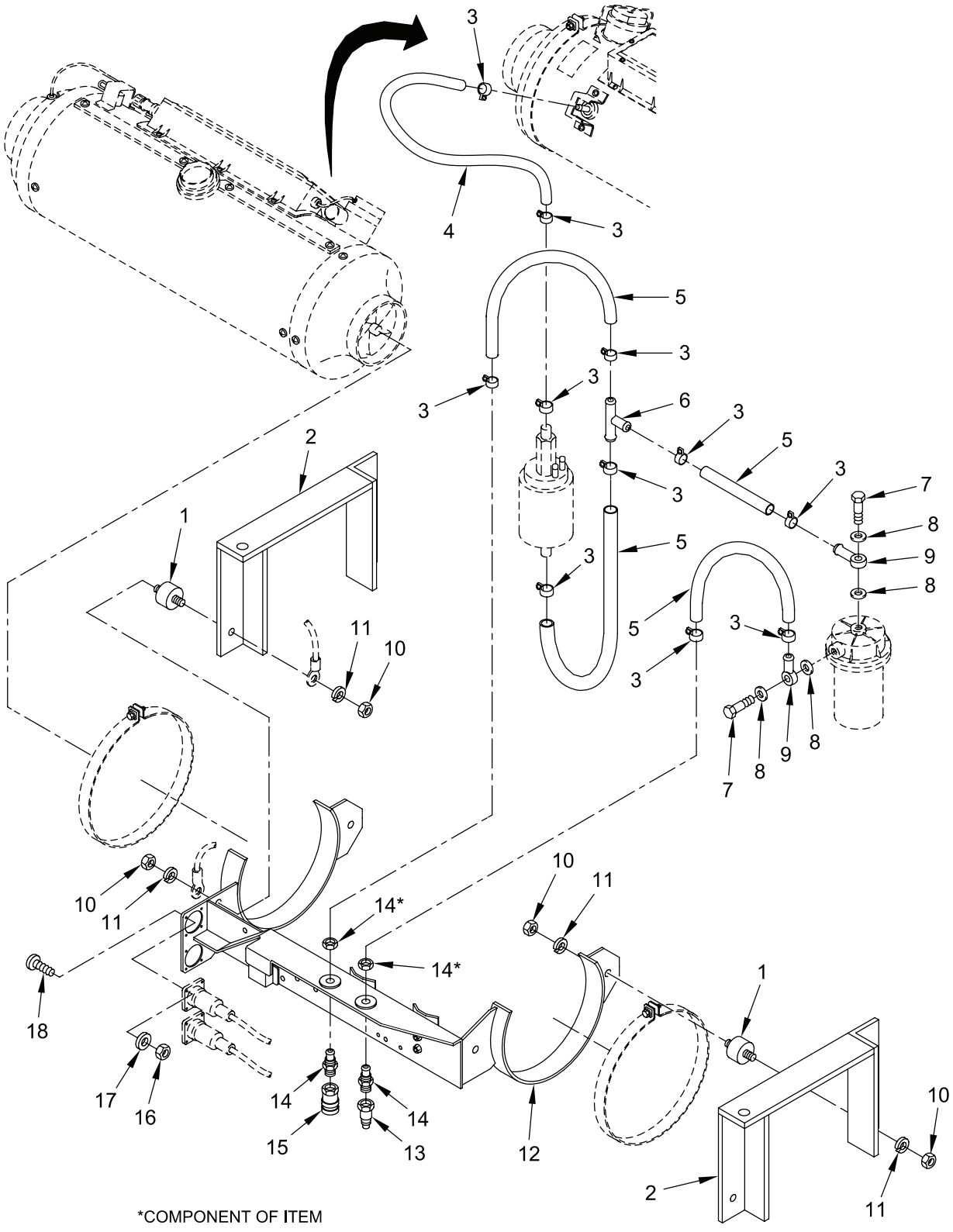


Figure 3. ESPAR V7S Vehicular Compartment Heater Mounting Assembly

SECTION II

(1) ITEM NO	(2) SMR	(3) NSN	(4) CAGE	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODE (UOC)	(7) QTY
					GROUP BIA FIG. 3 MOUNTNG ASSEMBLY 12476638	
1	PAOZZ		38453	FMC 1448 05	MOUNT RESILIENT.....	4
2	PAFZZ		38453	FMC 1448 04	BRACKET,MOUNTING.....	2
3	PAFZZ		D8435	10 2028 01 10 98	CLAMP,HOSE.....	11
4	XDFZZ	4720-12-331-5926	D8435	360 75 300	HOSE,NONMETALLIC.....	1
5	MFFZZ	4720-12-333-3860	D8435	360 75 350	HOSE MAKE FROM HOSE UNCUT	3
6	PAFZZ		D8435	262 31 150	TEE,HOSE.....	1
7	PAOZZ	4730-12-162-0513	D8435	104 10 008	BOLT,FLUID PASSAGE.....	2
8	PAOZZ	5330-12-156-5014	D2081	323 16 013	GASKET,COPPER.....	4
9	PAFZZ	4730-12-196-3832	D8435	25 1352 88 0005	CONNECTOR,MULTIPLE,.....	2
10	PAFZZ		38453	CA3 00 203	NUT,PLAIN,HEXAGON.....	8
11	PAFZZ		38453	CA3 00 304	WASHER,LOCK.....	8
12	PAOZZ	5340-20-001-3768	38453	501-402-0033	BRACKET,CONTROLS MO.....	1
13	PAFZZ		38453	FMC 1448 11	COUPLING HALF,QUICK.....	1
14	PAFZZ		38453	FMC 1448 09	ADAPTER,STRAIGHT	2
15	PAFZZ		38453	FMC 1448 10	COUPLING BODY,TUBE.....	1
16	PAFZZ		38453	CA3 00 210	NUT,SELF-LOCKING,HE.....	8
17	PAFZZ	5310-20-002-3041	38453	CA3 00 313	WASHER,FLAT.....	8
18	PAFZZ		38453	CA3 00 141-006	SCREW,MACHINE.....	8

END OF FIGURE 3

ESPAR V7S VEHICULAR COMPARTMENT HEATER

FUEL SYSTEM COMPONENTS

REPAIR PARTS LIST

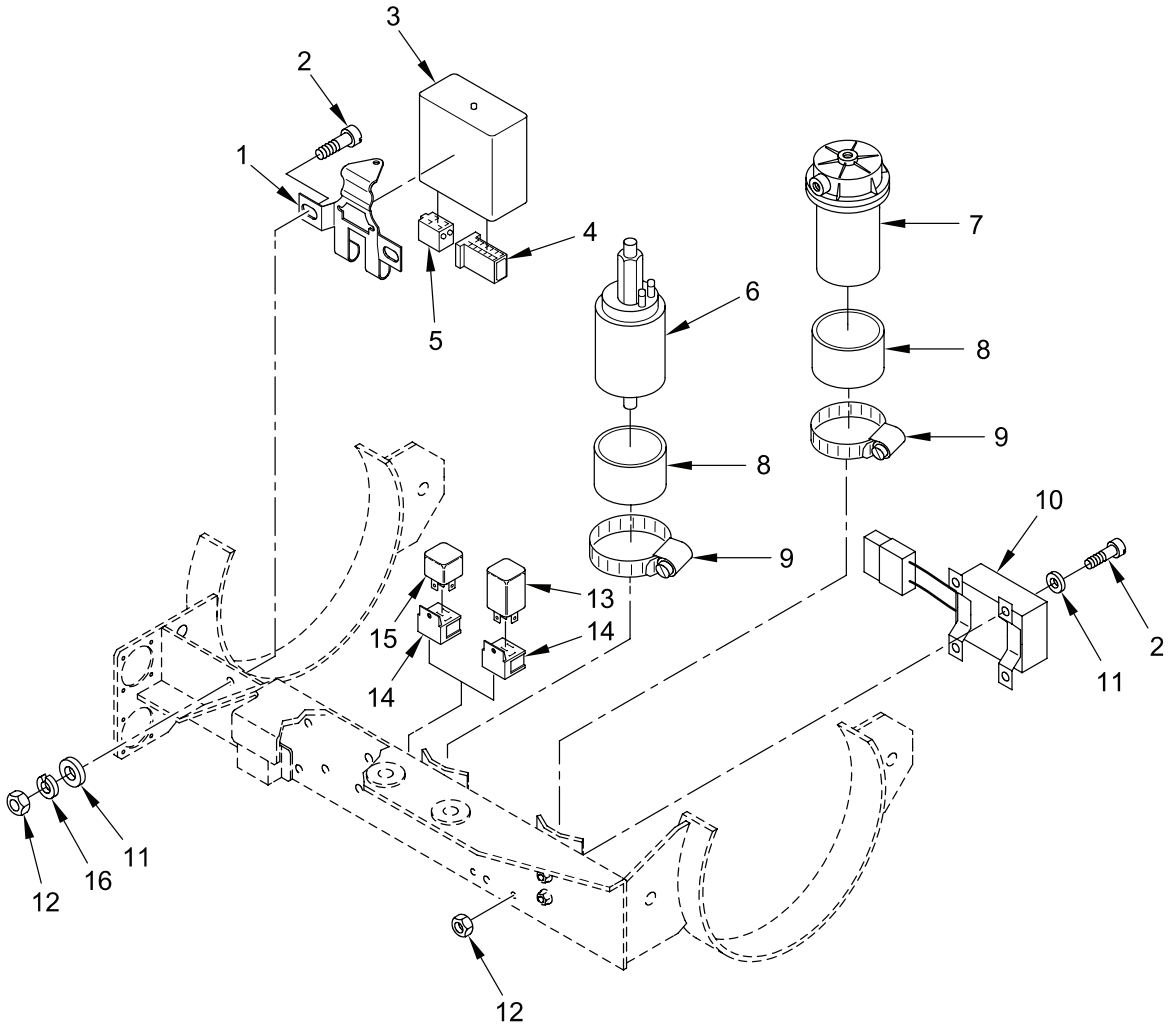


Figure 4. ESPAR V7S Vehicular Compartment Heater Fuel System Components

SECTION II

(1) ITEM NO	(2) SMR	(3) NSN	(4) CAGE	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODE (UOC)	(7) QTY
					GROUP BIA	
					FIG. 4 FUEL SYSTEM COMPONENTS	
					12476638	
1	PAOZZ	2540-12-327-6531	38453	251688650001	BRACKET,CONTROL BOX.....	1
2	PAFZZ	5306-20-002-3046	38453	CA3 00 108	BOLT, MACHINE M5X12MM.....	9
3	PAOZZ	2540-20-001-3258	38453	25 1689 50 00 51	CONTROL UNIT.....	1
4	PAFZZ	5935-12-175-3241	D8435	206 00 101	CONNECTOR,BODY,PLUG,ELECTRICAL....	1
5	PAOZZ	5935-12-351-2153	D8435	25 1742 00 03 00	SOCKET HOUSING.....	1
6	PAOZZ	4320-12-346-2040	D8435	251728450000	PUMP UNIT,RECIPROCA.....	1
7	PAFZZ	4320-12-190-9540	D8435	251226898300	PUMP UNIT,ROTARY.....	1
8	PAFZZ		D8435	20 1449 00 10 01	CUSHION,RING,SOLID.....	2
9	PAFZZ		D8435	CA 101 040	CLAMP,HOSE.....	2
10	XAOZZ		D8435	501.101.073	FILTER, EMI.....	1
11	PAOZZ	5310-20-002-3039	D8435	CA3 00 306	WASHER, FLAT 5MM DIN137.....	9
12	PAOZZ	5310-20-002-3042	D8435	CA3 00 206	NUT,PLAIN,HEXAGON 5MM D934-8ZPL...	9
13	PAOZZ	5996-20-002-2627	38453	501-103-0065	AMPLIFIER,DIRECT CU.....	1
14	PAOZZ	5935-12-171-4344	D8435	203 00 085	SOCKET.....	3
15	PAOZZ	5945-12-159-7938	D8435	20300066	RELAY,ELECTROMAGNET.....	2
16	PAOZZ	5310-20-002-3039	38453	CA3 00 306.001	WASHER,LOCK.....	5

END OF FIGURE 4

ESPAR V7S VEHICULAR COMPARTMENT HEATER

EXTERNAL COMPONENTS

REPAIR PARTS LIST

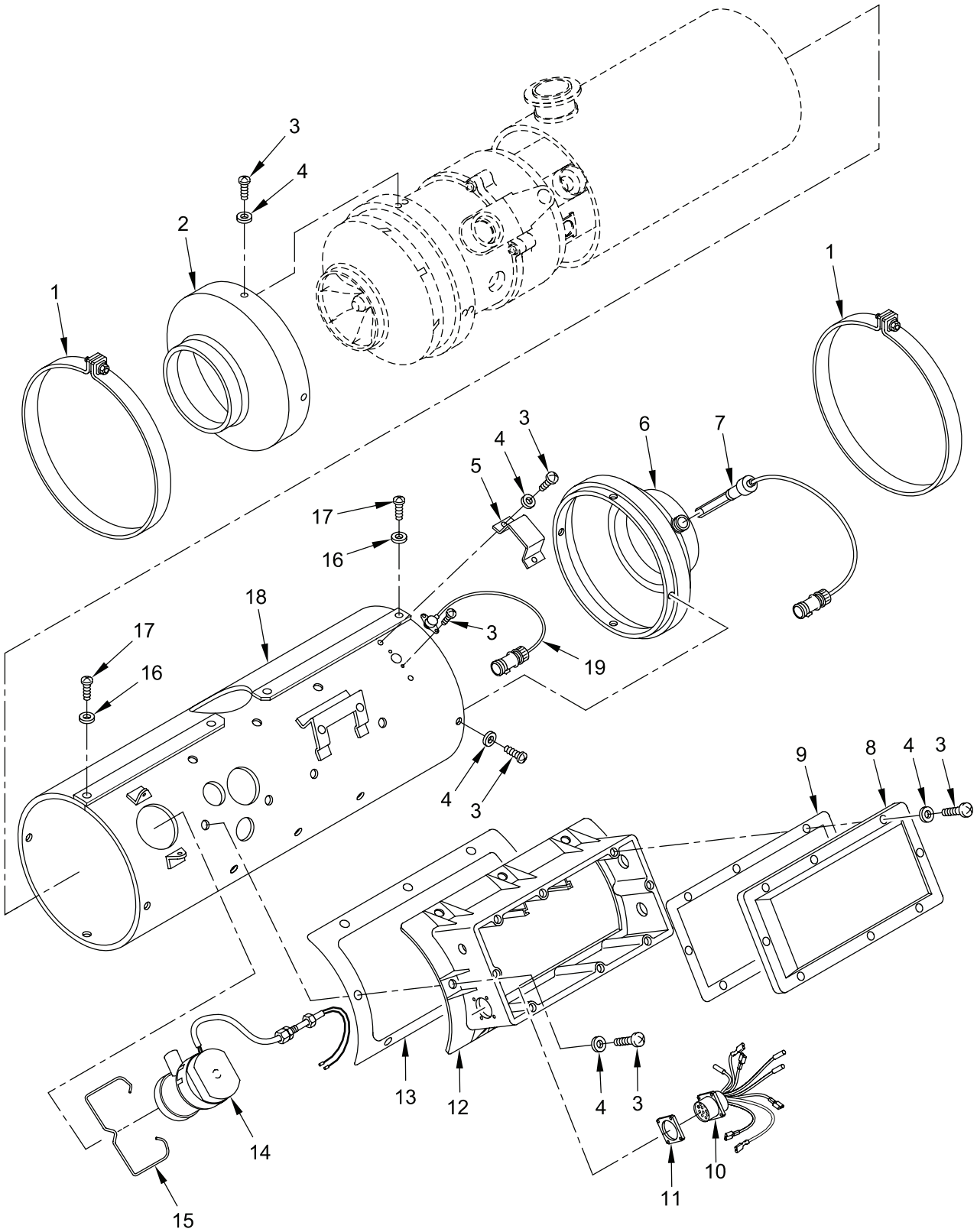


Figure 5. ESPAR V7S Vehicular Compartment Heater External Components

SECTION II

(1) ITEM NO	(2) SMR	(3) NSN	(4) CAGE	(5) PART NUMBER	(6) DESCRIPTION AND USABLE ON CODE (UOC)	(7) QTY
					GROUP BIA FIG. 5 EXTERNAL COMPONENTS 12476638	
1	PAFZZ	5340-12-171-2845	D8435	10 2062 19 22 09	CLAMP,LOOP.....	2
2	PAOZZ	2540-12-346-1970	D8435	251728010002	HOOD,INTAKE,OUTTAKE.....	1
3	XAOZZ		38453	CA3 00 104 004	SCREW.....	16
4	XAOZZ		38453	CA3 00 314	WASHER.....	24
5	PAOZZ	5340-12-351-0953	D8435	251728010013	COVER,ACCESS.....	1
6	PAOZZ	2540-12-346-1971	D8435	251728011000	HOOD,AIR.....	1
7	PAOZZ	6685-12-346-1972	D8435	251728011400	TRANSMITTER,TEMPERA.....	1
8	PAOZZ	2540-12-334-7983	D8435	251731010003	COVER,ELECTRICAL,CO.....	1
9	PAOZZ	5330-12-334-7148	D8435	251731010005	GASKET.....	1
10	PAOZZ	6150-12-346-1915	D8435	25 1728 01 03 00	CABLE SECTION.....	1
11	PAOZZ	5330-12-334-7147	D8435	25 1713 01 00 07	SEAL.....	1
12	PAOZZ	2540-12-346-1914	D8435	25 1728 01 00 04	BOX.....	1
13	PAOZZ	5330-12-334-7146	D8435	251731010004	GASKET.....	1
14	PAOZZ	4810-12-346-2743	D8435	25 1728 01 11 00	SOLENOID VALVE.....	1
15	PAOZZ	5340-12-346-2422	D8435	251728010007	CLIP,SPRING TENSION.....	1
16	PAFZZ	5310-12-142-0656	D8435	171 22 083	WASHER,LOCK.....	3
17	PAFZZ		D8435	103 10 307	FILLISTER HEAD SCRE.....	3
18	PAOZZ	2540-12-351-1350	D8435	25 1728 02 00 00	LOWER,COMPLETE.....	1
19	PAOZZ	6685-12-334-9534	D8435	25 1713 01 05 00	SENSOR,THERMAL,SAFE.....	8

END OF FIGURE 5

NATIONAL STOCK NUMBER INDEX

SECTION IV

CROSS REFERENCE INDEXES

NATIONAL STOCK NUMBER INDEX

STOCK NUMBER	FIGURE NO	ITEM NO	STOCK NUMBER	FIGURE NO	ITEM NO
5310-00-167-0721	3	11	2540-12-346-1918	1	9
5310-00-829-9981	3	10	2540-12-346-1970	5	2
5305-00-914-6125	4	2	2540-12-346-1971	5	6
5310-00-925-9645	3	16	6685-12-346-1972	5	7
5305-00-958-5457	3	18	4530-12-346-2940	1	6
5340-01-114-7458	3	2	6685-12-346-1975	1	14
4730-01-116-3691	3	6	4320-12-346-2040	4	6
4730-01-134-8294	3	14	5335-12-346-2042	1	8
4730-01-151-2740	3	13	5340-12-346-2422	5	15
4730-01-151-2754	3	15	5340-12-346-2423	1	13
4730-12-136-1127	3	3	5910-12-346-2742	2	13
5310-12-142-0656	5	16	4810-12-346-2743	5	14
5305-12-142-5547	2	3	5905-12-346-2744	2	9
5330-12-156-5014	3	8	4530-12-346-2939	1	4
5945-12-159-7938	4	15	3010-12-346-3282	1	5
4730-12-162-0513	3	7	6150-12-351-0792	2	12
5330-12-171-2725	1	7	5310-12-351-0795	2	5
5340-12-171-2845	5	1	5340-12-351-0953	5	5
5935-12-171-4344	4	15	2540-12-351-1350	5	18
5935-12-175-3241	4	4	5940-12-351-1955	2	8
4320-12-190-9540	4	7	5935-12-351-2153	4	5
5325-12-192-2886	1	1	5996-20-002-2627	4	13
4730-12-196-3832	3	9	2540-20-001-3258	4	3
2540-12-327-6531	4	1	5340-20-001-3768	3	12
4720-12-331-5926	3	4	5310-20-002-3039	1	10
5935-12-332-5263	2	4		2	2
4720-12-333-3860	3	5		4	11
5342-12-333-9587	3	1		4	16
5330-12-334-7146	5	13	5310-20-002-3041	2	7
5330-12-334-7147	5	11		3	17
5330-12-334-7148	5	9	5310-20-002-3042	1	11
2920-12-334-7439	2	10		4	12
2540-12-334-7983	5	8	5306-20-002-3046	1	15
6685-12-334-9534	5	19		4	2
4520-12-335-3261	2	1	6105-20-002-6758	1	3
2540-12-346-1914	5	12			
6150-12-346-1915	5	10			
2540-12-346-1916	1	2			
2540-12-346-1917	1	12			

PART NUMBER INDEX

SECTION IV

CROSS REFERENCE INDEXES

PART NUMBER INDEX

PART NUMBER	FIG.	ITEM
10 2028 01 10 98	3	3
10 2062 19 22 09	5	1
103 10 307	5	17
104 10 008	3	7
109 10 53	2	3
171 22 083	5	16
20 1449 00 10 01	4	8
203 00 085	4	14
20300066	4	15
206 00 101	4	4
206 31 060	2	4
206 31 061	2	5
25 1226 01 00 04	1	7
25 1244 02 00 00	5	18
25 1244 07 00 03	1	9
25 1352 88 0005	3	9
25 1689 50 00 51	4	3
25 1713 01 05 00	5	19
25 1713 01 00 07	5	11
25 1728 01 00 04	5	12
25 1728 01 03 00	5	10
25 1728 01 05 00	2	9
25 1728 01 11 00	5	14
25 1728 06 00 00	1	12
25 1728 06 00 02	1	8
25 1728 15 00 00	1	4
25 1728 15 01 00	1	7
25 1728 15 05 00	1	5
25 1731 01 00 06	2	10
25 1742 00 03 00	4	5
251226898300	4	7
251688650001	4	1
251728010002	5	2
251728010007	5	15
251728010010	1	13
251728010013	5	5
251728010400	2	12
251728010700	2	13
251728010900	2	8
251728011000	5	6
251728011400	5	7
251728201500	1	2
251728450000	4	6
251731010003	5	8
251731010004	5	13
251731010005	5	9
251766360000	1	14
25 2239 20 00 00	1	3
262 31 150	3	6
323 16 013	3	8
360 75 300	3	4
360 75 350	3	5
501 101 073	4	10
501-103-0065	4	14
501-402-0033	3	12
AS6ZN12	1	1
CA 101 040	4	9
CA3 00 104	2	6
CA3 00 104 004	5	3
CA3 00 108	1	15
	4	2
CA3 00 141 006	3	18
CA3 00 203	3	10
CA3 00 206	1	11
	4	13
CA3 00 210	2	12
	3	16
CA3 00 306	1	10
	2	2
	4	11
CA3 00 306.001	4	16
CA3 00 313	2	7
	3	17
CA3 00 314	5	4
EZB12/2-18	2	1
FMC 1448 04	3	2
FMC 1448 05	3	1
FMC 1448 09	3	14
FMC 1448 10	3	15
FMC 1448 11	3	13
MS35333-41	3	11

EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST 0047 00

INTRODUCTION

SCOPE

This work package lists expendable and durable items that you will need to overhaul the generator assembly. This list is for information only and is not authority to requisition the listed items. These items are authorized to use by CTA 50-970, Expendable/Durable Items (Except Medical, Class V Repair Parts, and Heraldic Items), or CTA 8-100, Army Medical Department Expendable/Durable Items.

Explanation of Columns in the Expendable/Durable Items List

Column (1) – Item Number. This number is assigned to the entry in the list and is referenced in the narrative instructions to identify the item (e.g., “Use wiping rag (WP 0047 00, Item 2)”).

Column (2) – Level. This column includes the lowest level of maintenance that requires the listed item (C=Operator/Crew).

Column (3) – National Stock Number. This is the NSN assigned to the item which you can use to requisition it.

Column (4) – Item Name, Description, Commercial and Government Entity Code (CAGE), and Part Number (P/N). This column provides the other information you need to identify the item.

Column (5) – Unit of Measure (U/M). This code shows the physical measurement or count of an item, such as gallon, dozen, gross, etc.

EXPENDABLE AND DURABLE ITEMS LIST

Table 1. Expendable and Durable Items List.

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) ITEM NAME, DESCRIPTION, CAGE, PART NUMBER	(5) U/M
1	O	7930-00-282-9699	Detergent, General (81349) MIL-D-16791	GL
2	O	7920-00-205-1711	Rag, Wiping (58536) A-A-2522	BE
3	O	6850-01-378-0698	Solvent, Dry-cleaning (0K209) BREAKTHROUGH	CN
4	O	9905-00-537-8954	Tags, Marking (81349) MIL-T-12755	BD

END OF WORK PACKAGE

COMMON TOOLS AND SUPPLEMENTS AND SPECIAL TOOLS/FIXTURES LIST

0048 00

INTRODUCTION

Scope

This work package lists all common tools, supplements, and special tools/fixtures needed to maintain the ESPAR V7S Vehicular Compartment Heater.

Explanation of Columns

Column (1) – Item Number. This number is assigned to the entry in the listing and is referenced in the Initial Setup to identify the item (e.g., “General Mechanic’s Tool Kit (WP 0047 00, Item 1)”).

Column (2) – Name. This column lists the item by noun nomenclature and other descriptive features (e.g., “General Mechanic’s Tool Kit”).

Column (3) – National Stock Number. This is the National Stock Number (NSN) assigned to the item; use it to requisition the item.

Column (4) – Part Number. Indicates the primary number used by the manufacturer (individual, company, firm, corporation, specifications, standards, and inspection requirements to identify an item or range of items.

Column (5) – Reference. This column identifies the authorizing Supply Catalog (SC) or Repair Parts and Special Tools (RPSTL) for items listed in this appendix.

Table 1. Tool Identification List.

(1) ITEM NO.	(2) ITEM NAME	(3) NATIONAL STOCK NUMBER	(4) PART NUMBER	(5) REFERENCE
1	GENERAL MECHANIC’S TOOL KIT	5180-00-177-7033	SC 4180-90-CL-N26	SC 4180-90-CL-N26
2	SOCKET, SOCKET WRENCH, 7/8”	5120-00-235-5809	B107.1	SC 4910-95-CL-A72
3	SOCKET, SOCKET WRENCH	5120-00-235-5879	B107.1	SC 4910-95-CL-A72
4	TOOL, PIN REMOVAL		7704496	Active Gear Co of Canada LTD CAGEC 38453

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INDEX – Continued

INDEX – Continued

INDEX – Continued

INDEX – Continued

RECOMMENDED CHANGES TO PUBLICATIONS AND BLANK FORMS For use of this form, see AR 25-30; the proponent agency is ODISC4.	Use Part II *(reverse)* for Repair Parts and Special Tool Lists (RPSTL) and Supply Catalogs/Supply Manuals (SC/SM).	DATE Date you filled out this form.
TO: *(Forward to proponent of publication or form) (Include ZIP Code)* AMSTA-LC-LMPP / TECH PUBS, TACOM-RI 1 Rock Island Arsenal Rock Island, IL 61299-7630	FROM: *(Activity and location) (Include ZIP Code)* Your mailing address	

PART I – ALL PUBLICATIONS (EXCEPT RPSTL AND SC/SM) AND BLANK FORMS

PUBLICATION/FORM NUMBER	DATE	Field and Sustainment for Heater, Vehicular Compartment,
TM 9-2540-220-24&P	30 Nov 07	ESPAR V7S NSN 2540-01-511-5293

ITEM NO.	PAGE NO.	PARA-GRAPH	LINE NO. *	FIGURE NO.	TABLE NO.	RECOMMENDED CHANGES AND REASON (Provide exact wording of recommended changes, if possible).
						.  .

**Reference to line numbers within the paragraph or subparagraph.*

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	SIGNATURE
Your Name		Your Signature

DA FORM 2028, FEB 74 REPLACES DA FORM 2028, 1 DEC 68, WHICH WILL BE USED. USAPPC V3.00

TO: (*Forward direct to addressee listed in publication*)	**FROM:** (*Activity and location) (Include ZIP Code)*	**DATE**
AMSTA-LC-LMPP / TECH PUBS, TACOM-RI 1 Rock Island Arsenal Rock Island, IL 61299-7630	Your address	Date you filled out this form

PART II – REPAIR PARTS AND SPECIAL TOOL LISTS AND SUPPLY CATALOGS/SUPPLY MANUALS

PUBLICATION NUMBER	DATE	TITLE
TM 9-2540-220-24&P	30 Nov 07	Field and Sustainment for Heater, Vehicular Compartment, ESPAR V7S NSN 2540-01-511-5293

PAGE NO.	COLM NO.	LINE NO.	NATIONAL STOCK NUMBER	REFERENCE NO.	FIGURE NO.	ITEM NO.	TOTAL NO. OF MAJOR ITEMS SUPPORTED	RECOMMENDED ACTION

SAMPLE

PART III – REMARKS (*Any general remarks or recommendations, or suggestions for improvement of publications and blank forms. Additional blank sheets may be used if more space is needed.)*

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	SIGNATURE
Your Name		Your Signature

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PART I – ALL PUBLICATIONS (EXCEPT RPSTL AND SC/SM) AND BLANK FORMS

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ITEM NO.	PAGE NO.	PARA-GRAPH	LINE NO. *	FIGURE NO.	TABLE NO.	RECOMMENDED CHANGES AND REASON *(Provide exact wording of recommended changes, if possible).*

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TO: (*Forward direct to addressee listed in publication*) AMSTA-LC-LMPP / TECH PUBS, TACOM-RI 1 Rock Island Arsenal Rock Island, IL 61299-7630	**FROM:** (*Activity and location) (Include ZIP Code)*	**DATE**

PART II – REPAIR PARTS AND SPECIAL TOOL LISTS AND SUPPLY CATALOGS/SUPPLY MANUALS

PUBLICATION NUMBER TM 9-2540-220-24&P	DATE 30 Nov 07	TITLE Field and Sustainment for Heater, Vehicular Compartment, ESPAR V7S NSN 2540-01-511-5293

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PUBLICATION/FORM NUMBER	DATE	TITLE
TM 9-2540-220-24&P	30 Nov 07	Field and Sustainment for Heater, Compartment, ESPAR V7S NSN 2540-01-511-5203

ITEM NO.	PAGE NO.	PARA-GRAPH	LINE NO. *	FIGURE NO.	TABLE NO.	RECOMMENDED CHANGES AND REASON *(Provide exact wording of recommended changes, if possible).*

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TO: (*Forward direct to addressee listed in publication*) AMSTA-LC-LMPP / TECH PUBS, TACOM-RI 1 Rock Island Arsenal Rock Island, IL 61299-7630	**FROM:** (*Activity and location) (Include ZIP Code)*	**DATE**

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By Order of the Secretary of the Army:

GEORGE W. CASEY, JR.
General, United States Army
Chief of Staff

Official:

JOYCE E. MORROW
Administrative Assistant to the
Secretary of the Army
0719802

DISTRIBUTION: To be distributed in accordance with the initial distribution number (IDN) 381164, requirements for TM 9-2540-220-24&P.

THE METRIC SYSTEM AND EQUIVALENTS

LINEAR MEASURE
1 Centimeter = 10 Millimeters = 0.01 Meters = 0.3937 Inches
1 Meter = 100 Centimeters = 1000 Millimeters = 39.37 Inches
1 Kilometer = 1000 Meters = 0.621 Miles

WEIGHTS

1 Gram = 0.001 Kilograms = 1000 Milligrams = 0.035 Ounces
1 Kilogram = 1000 Grams = 2.2 Lb.
1 Metric Ton = 1000 Kilograms = 1 Megagram = 1.1 Short Tons

LIQUID MEASURE
1 Milliliter = 0.001 Liters = 0.0338 Fluid Ounces
1 Liter = 1000 Milliliters = 33.82 Fluid Ounces

SQUARE MEASURE
1 Sq. Centimeter = 100 Sq. Millimeters = 0.155 Sq. Inches
1 Sq. Meter = 10,000 Sq. Centimeters = 10.76 Sq. Feet
1 Sq. Kilometer = 1,000 Sq. Meters = 0.386 Sq. Miles

CUBIC MEASURE

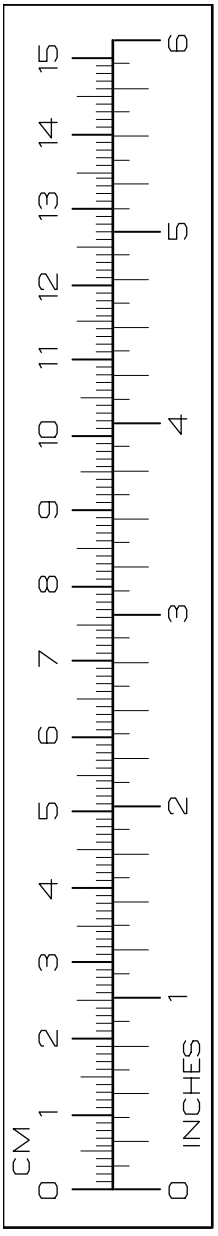
1 Cu. Centimeter = 1000 Cu. Millimeters = 0.06 Cu. Inches
1 Cu. Meter = 1,000,000 Cu. Centimeters = 35.31 Cu. Feet

TEMPERATURE

5/9 (ºF - 32) = ºC
212º Fahrenheit is equivalent to 100º Celsius
90º Fahrenheit is equivalent to 32.2º Celsius
32º Fahrenheit is equivalent to 0º Celsius
(9/5 x ºC) + 32 = ºF

TO CHANGE	TO	MULTIPLY BY
Inches	Centimeters	2.540
Feet	Meters	0.305
Yards	Meters	0.914
Miles	Kilometers	1.609
Square Inches	Square Centimeters	6.451
Square Feet	Square Meters	0.093
Square Yards	Square Meters	0.836
Square Miles	Square Kilometers	2.590
Acres	Square Hectometers	0.405
Cubic Feet	Cubic Meters	0.028
Cubic Yards	Cubic Meters	0.765
Fluid Ounces	Milliliters	29.573
Pints	Liters	0.473
Quarts	Liters	0.946
Gallons	Liters	3.785
Ounces	Grams	28.349
Pounds	Kilograms	0.454
Short Tons	Metric Tons	0.907
Pound-Feet	Newton-Meters	1.356
Pounds per Square Inch	Kilopascals	6.895
Miles per Gallon	Kilometers per Liter	0.425
Miles per Hour	Kilometers per Hour	1.609

TO CHANGE	TO	MULTIPLY BY
Centimeters	Inches	0.394
Meters	Feet	3.280
Meters	Yards	1.094
Kilometers	Miles	0.621
Square Centimeters	Square Inches	0.155
Square Meters	Square Feet	10.764
Square Meters	Square Yards	1.196
Square Kilometers	Square Miles	0.386
Square Hectometers	Acres	2.471
Cubic Meters	Cubic Feet	35.315
Cubic Meters	Cubic Yards	1.308
Milliliters	Fluid Ounces	0.034
Liters	Pints	2.113
Liters	Quarts	1.057
Liters	Gallons	0.264
Grams	Ounces	0.035
Kilograms	Pounds	2.205
Metric Tons	Short Tons	1.102
Newton-Meters	Pound-Feet	0.738
Kilopascals	Pounds per Square Inch	0.145
Kilometers per Liter	Miles per Gallon	2.354
Kilometers per Hour	Miles per Hour	0.621



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